Review of Cost of Capital 2022/2023

New Zealand Commerce Commission

29 November 2022

FINAL REPORT

Important notice

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1. EXECUTIVE SUMMARY

CEPA was commissioned to provide an analysis of various cost of capital parameters to support the Commission's 2022/23 review of the cost of capital. We were requested by the Commission to replicate the methodology applied in 2016 but updated for new data. We have not been asked to critique or update the methodology itself. We have attempted to deliver this as faithfully as possible. The table below provides our estimates of asset beta, notional leverage and equity beta for airports and energy using this method.

Sample	Asset Beta	Notional leverage	Equity Beta
Airports	0.74	15%	0.88
Energy	0.35	39%	0.57

This report sets out the process we have followed and compares the results to 2016 for the following areas:

- **Comparator selection**: The Commission's method from 2016 requires the creation of a comparator sample to estimate beta. We have aimed to replicate the process applied by the Commission as described in the topic paper on cost of capital. The same process applied in 2022 will create a different set of comparators than in 2016. This is because of delistings, comparators now having sufficient data for estimation when they previously did not and changing characteristics of the comparators themselves. For airports we drop 6 comparators and add 3 while for energy we remove 24 and add 6.
- **Beta estimation:** We estimated asset beta for this new set of comparators and the new time period up to 2022 using a replication of the methodology applied by the Commission in 2016. For both samples we find evidence that recent period impacted by Covid produces higher estimates of asset beta.
  - For airports we find a marked increase in asset beta. In 2016 the Commission applied an asset beta of 0.60 for airports after adjusting down from the average of 0.65. Applying the same averaging procedure, we find the average this time round to be 0.83 which if adjusted down by the same factor would be 0.74.
  - For energy, despite the large change in comparator sample, we produce exactly the same asset beta estimate as in 2016 which is 0.35.
- **Comparisons between electricity and gas:** The Commission asked us to consider the evidence for establishing separate sub-samples for electricity and gas. The two sub-samples for gas and electricity are relatively small with 11 or 12 comparators each depending on period examined. We find some evidence that the asset beta for gas is greater than that for electricity, but this is not statistically significant. The exact size of this difference is likely to require Commission judgement but may be greater than 0.05.
- **Leverage:** We find that for airports notional leverage has fallen from the 19% set by the Commission in 2016. We find that leverage for the current airport sample is between 14%-16% depending on time period. The estimated leverage for energy has also fallen. The Commission determined leverage for EDBs, Transpower and GPBs in 2016 to be 42%. Applying the same weights as previously produces leverage of 39%.
- **Credit rating:** If the Commission maintains the same reasoning for setting the notional credit rating as in 2016, we find no evidence from the credit ratings of comparators that would contradict this reasoning.
- **WACC percentile:** The Commission is unique when compared to other regulators in the way it sets an uplift to the allowed return on capital. This includes estimating the uncertainty around each parameter of WACC and creating an uncertainty band around the overall estimate of the WACC. This allows an estimation of WACC at various percentiles away from the mid-point. The Commission previously commissioned Oxera to provide a methodology for determining the appropriate WACC percentile to apply. Referencing this methodology, the Commission set the allowed return for electricity and gas businesses at

the 67th percentile. We have updated the evidence but pass no judgement on the methodology itself. Two pieces of evidence point in different directions. On the one hand, other regulators have reduced their support for choosing an allowed return above the mid-point. On the other hand, we find evidence that the importance of network reliability has increased in New Zealand.

2. ASSET BETA AND NOTIONAL LEVERAGE

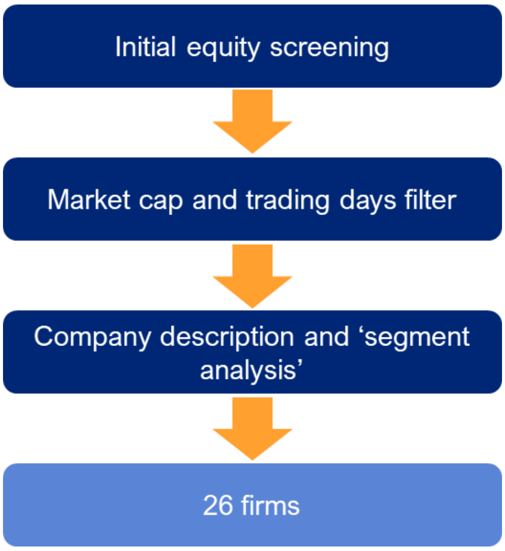
This section outlines the comparator selection process to establish the samples for both airports and energy. It explains the differences between the updated samples for 2022 and the comparator samples used in 2016. This section also outlines the steps we took to estimate asset betas for these comparator samples and provides an estimate of notional leverage.

2.1. COMPARATOR SELECTION

2.1.1. Airports

The following figure outlines the Commission's approach to constructing their comparator sample in 2016. It largely follows the approach set out in the 2010 Input methodologies.

Figure 2.1: 2016 Commission airport comparator selection method



Source: CEPA analysis of 2016 NZCC Input Methodologies

The Commission's first step was to do a broad equity screen to identify potential comparator firms. The Commission used Bloomberg's security finder to search for firms with 'Airport' in the description. The Commission only considered firms with a market cap of at least $100m USD and five years of trading data. The Commission then assessed the nature and extent of each company's business and excluded firms which were not sufficiently comparable. For this they relied on Bloomberg company descriptions and 'Segment Analysis'.

We have applied the Commission's 2016 approach to construct our sample. The following table identifies differences in the 2016 sample and a 2022 updated sample. In addition, we analysed the percentage of days traded for each of our comparators and found no outliers.

Table 2.1: Summary of change in airport sample

Bloomberg code	Name	Reason for exclusion/inclusion
SAVE IM	Venice Airport	Delisted 2017
SYD AU	Sydney Airport	Delisted 2022
8864 JP	Airport Facilities Co	Not involved in regulated airport operations
9706 JP	Japan Airport Terminal Co.	Low percentage of aeronautical revenues
TAVHL TI	TAV Havalimanlari Holding	Aeroports de Paris purchased 46% stake
AERO SG	Aerodrom Nikola Tesla	Concession sold to Vinci

Bloomberg code	Name	Reason for exclusion/inclusion
AENA SM	AENA	Operates a portfolio of airports in Spain and across the globe
ACV VN	Airports Corporation of Vietnam	Operates a portfolio of airports in Vietnam.
ADB IM	Aeroporto Guglielmo Marconi di Bologna	Operates an airport in Italy

Source: CEPA analysis of 2016 NZCC Input Methodologies

Airport Facilities Co (8864 JP) is a Japanese company primary involved in real estate leasing in airports and other related airport infrastructure such as air conditioning and water. Airport Facilities Co was included the Commission's 2016 Airport comparator sample. After a review of their business operations, we have not included it in our 2022 comparator sample. 79.3% of its net sales are attributed to its 'Real Estate Business'[1]. This involves the "leasing of real estate as multi-purpose general buildings, hangars, maintenance plants, apartments, and hotels in airports in Japan and abroad and regions along the railway line connected to the airport"[2]. The remainder of its revenues come from 'Area Heating & Cooling Business' and 'Water supply & Drainage Service and Other Business'.[3] We do not consider these business operations relevant enough to the fee based, regulated aeronautical operations of the rest of our sample.

Japan Airport Terminal Co (9706 JP) is a Japanese company involved in the management of several Tokyo airports including Haneda, Narita and Kansai Airport. Japan Airport Terminal Co has a low percentage of its total revenue from aeronautical sources, just 23% in 2018.[4] Approximately 60% of revenue comes from merchandise sales at stores in the domestic and international terminals. Aeronautical revenues of 23% are in line with other firms which we haven't included in our sample and which the Commission previously didn't include such as Esken (27%), Ferrovial (34%) and Atlantia (7%).

In 2018 the concession for Belgrade Nikola Tesla Airport (AERO SG) was granted to Vinci Airports. Under the agreement AERO SG still owns the airport assets but receives an annual concession fee from Vinci who is responsible for operating the airport.

Other businesses previously included in the Commission's 2016 sample which we have excluded are Venice Airport (SAVE IM) and Sydney Airport (SYD AU) both of which have been acquired and subsequently delisted, as well as TAV Havalimanlari Holding (TAVHL TI) which ADP (included in our sample) purchased a 46% stake in.[5]

Overall, our 2022 Airport comparator sample consists of 24 firms, compared to 26 in 2016.

2.1.2. Energy

The Commission followed a similar method to that used for its 2010 IMs in constructing its energy comparator sample. The following chart summarises the approach.

[1] Airport Facilities Co, Annual report 2022, page 3.

[2] Ibid

[3] Ibid

[4] Japan Airport Terminals Co. Ltd. Earnings Presentation Material, November 13, 2018. Page 9.

[5] Consistent with the Commissions approach to include only the 'most relevant' comparator between a parent and subsidiary in their energy sampling method.

Figure 2.2: 2016 Commission energy comparator selection method

Source: CEPA analysis of 2016 NZCC Input Methodologies

In the initial equity screening the Commission searched for firms within the 'Electricity', 'Gas distribution', 'Pipelines' and 'Multiutilities' Industry Classification Benchmarks (ICB) as reported by Bloomberg based in either New Zealand, Australia, UK or USA. In 2016 the Commission did not include comparators from other developed markets such as Canada. The Commission then used Bloomberg company descriptions and 'Segment Analysis' information to assess the company's operations and exclude any that were not comparable.

We have applied the Commission's 2016 approach to construct our sample. The following table identifies differences in the 2016 sample and a 2022 updated sample. In addition, we analysed the percentage days traded of potential comparators, two companies[6] which made it past our initial equity screen were subsequently dropped for having a low percent of days traded.

Table 2.2: Summary of change in energy sample

Bloomberg code	Name	Reason for exclusion/inclusion
AST AU	Ausnet Services	Delisted
BWP US	Boardwalk Pipeline Partners LP	Delisted
CNL US	Cleco Corporate Holdings LLC	Delisted
DGAS US	Delta Natural Gas Co Inc	Delisted
EDE US	Empire District Electric Co/Th	Delisted
EEP US	Enbridge Energy Partners LP	Delisted
EE US	El Paso Electric	Delisted
GAS US	AGL Resources Inc	Delisted
GXP US	Great Plains Energy Inc	Delisted
ITC US	ITC Holdings Corp	Delisted
PNY US	Piedmont Natural Gas Co Inc	Delisted

[6] Alaska Power and Telephone Co. and Mount Carmel Public Utilities Co.

Bloomberg code	Name	Reason for exclusion/inclusion
POM US	Pepco Holdings LLC	Delisted
SCG US	SCANA Corp	Delisted
SE US	Spectra Energy Corp	Delisted
SKI AU	Spark Infrastructure Group	Delisted
STR US	Questar Corp	Delisted
TCP US	TC PipeLines LP	Delisted
TE US	TECO Energy Inc	Delisted
UGI US	UGI Corp	Low percentage of regulated revenues
VVC US	Vectren Corp	Delisted
WGL US	WGL Holdings Inc	Delisted
WPZ US	Williams Partners LP	Delisted
WR US	Westar Energy Inc	Delisted
APA AU	APA Group	Low percentage of regulated revenues
CAN LN	Centrica Plc	Owns British Gas
AGR US	Avangrid Inc	Electricity Distribution
POR US	Portland General Electric co	Integrated Electricity company
EVRG US	Energy Inc	Electricity Distribution
OGS US	One Gas Inc	Gas Distribution
RGCO US	RGC Resources Inc	Gas Distribution

Source: CEPA analysis of 2016 NZCC Input Methodologies

In addition to companies which have been delisted since 2016 we also dropped two other firms after assessing their business operations. UGI Corp (UGI) has four business segments:[7] AmeriGas Propane (34% of revenue), UGI International (34% of revenue), Midstream and Marketing (18% of revenue) and UGI Utilities (14% of revenue). Of these UGI Utilities is subject to both FERC and state regulation and parts of the midstream segment including storage, LNG and parts of their midstream transmission are also subject to regulation by the FERC. UGI Utilities only consists of 14% of UGI's total revenue, in additional although Midstream and Marketing is another 18% of total revenue, not all is subject to FERC regulation, including natural gas processing, electricity generation and some midstream transmission.[8]

There is potentially a judgement to be made regarding what percentage of regulated revenues is required for a comparator to be relevant.[9] We explore this issue further in the asset beta section below. For example, as part of our core sample we have dropped APA Group due to its reported low percentage of regulated revenues. We do however provide a consideration of the asset beta if it were included.

[7] UGI Corporation 2021 10-K, section 6 other financial data.

[8] UGI Corporation 2021 10-K, page 10.

[9] If proportion of regulated activities is considered a key driver of systematic risk, then percentage of regulated revenues is only one potential measure for determining comparability. Other measures such as percentage of profit could also be considered.

Table 2.3: Summary of energy sample

	Electricity	Gas	Integrated	Total
Number of firms (2022)	12	12	30	54
Number of firms (2016)	15	17	40	72

Source: CEPA analysis of Bloomberg Data and 2016 NZCC Input methodologies

Of the 54 total comparators, 50 are from the United States, 3 from the UK and 1 from New Zealand.

2.2. Beta estimation

This section sets out the beta estimates for the airport and energy comparator samples outlined above. We also provide a comparison between the various energy sub-samples – integrated, gas and electricity. The full estimation results for each comparator are shown in Appendix B. We were asked to implement the same method as used by the Commission in 2016.[10] We have implemented our estimation procedure in R and have provided the code to the Commission. In terms of estimation procedure, we have:[11]

- estimated beta over five-year intervals. The cut-off date was set as 30th September 2022. The five-year intervals are 2017-2022, 2012-2017 and 2007-2012.
- estimated beta against the local index identified by Bloomberg.
- estimated daily, weekly, and four-weekly asset betas. We have implemented the procedure for weekly and four-weekly beta as set out previously by the Commission.
- applied the Commission's preferred de-leveraging formula and assume a zero debt beta.[12]
- estimated the raw equity betas using OLS with no special adjustments.

We have also estimated the standard errors for each comparator following the procedure as outlined in the Commission's 2016 spreadsheet. Specifically:

- For weekly and four-weekly several regressions are undertaken for each comparator. The standard error for each comparator was estimated using the standard errors reported for the beta parameter in each n regressions and aggregated using formula 1 below.
- Following this procedure, for daily, weekly, and four-weekly formula 2 was used to recover the standard error of the overall comparator sample.[13]

Formula 1: $\sqrt{\frac{\sum_1^n se(\beta_i)^2}{n}}$

Where n is the number of regressions for each comparator, 5 for weekly and 20 for four-weekly, and se(β) is the standard error estimated for the beta parameter in each of those regressions.

[10] As a guide we have used the spreadsheet *Input-methodolgoies-review-draft-decisions-Asset-beta-spreadsheet-11-July-2016.xls* as previously published by the Commission.

[11] We have provided copies of the R code which implements the asset beta estimation procedure to the Commission.

[12] $\beta a = \beta e(1 - L) + \beta dL$

[13] We understand that this formula was provided by Lally (2008), The Weighted Average Cost of Capital for Gas Pipeline Businesses.

Formula 2: $\sqrt{v \times \left(\frac{N+1}{N}\right) - (\sigma \times (1 - (2 \times \rho))}$

Where:

- v is the expectation of cross-sectional sample variance in the estimated asset beta as estimated using the equation in Lally (2008), page 171.
- N is the number of comparators.
- σ is the average variance of the asset beta for the comparator sample.
- ρ is a constant of 0.2 as defined by Lally (2008), page 176.

2.2.1. Airports

Estimates of asset beta

The table below provides the asset beta estimates for the airport comparators.

Table 2.4: Summary of average asset beta estimates for airport sample – 5 year

Specification	2017-2022	2012-2017	2007-2012
Daily asset beta	0.77	0.65	0.59
Weekly asset beta	0.85	0.69	0.62
Four-weekly asset beta	0.85	0.76	0.70
# of companies in sample	23	20	20

Source: CEPA analysis of Bloomberg Data

In 2016 the Commission determined an asset beta of 0.60 for airports.[14] This is markedly lower than the sample averages in the table above. The Commission previously found that the average asset beta for the two most recent periods (2006-2011 and 2011-2016) and placing weight on four-weekly and weekly was 0.65. This is close to the results we find for the period 2007-2012. If the same weights were applied this time round the initial asset beta estimate would be 0.79. To get to the final asset beta decision of 0.60 the Commission applied a downward adjustment of 0.05. We would note the following:

- There appears to have been a marked increase in asset beta in the most recent period (2017-2022). This includes the period impacted by Covid, which may have increased betas for airports.
- There are three new airport comparators included in the most recent sample period.[15] Their removal has an immaterial difference on the averages for 2017-2022 producing average betas of 0.78, 0.86 and 0.84 for daily, weekly, and four-weekly respectively.
- Sydney Airport was previously included in the Commissions sample but was delisted in February 2022. We have included beta estimations as at 30/01/2022 in the appendix. Including Sydney Airport makes no material changes to the overall average.
- We checked whether these results are due to an inadvertent change in method as we have implemented asset beta estimation in R code rather than relying on the Excel spreadsheets. The table below shows a

[14] Commerce Commission (2016), Input methodologies review decisions, Topic paper 4: Cost of capital issues.

[15] AENA, Airports Corporation of Vietnam, and Aeroporto Guglielmo Marconi di Bologna.

comparison between what we would find now for the 2011 to 2016 period and the Commission's previous results.[16] This shows that similar results would have been achieved using the updated method.

Table 2.5: Check of asset beta against 2011 to 2016 results

Method	CEPA result 2011 to 2016	Previous Commission result 2011 to 2016
Average daily asset beta	0.59	0.59
Average weekly asset beta	0.63	0.62
Average four-weekly asset beta	0.68	0.66

Source: CEPA analysis of Bloomberg Data

The Commission requested we estimate asset betas over a 2-year estimation window. The aim is to provide more targeted evidence on the impact of Covid. In the table below instead of using 30th September as the cut-off as for the other beta results we have used 28th February. Again, the aim is to provide evidence on the impact of Covid on the asset betas of the airport comparators so using a cut-off of 30th September was not sensible. The table provides evidence that asset beta's rose significantly during the 2020-2022 period. A 2-year estimation window uses less data than a 5-year estimation window, this means that beta estimate is likely to be less stable and have higher uncertainty.

Table 2.6: Summary of average asset beta estimates for airport sample – 2 year

Specification	2020-2022	2018-2020
Daily asset beta	0.80	0.72
Weekly asset beta	0.93	0.76
Four-weekly asset beta	0.85	0.73
# of companies in sample	23	23

Source: CEPA analysis of Bloomberg Data

Standard error

The Commission uses the standard error of the asset beta as an input into estimating the overall WACC percentiles. The table below provides the average estimates of standard error for each time period and regression specification.

Table 2.6: Estimates of standard error for asset beta - Airports

Specification	2017-2022	2012-2017	2007-2012
Daily asset beta	0.292	0.375	0.245
Weekly asset beta	0.283	0.342	0.200
Four-weekly asset beta	0.294	0.315	0.243

Note: Standard error estimates are provided at 3 decimal places in this table.

Source: CEPA analysis of Bloomberg Data

In 2016 the Commission found that the average standard error for airports was 0.24. The evidence in the table above suggests that the standard error has increased. Averaging weekly and four-weekly over the two most recent periods results in a standard error of 0.31. We note however that the Commission reported average for 2006-2011 was 0.26 which is slightly higher than the average of 0.23 we find for 2007-2012.

[16] 600009 CH Equity not included in our estimate.

Despite finding an average standard error of 0.24 in 2016 the Commission concluded that this was "too high" and "would provide an implausible result." The Commission instead adopted a standard error of 0.16. We leave it to Commission judgement to interpret the evidence provided in the table above. However, we note that if the standard error estimation procedure is considered robust then the evidence suggests substantially higher uncertainty around the asset beta estimate for airports than would be captured by applying a standard error of 0.16.

2.2.2. Energy

Estimates of asset beta

The Commission requested that the energy sample be split into three sub-samples: integrated, gas and electricity. We understand the Commission intends to explore whether there is sufficient evidence to set separate asset betas for gas and electricity. The four tables below provide our asset beta estimates.[17]

Table 2.7: Summary of asset beta estimates for overall energy sample

Specification	2017-2022	2012-2017	2007-2012
Daily asset beta	0.42	0.38	0.38
Weekly asset beta	0.40	0.34	0.36
Four-weekly asset beta	0.37	0.30	0.33
# of companies in sample	54	53	51

Source: CEPA analysis of Bloomberg Data

Table 2.8: Summary of asset beta estimates for integrated sub-sample

Specification	2017-2022	2012-2017	2007-2012
Daily asset beta	0.39	0.36	0.36
Weekly asset beta	0.37	0.31	0.33
Four-weekly asset beta	0.34	0.27	0.31
# of companies in sample	30	30	29

Source: CEPA analysis of Bloomberg Data

Table 2.9: Summary of asset beta estimates for gas sub-sample

Specification	2017-2022	2012-2017	2007-2012
Daily asset beta	0.51	0.48	0.45
Weekly asset beta	0.45	0.46	0.42
Four-weekly asset beta	0.43	0.40	0.37
# of companies in sample	12	12	11

Source: CEPA analysis of Bloomberg Data

Table 2.10: Summary of asset beta estimates for electricity sub-sample

Specification	2017-2022	2012-2017	2007-2012
Daily asset beta	0.42	0.34	0.37
Weekly asset beta	0.40	0.31	0.36

[17] As shown in the full tables in Appendix B, including APA in the sample doesn't impact the overall averages.

Specification	2017-2022	2012-2017	2007-2012
Four-weekly asset beta	0.37	0.28	0.35
# of companies in sample	12	11	11

Source: CEPA analysis of Bloomberg Data

In the 2016 decision the Commission concluded that:

- The asset beta for EDBs and Transpower should be set at 0.35. This was based on the average of the overall energy comparator sample for the two most recent periods (2006-2022 and 2011-2016) using weekly and four-weekly.
- The asset beta for GPBs should be set at 0.40. This applied a 0.05 upwards adjustment to the asset beta determined for EDBs and Transpower.

If we were to apply the exact same methodology as in 2016 with updated figures we would find:

- The asset beta for EDBs and Transpower would be identical to the 2016 estimate at 0.35. This takes average of the overall energy sample in the two most recent periods (2017-2022 and 2012-2017) for weekly and four-weekly (the average of 0.40, 0.37, 0.34 and 0.30).
- If the same 0.05 upward adjustment to gas were applied this again results in exactly the same value for gas namely 0.40.

We observe that the most recent period (2017-2022) has slightly higher asset beta estimates than previous periods. This could suggest that asset betas have moved upwards, and this should be considered by the Commission. We have not however done a detailed analysis.

We also observe that the difference between the asset betas for the electricity and gas samples is generally greater than 0.05. The comparison between is shown in the table below. The difference is particularly large during the 2012-2017 period. This is of course based on only a few companies in each period as the sub-samples for electricity and gas are so small. We consider the evidence of the difference between the two samples further in the section on rolling betas below.

Table 2.11: Summary of difference between the gas sub-sample and electricity sub-sample

Specification	2017-2022	2012-2017	2007-2012
Daily asset beta	0.09	0.14	0.08
Weekly asset beta	0.05	0.14	0.06
Four-weekly asset beta	0.06	0.12	0.03

Source: CEPA analysis of Bloomberg Data

In addition, we provide estimates of a ‘narrow’ energy sample for the Commission’s consideration which excludes the following companies: AES US, CAN LN, NG/ LN, NJR US, OKE US and SWX US. These firms were excluded based on the proportion of regulated revenues. These six firms had between approximately 30-40%[18] of their total revenues from regulated sources. The following table shows a summary of results from the narrow sample. The results are largely the same as the full energy sample.

[18] In the case of OKE US we were unable to determine an exact percentage of regulated revenues.

Table 2.12: Summary of asset beta estimates for narrow sample

Specification	2017-2022	2012-2017	2007-2012
Daily asset beta	0.41	0.37	0.37
Weekly asset beta	0.38	0.32	0.35
Four-weekly asset beta	0.34	0.28	0.32
# of companies in sample	48	47	45

Source: CEPA analysis of Bloomberg Data

Standard error

In addition to setting the WACC percentile in the case of energy the standard errors may assist the Commission in judging whether the electricity and gas sub-samples have different betas. This is examined in the next section on rolling betas. The table below provides the average estimates of standard error for each time period and regression specification.

Table 2.13: Standard error estimates for overall energy sample

Specification	2017-2022	2012-2017	2007-2012
Daily asset beta	0.102	0.123	0.119
Weekly asset beta	0.130	0.141	0.110
Four-weekly asset beta	0.154	0.112	0.106

Note: Standard error estimates are provided at 3 decimal places in this table.

Source: CEPA analysis of Bloomberg Data

In 2016 to obtain the standard error of the asset beta the Commission averaged the weekly and four-weekly estimates over the two most recent periods. In 2016 this led to an estimate of 0.12 (at two decimal places). Following this same procedure would result in an estimate of 0.13 for 2022.

2.2.3. Rolling betas

As outlined above, we were asked by the Commission to consider the evidence for establishing separate asset beta estimates for electricity and gas using the comparator samples. One potential way of considering this issue is to examine the evolution of the two samples' asset betas over time as well as considering the uncertainty around the estimates.

The figure below shows an estimate of the rolling five-year asset beta using weekly data.[19] This is for the period 1/10/2012 to 30/9/2022. We have estimated the standard errors on each date using the same method as outlined above in section 2.2. We have also provided the 95% confidence intervals.[20] We find that:

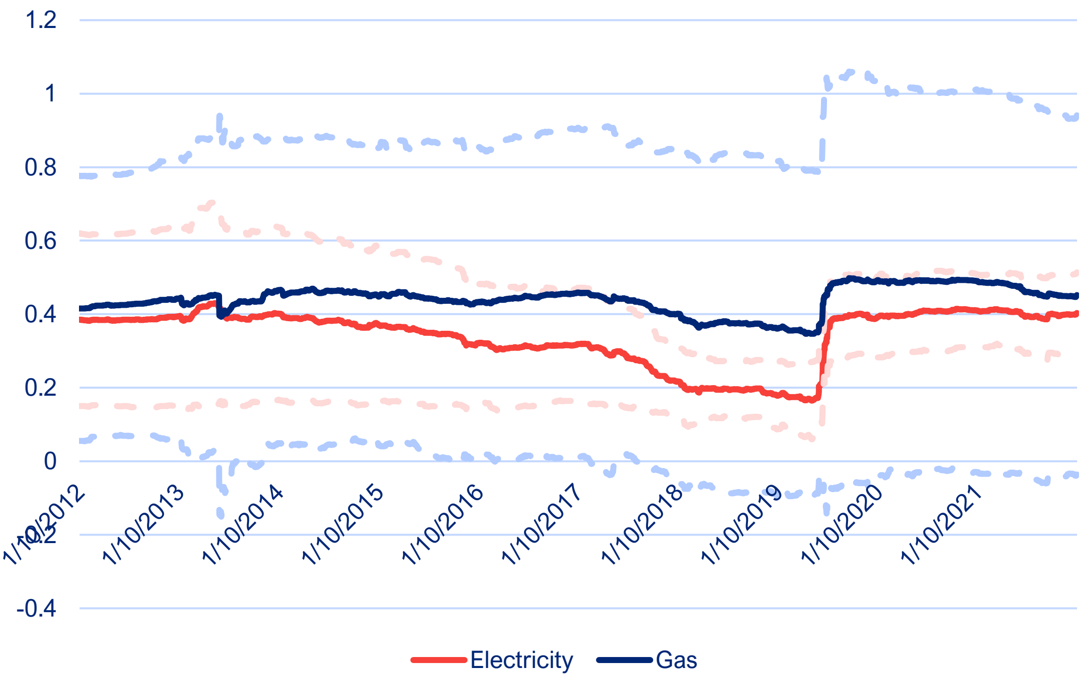
- Between 2016 and the beginning of 2020 there was a declining trend in asset beta for both the electricity and gas sub-samples. There was an abrupt increase in the estimated asset beta from approximately the beginning of 2020. This coincides with the beginning of the Covid period. Following this average asset betas have begun declining again.

[19] Rolling estimates mean the comparator sample changes slightly over time. Furthermore, if an asset beta was unobtainable on a particular date for a comparator for any reason they are dropped from the average on that date.

[20] Obtained by calculating +/- (1.96 * SE).

- The average asset betas of the two samples for the entire period 2012 to 2022 generally remain separated with the asset beta for gas above that of electricity. However, this is not the case when considering the confidence intervals. We find that the difference between the electricity and gas asset betas are not statistically significant.[21] The confidence intervals for the gas sample are particularly wide. Indeed, there are periods where at the 95% confidence interval level the asset beta for the gas sample is statistically indistinguishable from both 0 and 1 at the same time. This may suggest that the gas sub-sample cannot be used alone to estimate asset beta.

Figure 2.3: Rolling 5-year weekly asset betas for the electricity and gas sub-samples



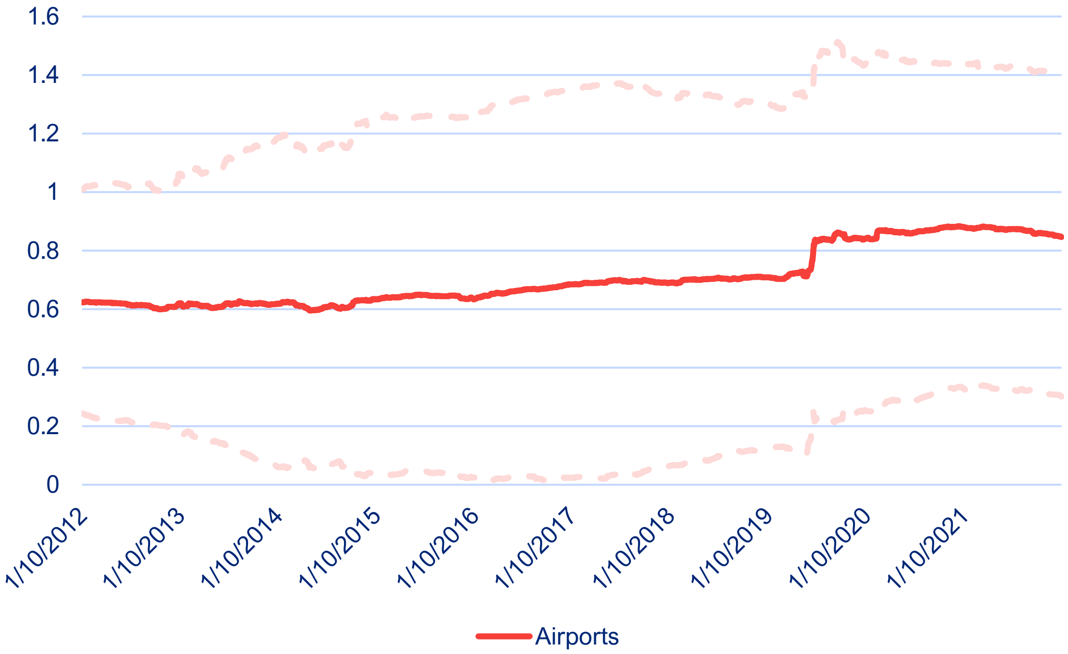
Source: CEPA analysis of Bloomberg Data

The figure below provides a similar chart for airport comparators. We make two observations:

- Firstly, there has been a general trend upwards in asset beta over time. Which accords with our finding that asset beta has increased since 2016. The start of the Covid period led to a marked increase in asset beta of at least 0.1. However, the increasing trend appears to pre-date this. Our asset beta estimate does however appear to be coming back down.
- The uncertainty interval is incredibly wide. There are periods where the 95% confidence interval means the asset beta estimate is statistically indistinguishable from both 0 and 1 at the same time. We would advise the Commission to consider the standard error estimation procedure and implications of this carefully.

[21] We have used methodology as outlined in Section 2.2 above to determine the comparator sample standard errors and confidence intervals.

Figure 4: Rolling 5-year weekly asset betas for Airport sample



Source: CEPA analysis of Bloomberg Data

2.3. Notional leverage

This section sets out the estimates of leverage for the comparator samples following the Commission's 2016 method.

We have calculated leverage using the formula: [net debt] / [net debt] + [market cap].

We also observe that in 2016 where an estimate of leverage was negative the Commission set this to zero to compute the averages. We have also applied this adjustment in the tables shown in this section. The estimates of leverage for each comparator prior to this adjustment are shown in Appendix C.

2.3.1. Airports

The table below shows our estimates of leverage for the airport sample for the various time periods. We observe that in 2016 the Commission presented leverage numbers with an assumption that if measured leverage for a comparator falls below zero then this is instead replaced with zero. The table also provides the average leverage figure with this assumption.

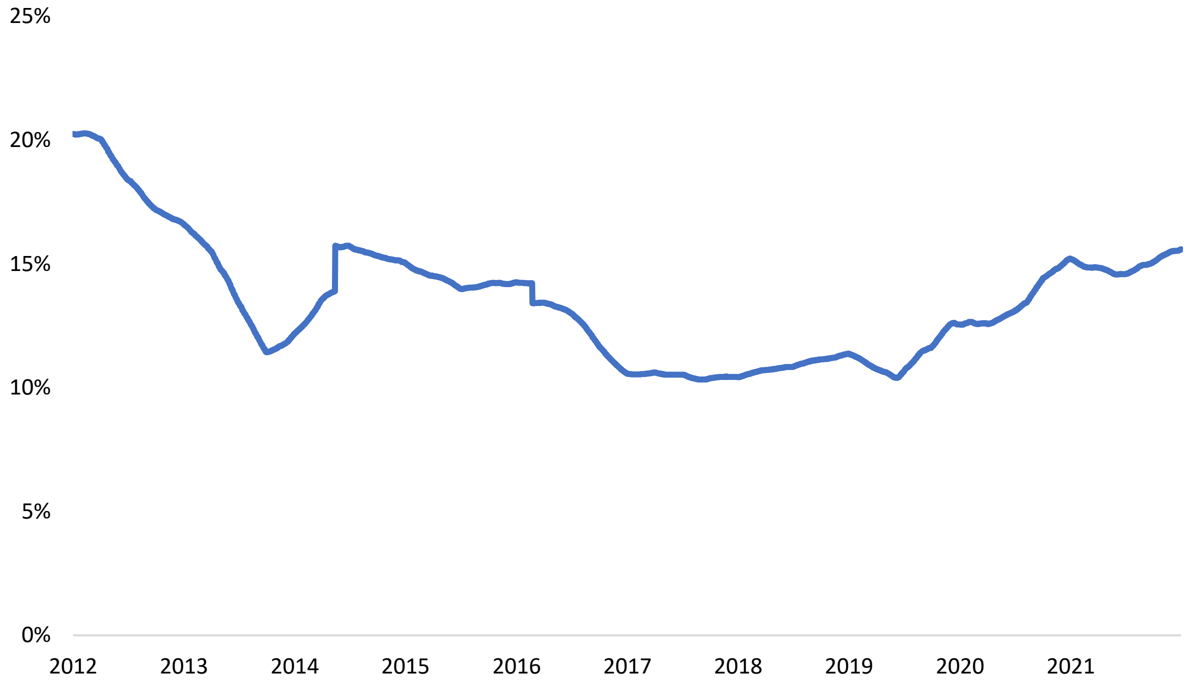
Table 2.14: Summary of average leverage estimates for airport sample

Specification	2017-2022	2012-2017	2007-2012
Average leverage (assuming zero leverage if negative)	14.3%	16.3%	16.6%
Average leverage	12.5%	14.1%	13.8%

Source: CEPA analysis of Bloomberg Data

In the 2016 the Commission set notional leverage for airports at 19% for airports. The table above suggests the leverage of the comparator sample may have fallen. Taking the average of the two most recent five-year periods without an adjustment results in leverage of 15.3%. The figure below shows the trend in leverage over time. On average across the sample, leverage decreased up until 2017 where it remained steady. In the past couple of years leverage has increased, likely in response to Covid-19.

Figure 5: Rolling 6-month average leverage for airport sample



Source: CEPA analysis of Bloomberg data

2.3.2. Energy

The table below shows our estimates of leverage for the energy sample for the various time periods. We also provide separate estimates for the various energy sub-samples.

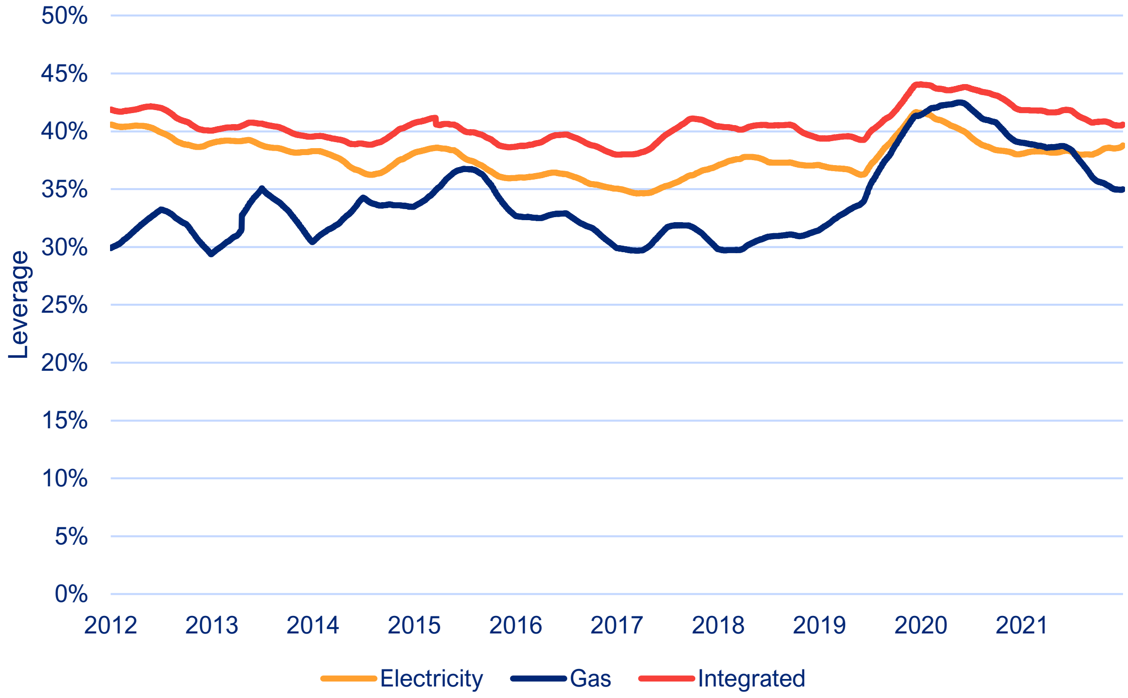
Table 2.15: Summary of average leverage estimates for energy sample

Specification	2017-2022	2012-2017	2007-2012
Overall energy sample			
Average leverage for overall energy sample	39.3%	38.3%	42.3%
Integrated sub-sample			
Average leverage for integrated sub-sample	41.2%	39.5%	44.6%
Electricity sub-sample			
Average leverage for electricity sub-sample	38.5%	40.9%	45.6%
Gas sub-sample			
Average leverage for gas sub-sample	35.5%	32.7%	32.9%

Source: CEPA analysis of Bloomberg Data

In the 2016 decision the Commission determined that leverage should be 42% for EDBs, Transpower and GPBs. This was determining by using the whole energy sample and averaging across the two most recent five-year periods. Using this same procedure here would result in a lower leverage estimate of 39%. The figure below shows average leverage of the overall energy sample and sub-samples since 2012. Leverage was elevated during the Covid period but is now trending downwards. We highlighted above that there may be insufficient comparators to construct a separate gas sub-sample. However, we observe that in general leverage for the gas sub-sample is below the other samples apart from in the Covid period.

Figure 6: Rolling 6-month leverage for the energy samples



Source: CEPA analysis of Bloomberg data

3. CREDIT RATING

The Commission is required to specify a notional long-term credit rating which is used to estimate the debt premium. In the last input methodologies review decision, the Commission set an S&P (or equivalent) long-term credit rating of:[22]

- BBB+ for EDBs, GPBs, and Transpower; and
- A- for airports

The Commission outlined their expectation that an efficient operator would seek to maintain an appropriate investment grade credit rating. S&P's minimum long-term credit rating considered to be investment grade is BBB-. The Commission uses slightly higher credit ratings to provide an adequate safety margin above the minimum investment grade.

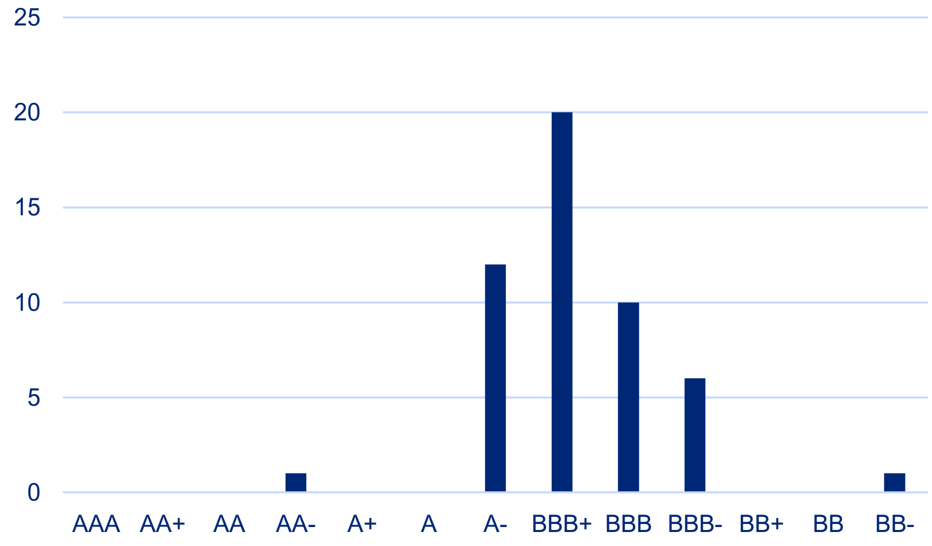
In this section we:

- Provide evidence on the credit ratings of comparators for both energy and airports
- Examine how these credit ratings have evolved over time since 2016.

Credit ratings of comparators

The figure below shows the long-term issuer credit ratings as rated by S&P for each comparator as of 30th September 2022.[23] Of the 54 energy comparators 50 have long-term issuer ratings from S&P. The most common credit rating was BBB+ with most comparators closely grouped around this investment grade credit rating. There is just one comparator with a below investment grade credit rating. This is Pacific Gas and Electric Company which entered bankruptcy on 29th January 2019 and exited on 1st July 2020. This event and the circumstances surrounding it are likely to be weighing down on the credit rating.

Figure 3.1: Credit ratings of energy comparators



Source: CEPA analysis of Bloomberg Data

There are only 3 airport comparators which had a long-term issuer rating from S&P as of 30th September 2022. These are Aeroports de Paris, Auckland International Airport and Flughafen Zurich which all have investment grade

[22] Commerce Commission (2016), Input methodologies review decisions, Topic paper 4: Cost of capital issues.

[23] Full list of comparators and credit ratings shown in Appendix B.

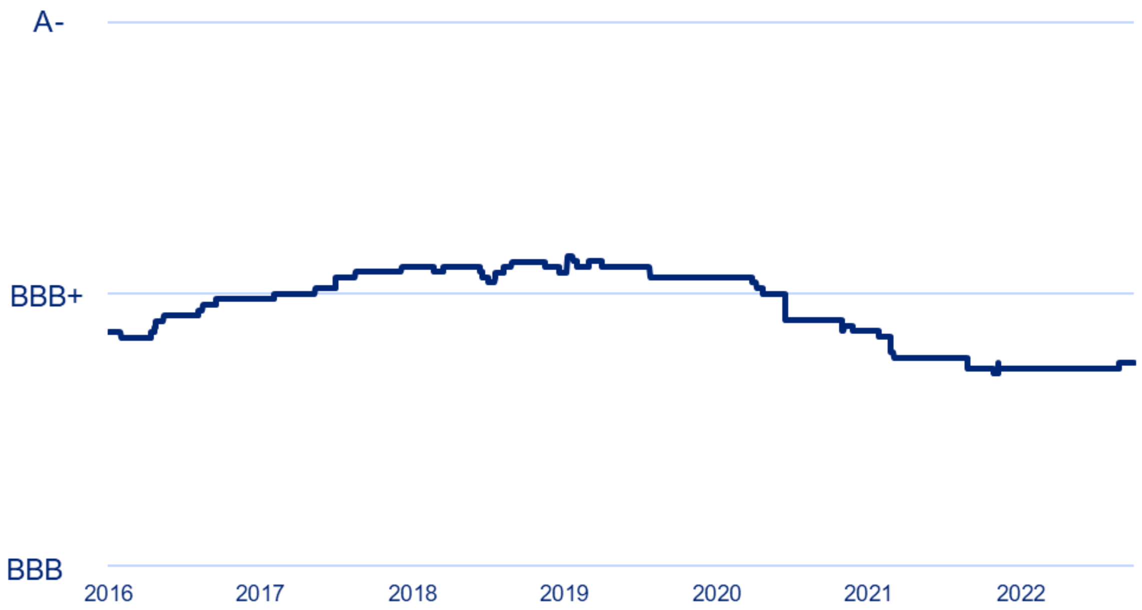
credit ratings of A, A- and A+ respectively. We can supplement this assessment by examining Moody's long-term issuer ratings which provide an additional two ratings for Malaysia Airports Holdings and AENA both of which are rated A3 (equivalent to A- as per S&P's rating scheme). Finally, we can add Sydney Airports which was delisted on 10th March 2022 and as such is no longer a valid comparator for beta estimation. Sydney Airports has a Baa1 credit rating from Moody's (equivalent to BBB+ as per S&P's rating scheme).

Credit ratings over time

We observe that previously the Commission did not place substantial emphasis on the credit ratings of comparators when setting the notional credit rating. Nonetheless, it may be informative to consider how credit ratings of the comparators have evolved since 2016.

The figure below shows the average credit rating for the 51 energy comparators. The average credit rating has been relatively stable since 2016 staying close to BBB+.[24] There has however been a marked decline in the average credit rating during the Covid period with the average now being below BBB+.

Figure 3.2: Credit ratings of energy comparators since 2016



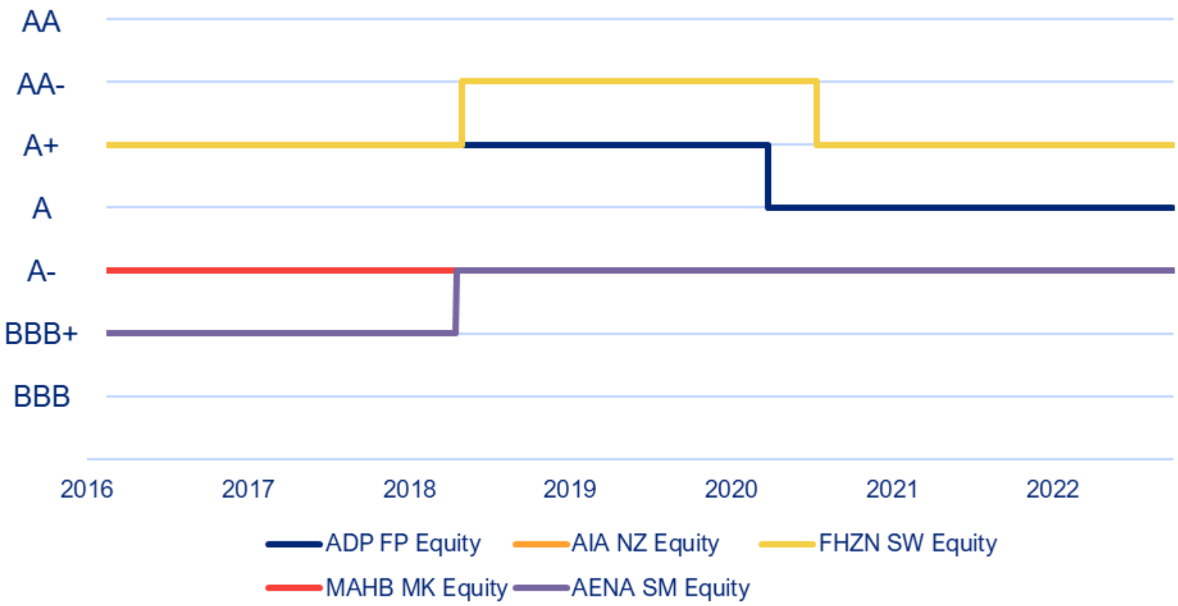
Note: The impact of PG&E's credit rating during the period immediately prior and during their recent bankruptcy is not included.

Source: CEPA analysis of Bloomberg Data

The figure below shows the credit ratings for five comparator airports. For this figure we converted the Moody's ratings into S&P equivalents. The credit ratings for these five comparators have been relatively stable since 2016. Two comparators, Aeroports de Paris and Flughafen Zurich, experienced downgrades during the Covid period but all remain comfortably above investment grade.

[24] The average credit rating was determined by assigning a numerical value against each credit rating and taking the average.

Figure 3.3: Credit ratings of airport comparators since 2016



Source: CEPA analysis of Bloomberg Data

4. WACC PERCENTILE

4.1. Overview

The Commission in the past has set an allowed return above the mid-point estimate of WACC for energy, which includes both electricity and gas. CEPA has been requested by the Commission to provide advice on whether it should continue to set an allowed return above the mid-point estimate and more specifically at what percentile. We have been instructed to adopt the methodology previously developed by Oxera.[25] We are therefore not advising on the overall appropriateness of this method and have only set out to update the relevant evidence.

We would describe Oxera's methodology as a cost benefit test. While Oxera provided analysis of various costs and benefits from setting the allowed return on capital above the midpoint there are only two factors which Oxera consider to be material. The first is the direct impact of increased cost to consumers from increasing the allowed return on capital. The second is the expected benefit from reducing the probability of network failures caused by under-investment. Our interpretation of the Oxera's chain of logic demonstrated using the 60th percentile WACC estimate is as follows:[26]

- The first factor is the direct impact of increased cost to consumers from increasing the allowed return on capital.
    - The probability distribution of WACC estimates is assumed to be normally distributed with mean of the base case estimate and standard deviation of 0.0101.
    - The above parameters are used to estimate to estimate of the WACC value that is at the 60th percentile and obtain the difference between this value at the WACC estimate at the mid-point.
    - This leads to an increase of $50m of revenue annually obtained from customers.[27]
- The second factor is the expected benefit from reducing the probability of network failure caused by under-investment. This is estimated as the change in the probability of network failure multiplied by the estimate of the cost of network failure.
- The calculation of the change in the probability of network failure is based on assumptions that:
    - Under investment will occur and lead to network failures if the 'true' WACC is higher than the allowed return by more than a defined threshold. This threshold was left by Oxera as a judgement call for the Commission. Oxera provides illustrations of its calculations using estimates of 0.0%, 0.5%, 1.0% and 2.0%
    - The probability of network failure is the probability that the 'true' WACC is higher than the allowed return by that threshold, assuming the probability distribution of the WACC is as above.
    - The change in the probability of network failure is the probability that the 'true' WACC is higher than the allowed return plus the defined threshold when the allowed return is set at the 50% percentile.

  Using the 60% percentile example at the 0% threshold there is a 40% probability that network failure will occur because of under-investment. If the threshold between the 'true' WACC and the allowed that causes

[25] Oxera (2014), Input Methodologies – Review of the '75th percentile' approach.

[26] All values in Oxera's methodology are on an annualized basis.

[27] This is our updated cost figure, see table below.

this under-investment is increased to 0.5% then by setting the allowed return at the 50th percentile WACC estimate there is a 23% probability that network failure will occur.[28]

- Oxera determine the change in probability of network failure caused by under-investment at various thresholds.[29] For example, a move from the 50th percentile to the 60th percentile using a 0% threshold reduces the probability by 10%. If instead the 0.5% threshold is applied this reduction is 8%.
- Oxera determined the annualised cost of network failure to be $NZ 1 bn. We have provided an updated value of $NZ 1.9 bn.
- Oxera uses the calculated change in probability multiplied by the cost of network failure to calculate the benefit to consumers of moving away from the mid-point. As explained above, at the 0.5% threshold moving from the mid-point to the 60th percentile reduces the probability of network failure due to under-investment by 8%. This means the expected benefits to consumers is 8% multiplied by $NZ 1.9 bn. This equals $152 million.
- The direct costs of $50 million may be compared to the expected benefit of $152 million indicating that setting the allowed return at the 60th percentile estimate meets the cost benefit test. Indeed, in this stylised example there is a case for applying an even greater percentile.

The table below shows how the various elements of the methodology have been updated.

Table 4.1: Summary of our update on Oxera's analysis

Evidence	How this has been updated
Regulatory precedent	We have reviewed UK and Australian regulatory precedent and find that support for choosing a WACC above the 50th percentile has fallen.
Direct financial effects	We have updated Oxera's analysis of the price and demand effect using current values of NZ electricity consumption, average electricity price, RABs and regulated revenues for Transpower and electricity distribution businesses. We have also reviewed current evidence on the own-price elasticity of demand for electricity. We find that at the 67th percentile, the price effect is approximately an $80 million cost to consumers a year, while the demand effect is relatively small and is of insufficient magnitude to be relevant in the Commission's decision.
Indirect financial effects	We have updated Oxera's analysis of the impact on increases in electricity prices in markets where electricity is a substantial input cost. Oxera concluded that a change in input cost is unlikely to cause distortion to competition or investment decisions in downstream markets. We considered the same set of evidence but updated to 2020. The evidence has not shifted.
Wider social benefits	We have updated Oxera's analysis of the wider social and economic effects of the choice in WACC. We found no new evidence to build on Oxera's links between underinvestment and a loss of network reliability. Instead, we scaled Oxera's estimate for the cost of network outages if underinvestment were to occur accounting for New Zealand's increase in GDP and the change in the value of lost load in New Zealand, which we consider a proxy for changes in reliance on electricity driven by electrification and decarbonisation. Once these two effects are accounted

[28] Formally the 23% represents the the tail end of the normal distribution from the value which represents the 60th percentile of the WACC estimate (0.26% from the central-estimate in this case) plus 0.5%.

[29] This is determined as: $(P(U|midpoint) - P(U|percentile))$

Evidence	How this has been updated
	for, the estimated annualised cost of a loss of network reliability resulting from underinvestment is NZ$1.9bn. Oxera's estimate was NZ$1.0bn.
Probability of loss	We have used Oxera's probability of loss methodology with our updated value for the annualised cost of a loss of network reliability to calculate the potential benefit to consumers of setting a WACC above the midpoint. We find that benefits to consumers are driven by the choice of an appropriate threshold for the difference between the allowed WACC and the true cost of capital required for underinvestment to occur

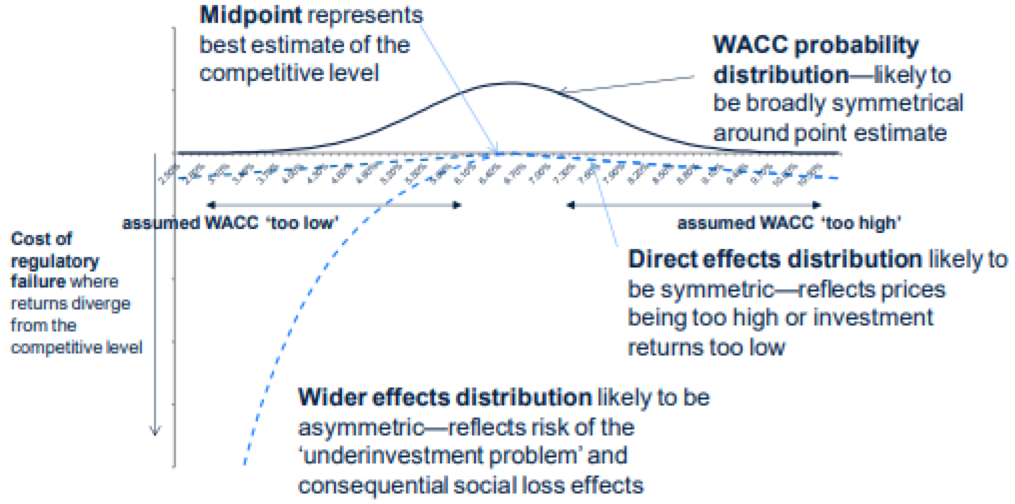
Regarding the appropriate WACC percentile, there are two key changes in the evidence which pull in different directions. Firstly, the regulatory precedent from elsewhere has reduced support for selecting a WACC percentile above the mid-point. Secondly, we find evidence that the cost of a loss of network reliability has increased. We also observe that the relative balance between direct costs (which we have also updated) and expected benefits from reduced likelihood of network failure has changed.

We have been instructed to apply the WACC standard errors as estimated by Commission in 2016. We recommend that once the Commission has estimated all the WACC parameters and standard errors that they update these estimates.

4.2. Summary of Oxera's analytical framework

Oxera describes the relevant aim of the regulator is to apply an allowance sufficient to promote investment. In the absence of a sufficiently high allowed return on capital investment may fall resulting in an 'underinvestment problem'. Oxera also draw on Dobbs (2011)[30]. Dobbs identified a social loss function that links this risk of underinvestment to a cost borne by consumers, through the deterioration of services. The resulting analytical framework is captured in the figure below.

Figure 4.1: Illustration of Oxera's analytical framework



Source : Oxera.

The total cost to consumers of a particular allowed return point estimate above (below) the midpoint is the sum of:

- The increase (decrease) in consumer's bills as the regulated entity can recover more (less) return on capital.

[30] Dobbs, I.M. (2011), 'Modelling welfare loss asymmetries arising from uncertainty in the regulatory cost of finance', Journal of Regulatory Economics, 39, pp. 1–28.

- The decrease (increase) in the expected cost of disruption to services as the risk of underinvestment decreases (increases), where the expected cost of disruption is the probability of a disruption given the level of investment, multiplied by the cost of the disruption.

The fundamental assumption underpinning this framework is the impact on consumers of investment away from the optimal level of investment are asymmetric. If underinvestment occurs, over time networks and services will deteriorate in quality and the risks of disruptions will increase, which reflect a cost to consumers. On the other hand, if overinvestment occurs in the current period, total costs will increase in future periods, leading to higher costs for consumers and decreasing the efficiency of opex benchmarking. However, this cost to consumers is assumed to be of a smaller magnitude than the cost of disruptions.

The Oxera method makes a series of assumptions. Network failures are assumed to only occur if underinvestment occurs, and underinvestment is assumed to occur if and only if the allowed cost of capital is sufficiently below the actual WACC. For example, Oxera consider a threshold of 0.5%. In this scenario, if the allowed return is at least 0.5% lower than the regulated company's true WACC, underinvestment will occur. Once underinvestment occurs, consumers face the annualised expected cost of a loss of network reliability (assumed to $1 billion). Hence, under this framework, reducing the probability of underinvestment occurring by 1% provides a $10 million benefit to consumers.

In a world of full information where the true value of the WACC is known, setting the regulatory cost of capital as this value will minimise the cost to consumers and ensure the regulated companies invest efficiently. However, as the true WACC can only be estimated and uncertainty exists, Oxera suggests that the regulatory cost of capital should minimise the expected cost to consumers when uncertainty surrounding the WACC estimate is accounted for.

4.3. Update on regulatory precedent

Oxera presented a range of regulatory precedent that supported setting a WACC above the midpoint of the estimated range. At the time, UK water, gas, electricity, communications, and airport regulators had a history of determining a range for the WACC and selecting a point estimate above the midpoint.[31]

In UK regulatory decisions from 2008-2014, the 73rd percentile[32] was chosen on average. Furthermore, the midpoint was not chosen once. Oxera argued that UK regulatory precedent was evidence of "a consistent commitment from the regulators to assume a WACC above the midpoint, and therefore to seek to address the underinvestment problem"[33]. They note that in contrast to the Commission's approach of choosing a particular percentile, the allowed return is set on judgement, on a case-by-case basis, and reflective of risks in the current period. Oxera conclude that international precedent is "generally supportive of the Commission's approach to assume a WACC above the midpoint"[34].

CEPA has conducted a similar review of recent regulatory decisions in the UK, while also considering further discussion that has occurred recently in Australia. There have been three main developments in regulatory precedent in the UK since the Commissions last review of setting the WACC percentile:

- Firstly, UK regulators jointly funded a report to analyse the role of cost of capital in the regulation of UK utilities. This report commented on the asymmetric costs associated with misestimating the WACC.

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[31] Oxera (2014a), page 22. Figure 3.2.

[32] Oxera assumed WACC estimates were drawn from a uniform distribution for UK regulators, in contrast the Commission assumes that WACC estimates are normally distributed.

[33] Oxera (2014a), page 25.

[34] Oxera (2014a), page 25.

- Secondly, Ofwat's PR19 Final Determinations were challenged, and a redetermination was carried out by the CMA. The resulting redetermination included picking a point estimate above the midpoint, whereas the original determination used the midpoint.
- Finally, the UK regulatory network are currently consulting on development of a common set of practices for estimating the allowed return on capital. As part of this consultation, they are considering the asymmetric costs associated with misestimating the WACC and how this should be addressed by regulators.

Recent regulatory decisions reflect a shift towards using the midpoint WACC estimate and including appropriate incentive and performance-based conditions in the regulatory package so that the cost of capital is not used to mitigate the risk of underinvestment. Decisions by Ofgem in RIIO-2, the CAA on regulation of air traffic control, ORR on network access, and Ofwat in water reflect this.

It is now uncommon for a WACC above the midpoint to be the default decision. The CMA is addressing 'aiming up' on a case-by-case basis. They overturned Ofwat's decision and moved the WACC estimate above the midpoint, while also removing Ofgem's 'expected outperformance' parameter that effectively shifted the WACC estimate below the midpoint.

The AER in Australia considered setting a WACC above the midpoint in their 2018 review of the rate of return instrument but decided that there was not sufficient evidence for a shift away from the midpoint. Other Australian regulators often discuss ranges for individual WACC parameters, especially market risk premium, but the ranges reflect a mixture of methodologies, as opposed to a selection from a probability distribution.

4.3.1. UK Regulatory Precedent

Table 4.2: Recent UK regulatory precedent

Regulator	Year	Sector	Percentile
UK ORR	2018	Network Rail access charges	50
UK CMA	2019	Water	78
UK CAA	2019	Air traffic control	44
UK Ofcom	2021	Wholesale fixed telecoms	59
UK Ofgem	2021	Gas distribution	50
UK Ofgem	2021	Transmission	50
UK Ofgem	2022	Electricity distribution	51

Source: CEPA analysis. UK regulators report upper and lower bounds for their cost of equity or overall cost of capital estimates. Percentiles were calculated by assuming the WACC estimates were drawn from a uniform distribution between the bounds for the cost of capital estimates.

Estimating the cost of capital for implementation of price controls by UK Regulators (2018)[35]

In 2018, this report was published to take a fresh look at the role of the cost of capital in the regulation of UK utilities, providing updates on an earlier report by Mason, Miles, and Wright (2003)[36], which formed the basis for many of the regulatory decisions in the UK post 2003. The report was commissioned by Ofgem, Ofcom, CAA, and the Utility Regulator.

[35] Estimating the cost of capital for implementation of price controls by UK Regulators, Wright, Burns, Mason and Pickford, 2018.

[36] A Study into Certain Aspects of the Cost of Capital for Regulated Utilities in the U.K, Wright, Mason and Miles, 2003.

The basic incentive problem facing regulators is the need to ensure that regulated companies can finance the efficient investments while avoiding excessive prices for consumers. The framework adopted in this paper decomposes regulatory expected return in the following way.

$$RER = RAR + W_I$$

$$RAR = WACC + W_R$$

Regulatory expected return is equal to the regulatory allowed return (or the allowed WACC) plus an informational wedge, which captures expected outperformance, while the regulatory allowed return is simply the sum of the true WACC and a regulatory wedge (representing uncertainty).

This paper argues that regulatory expected returns should always be set above the true WACC, and that this has been the case in recent UK regulatory decisions as evidenced by a high positive bid premium. For new investments, the paper assumes that setting the RAR in such a way that the RAR is below the true WACC results in a complete loss of surplus. Under a variety of parameterisations, the paper argues that "*the optimal RAR routinely lies above the 90th percentile*"[37]. However, for sunk investment decisions, the paper considers that the optimal RAR is simply the midpoint WACC estimate. It is suggested that ideally, the allowed WACC would be a weighted average of these two percentiles. For National Grid Gas during RIIO-T1, the suggested range for WACC percentile is 52-58%, which is much lower than the 67th percentile chosen by Ofgem in RIIO-T1. Therefore, the paper argues that there is a case for choosing a WACC percentile above the midpoint but that this case is a limited one and "*more limited than appears to have been adopted in a number of past regulatory decisions in the UK*".[38]

The authors recommend that the ideal approach by regulators would be explicitly target values for the total aiming-up wedge and the information wedge (representing expected outperformance). To set this second parameter:

> *Regulators should assemble a systematic and comprehensive database of historic outperformance, to enable them to make their best-informed forecast of the "informational wedge"*.[39]

Ofgem's adoption of recommendations

In Ofgem's Final Determinations for RIIO GD&T2, an outperformance wedge was included to adopt the above recommendations. Using historical data on outperformance, Ofgem estimated that networks were expected to outperform by 25 basis points and then deducted this from its estimate of the cost of equity. This decision was controversial, and many networks critiqued the inclusion of an outperformance wedge, arguing that it would disincentivise investment. Outperformance is generally driven by productivity gains achieved above those estimated by the regulator and the inclusion of an outperformance wedge effectively penalised networks for past productivity gains, disincentivising future attempts at increasing productivity (through investment or cost reduction). As Phil Burns[40] commented

> *Ofgem's focus on the "outperformance" wedge therefore ignores the fact that if high powered incentives did not reveal outperformance, then the rents would simply be enjoyed by the insiders in a closed system, paid for by consumers. The experience of the pre and post privatisation period in the UK suggests that for all the political inconvenience of higher returns, consumers have been better off in an incentive-based system than in the low-powered system that preceded it.*[41]

CMA decision on outperformance wedge

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[37] Wright, Burns, Mason, Pickford (2018)

[38] Wright, Burns, Mason, Pickford (2018)

[39] Wright, Burns, Mason, Pickford (2018)

[40] Frontier Economics, Director, author of the previous report.

[41] Frontier Economics – Incentive implications of Ofgem's outperformance wedge.

All networks lodged a joint appeal to the CMA to overturn Ofgem's inclusion of the outperformance wedge. CMA found that Ofgem was wrong to impose the outperformance wedge.[42] However, CMA recognised that the extent of operational outperformance in RIIO-1, including totex outperformance, gave support for Ofgem addressing the issue but concluded that other changes to the RIIO price control addressed this issue and that the outperformance wedge was not a well-designed tool.

Implications for WACC percentile

For the RIIO-1 price control Ofgem chose a cost of equity above the midpoint[43] for determinations made before the Competition Commission's (now CMA) decision on the appropriate methodology for estimating the cost of equity for electricity distributors in Northern Ireland.[44] Following the methodological change, Ofgem chose the midpoint for electricity distribution in RIIO-1[45] and continued to use the midpoint of estimated ranges for cost of equity throughout RIIO-2 for all sectors.

The decision to include the outperformance wedge effectively meant that Ofgem was choosing a cost of equity below the midpoint, reflecting a belief that due to asymmetric information, estimates of WACC are upwardly biased. The CMAs decision to remove the outperformance wedge shifted the estimated cost of equity back to the midpoint for all determinations under the RIIO-2 framework.

Ofwat / CMA decision on aiming up in PR19 (2019-2020)

Ofwat, as part of its PR19 price control determination, set the cost of capital at the midpoint of its estimated range. This cost of capital was set within the context of negative real cost of debt and sharply declining cost of equity. The resulting inflation adjusted CPIH-real WACC estimate was 2.96%, significantly below the cost of capital requested by water networks, which ranged between 3.32% to 4.04%. Following this determination, four networks asked Ofwat to refer their price controls to the CMA for a redetermination.

During the redetermination, CMA paid particular attention to the issue of selecting a point estimate for the WACC, recognising that

> *There is a regulatory history of setting the cost of capital by using a range, and then picking a point estimate from the top half of that range, both in the UK and internationally.*[46]

The CMA reviewed regulatory precedent, in particular the Commission's reasoning for choosing a point estimate of the WACC above the midpoint, and previous Ofwat and CMA decisions.

Table 4.3: Regulatory precedent considered by CMA in 2021 price determination

Decision[47]	Evidence
Ofwat's PR04 determination	Ofwat believe the evidence supports a cost of capital in the range of 4.2% to 5.3% post-tax. Ofwat used a cost of capital towards the high end of the range but not at the top. Ofwat's judgement is that a cost of capital of 5.1% (real post-tax) should allow companies to maintain access to the capital markets.

[42] CMA (2021), RIIO-2 Energy Licence Modification Appeals – Summary of final determination.

[43] 83% for electricity transmission, 67% for gas transmission, 58% for gas distribution. See: Ofgem (2012), RIIO-T1: Final Proposals for National Grid Electricity Transmission and National Grid Gas.

[44] Competition Commission (2014), Northern Ireland Electricity Limited price determination.

[45] Ofgem (2014), Decision on our methodology for assessing the equity market return for the purpose of setting RIIO-ED1 price controls.

[46] CMA (2021), Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations – Final Report.

[47] ibid

Decision[47]	Evidence
Ofwat's PR09 determination	The weighted average cost of capital includes a 7.1% post-tax cost of equity derived from measurements of the risk-free rate, equity risk premium and asset beta estimates. Ofwat's final determination cost of equity is at the high end of the Europe Economics pre-marked-up range (3.5% to 7.2%), but we believe that it is necessary to allow the industry to maintain access to finance in difficult economic times.
Ofwat's PR14 determination (TMR)	The Competition Commission maintained their TMR range of between 5.0% to 6.5% between NIE's draft and final determination but moved from the middle to the top of their range (6.5%). Ofgem, following a consultation on TMR, revised down their estimate of the cost of equity from 6.3% to 6.0% for ED1 draft determinations. Overall, Ofwat have decided not to change the 6.75% assumption for the TMR.
CMA NIE determination 2014	Bearing in mind the available evidence and other aspects of the CMA's final determination, the CMA adopted the upper end of this range [3.3% - 4.1%], 4.1 per cent, as the WACC for RP5.
NZCC WACC percentile 2014	New Zealand energy regulation contains one of the clearest examples of explicitly adjusting the overall WACC outcome (rather than the individual metrics). The New Zealand Commerce Commission (NZCC) follows a policy of setting regulatory price controls in energy based on the 67th percentile of the WACC range. The NZCC suggest that it is appropriate to use a WACC significantly above the mid-point estimate for price-quality path regulation, stating that the potential costs of under-investment from a WACC that is too low are likely to outweigh the harm to consumers (including any over investment) arising from a WACC that is too high.

The CMA determined that there were three considerations when setting a point estimate for the WACC. Namely:

1. The financing duty: the cost of capital needs to be sufficient for an efficient firm to finance the performance of its statutory functions
2. The consumer objective: protection of consumers
3. The resilience objective: if significant investment is required in resilience, the cost of capital needs to be sufficient to provide incentives to the firms to meet those incentives.

The CMA sought to determine what cost of capital was sufficient to achieve the benefits associated with financing and resilience duties without being over-generous. The CMA concluded that

> *There are a number of benefits from choosing a point estimate of the cost of equity above the middle of the range. [The CMA's] view is that this will result in an appropriate balance of risk in the round across the determination, including addressing the level of risk to investment in the sector associated with setting the cost of equity too low, particularly in the context of a sharp reduction since AMP6, and also addressing asymmetry in the broader financial settlement. [The CMA] have also concluded that a decision to set a point estimate above the middle of the range will address the risks to financeability which would increase from setting the cost of equity at lower levels within the range.*[48]

The CMA's final decision was to use a cost equity point estimate 0.25% above the middle of their 3.76% to 5.21% range. This was equivalent to choosing the 67th percentile of their cost of equity range.

Implications for WACC percentile

The CMA's 2020 decision to pick the 67th percentile for their cost of equity range contrasts Ofgem, ORR and Ofwat's recent decisions to choose the midpoint for all components of the WACC and the WACC itself. Importantly, the CMA relied heavily on evidence from the Commission's 2014 decision to choose the 67th WACC percentile, which relied heavily on UK regulatory precedent for evidencing that aiming up is a common practice among international regulators. Going into this review, it is prudent to recognise that current regulatory decisions are

48 Ibid

based, in large part, on previous regulatory decisions, and that the Commission should take this opportunity for a fresh look at the issue of setting WACC percentile.

UKRN ongoing consultation on common approaches to setting WACC parameters (2022)

UKRN are currently consulting on a set of agreed approaches to setting WACC parameters and point estimates across price controls in the UK. Ofwat, Ofgem and Ofcom, with support from the CAA and UREGNI, are working together via the UKRN Cost of Capital Taskforce. Recommendations include a common set of principles for determining the range and picking a point estimate for WACC parameters that are inherently uncertain, including beta, market risk premium and the risk-free rate. On deriving a CAPM cost of equity range and point estimate, the Taskforce recommends:

> ***Recommendation 6:*** *The RFR, TMR and (re-levered) equity beta assumptions should be combined using the CAPM to produce a cost of equity range. The mid-point of the range should be used as the point estimate for the CAPM cost of equity.*[49]

The taskforce also directly considers the welfare impact from under-investment. The taskforce recognises that considering the welfare impacts from underinvestment is important but argues that most regulatory frameworks have developed alternative ways of incentivising investment withing the building blocks of a cost-based price control. Some tools suggested by the Taskforce are presented in the table below. With respect to setting a cost of equity away from the midpoint, the Taskforce recommends:

> ***Recommendation 7:*** *Regulators should only deviate from the mid-point of the CAPM cost of equity range if there are strong reasons to do so.*[50]

Table 4.4: Alternative regulatory tools that can be used to minimize the risk of underinvestment

Tool	Description
Statutory requirements	Significant investment is driven by statutory requirements or official planning exercises, as opposed to purely commercial motivations. Where statutory investment is included in business plans, regulators typically allow for the recovery of these costs (subject to an appropriate efficiency challenge) in the allowed expenditure profile. Failure by regulated companies to fulfil their statutory duties can result in enforcement action and could ultimately result in them forfeiting control of the license to operate, which is a powerful incentive against under-investment.
Service delivery incentives	Regulators increasingly rely on service delivery incentives to reduce the risk of under-investment (e.g., in general maintenance, asset health and in circumstances where spend is discretionary). Such incentives may mitigate the risk of under-investment in existing infrastructure.
Separate treatment of large one-off projects	It may be possible to treat new investments separately from existing assets within the price control, where the cost of capital is set by a market exercise. For example, Ofgem has used a separate delivery approach for offshore investment (through the Offshore Transmission Owner (OFTO) regime) and Ofwat is exploring direct procurement for customers (DPC) in which water companies seek bids from third parties to design, operate and build new infrastructure.
Pricing freedom for new investments when competing infrastructure and/or regulation of	For example, in recognising the scale of investment required for gigabit capable networks and the scope for competing network build in many parts of the country, Ofcom has allowed Openreach pricing freedom on most fibre broadband services, with anchor pricing (a safeguard cap) on the entry-level superfast broadband service. This approach allows scope for returns above the cost of capital on the new

[49] UKRN guidance for regulators on the methodology for setting the cost of capital – consultation.

[50] UKRN guidance for regulators on the methodology for setting the cost of capital – consultation.

Tool	Description
legacy services constrains market power	investment, in order to offset the risk that demand in future turns out to be insufficient to allow for recovery of the upfront investment.

4.3.2. Australian regulatory precedent

Rate of return instrument, AER, 2018

The AER explicitly consider the risk of underinvestment occurring because of the true cost of capital lying above the allowed WACC. However, after considering available evidence, the AER decided to not apply an arbitrary adjustment to their WACC estimate and use the midpoint. The following observations were used to justify this:[51]

- The evidence does not clearly support the application of a bias in one direction or the other. Reasonable points are made in support of both directions.
- A comprehensive and systematic assessment was undertaken, leading to the estimation of an efficient rate of return.
- The probability of the rate of return being too high or too low is symmetrical.
- Any adjustment would be arbitrary. There is no objective analysis that can point to a particular magnitude of adjustment that might be made.
- If the rate of return is incorrect, then adding an arbitrary adjustment may move our rate of return even further from the efficient outcome.
- The AER sense that the costs arising from a rate of return that is too high or too low accelerate the further the estimate is from the efficient level. Adding an arbitrary adjustment may therefore introduce larger costs.

An important observation made by the AER is that, given their methodology for estimating WACC parameters is unbiased, in the long run the expectation of the difference between the allowed WACC and the true WACC is zero. That is, in the long run, the allowed WACC should not lie below the true WACC and cause sustained underinvestment, reducing the cost to consumers of underinvestment.

Review of WACC method, IPART, 2018

IPART do not explicitly consider the risk of underinvestment resulting from incorrect estimation of the WACC but recognise that if abnormal economic conditions occur, estimates of WACC parameters are likely to increase in uncertainty and discretion should be used to select the WACC point estimate. IPART argue that continuing to apply their standard WACC methodology during periods of increased uncertainty may lead to large estimation errors and adversely impact consumers, especially through disincentivising investment.

This is formulised by IPART in their WACC methodology through the uncertainty index. IPART keep track of an uncertainty index comprised of macroeconomic indicators. If this index rises above one standard deviation from the historical mean, then IPART has the power to diverge from their standard WACC methodology and arbitrarily choose WACC parameters to continue to support efficient investment.

While IPART are not explicit with what their approach would be in such a case, it is possible that they would apply an uplift to the WACC away from the midpoint in order to protect against underinvestment during times of economic uncertainty. Interestingly, IPART's uncertainty index only briefly passed one standard deviation at the onset of COVID-19 and IPART has not used its power to set WACC parameters since the uncertainty index was introduced in 2013.

[51] AER (2018), Rate of return instrument – Explanatory Statement.

Other Australian regulators

Most Australian regulators create a range of values for market risk premium, including ERAWA, ICRC, QCA, ACCC, ESC and ESCOSA, but just estimate the midpoint for other WACC parameters. However, the endpoints of these ranges are derived from using a range of methodologies to estimate market risk premium. Regulators use dividend growth models with varying assumptions and parameterisations, as well as looking at historical returns to estimate market risk premium. Therefore, when these regulators pick a point estimate from their range – the midpoint or otherwise – this reflects a weighting of methodologies as opposed to a choice of percentiles of a certain estimator.

4.4. Direct financial effects

We have updated Oxera's analysis of the price and demand effect using current values of NZ electricity consumption, average electricity price, and RABs and regulated revenues for Transpower and electricity distribution businesses provided by the Commission. Compared to Oxera's analysis, the price effect has increased slightly, driven by an increase in RAB value for Transpower and electricity distribution companies, and an increase in the share of consumer bills that Transpower accounts for.

We have also reviewed current evidence on the own-price elasticity of demand for electricity and find that a suitable estimate of the range is -0.25 to -0.75, meaning that electricity is relatively inelastic.

For this update, we have been instructed to use the WACC standard error as estimated previously. Using the WACC standard error of 0.0101 as fixed in the 2016 revisions to the IMs, we find that at the 67th percentile the price effect is approximately an $80 million cost to consumers, while the demand effect is relatively small and should not be considered by the NZCC in their decision.

4.4.1. Summary of Oxera's approach

The decision to choose a point estimate for the WACC above the midpoint allows regulated companies to recover a higher cost of capital, increasing consumer bills. Oxera explain the price effect of changing the WACC estimate for electricity transmission and distribution companies, observe that this effect is somewhat offset by decreased demand for electricity but conclude that this decrease in demand is insignificant compared to the increase in prices for consumers. Oxera's estimates of the cost to consumers of setting the WACC at different levels above the midpoint are presented in the table below.

Table 4.5: Oxera's calculation of the impact on electricity prices of increasing the allowed return to specified positions on the probability distribution of WACC estimates ("price effect")[52]

Percentile	Increase in WACC relative to midpoint	Approximate cost ($m)	Approximate increase in T&D revenues	Approximate increase in residential price
50%	0.0%	0	0%	0%
55%	0.1%	20	0.7%	0.2%
60%	0.3%	40	1.3%	0.5%
65%	0.4%	60	2.0%	0.7%
70%	0.6%	80	2.7%	1.0%
75%	0.7%	105	3.5%	1.3%
80%	0.9%	135	4.4%	1.6%
85%	1.1%	165	5.4%	2.0%
90%	1.4%	200	6.7%	2.5%

52 These numbers are calculated mechanically by multiplying the increase in the estimate of WACC by RAB.

Percentile	Increase in WACC relative to midpoint	Approximate cost ($m)	Approximate increase in T&D revenues	Approximate increase in residential price
95%	1.8%	260	8.6%	3.2%

Price effect

Oxera found that a shift from the 75th percentile to the midpoint would decrease the WACC estimate by 0.7%, reducing allowed revenues by around NZ$105m for Transpower and electricity distribution companies. Accounting for the contribution of electricity transmission and distribution costs to final consumer bills (8% and 29% respectively), Oxera then estimated the reduction in allowed revenues would imply a 1.3% reduction in price for household consumers, while this impact may be as high as 5% for industrial users. Oxera commented that:[53]

> *The direct price effect results in a transfer of wealth from end-users to investors in the transmission and distribution companies. This could be considered a redistribution of wealth as opposed to an overall welfare loss.*

However, Oxera argue that the Commission's duty is to protect end users, and as a result a consumer welfare approach is adopted, which basically assumes that the Commission is only concerned with how their decisions affect end-users.

Demand effect

Quoting a range of academic studies investigating the own-price elasticity of electricity, Oxera estimate the elasticity of demand between -0.2 and -0.4. Hence, decreasing prices by 1.3% leads to a slight increase in demand for electricity, creating a relatively small deadweight loss in the range of NZ$50,000 – NZ$100,000. Given the difference in magnitude compared to the decrease in allowed revenues (~NZ$100m), Oxera conclude that this demand effect is not significant, and this is captured in the table below.

Table 4.6: Comparison of the price and demand effect at the 75th and 67th percentile

	75th percentile	67th percentile
Increase in WACC from the midpoint	0.7%	0.48%
Transpower's RAB 2014/15	NZ$4.6bn	NZ$4.6bn
Electricity distribution RAB 2014/15	NZ$9.5bn-NZ$10bn	NZ$9.5bn-NZ$10bn
Price effect: Total reduced return	**NZ$105m**	**NZ$72m**
Decrease in consumer bills	1.3%	0.9%
Reduction in residential price	NZ$0.0034/kWh	NZ$0.0024/kWh
Increase in consumption	32 – 64 GWh	32 – 64 GWh
Demand effect: Deadweight loss	**-NZ$55,000 to -NZ$100,000**	**-NZ$40,000 to -NZ$70,000**

Welfare function

Total welfare can be represented as

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

[53] Oxera (2014a), page 29

In adopting a consumer welfare approach, Oxera set α = 1, assuming that the Commission was only concerned with impacts on end-users. Several stakeholders argued that it would be more fitting to use a total welfare approach (α = 0.5), or an approach that puts most weight on consumer surplus and some weight on producer surplus (0.5 < α < 1). Ultimately, Oxera's decision to use a consumer welfare approach results in a conservative estimate of the impact on total welfare from a change in price. For example, if a total welfare approach was used instead, an increase in price would decrease consumer surplus but have an offsetting increase in producer surplus. Given the Commission's true welfare function is unknown, Oxera concluded it was appropriate to set α = 1.

4.4.2. CEPA's update of evidence

CEPA has updated Oxera's analysis on the direct effects of choosing a WACC estimate above the midpoint using RAB and regulatory revenue allowances for electricity distribution and transmission companies provided by the Commission. The contribution of electricity transmission and distribution costs to final consumer bills has shifted slightly since Oxera's report, with transmission accounting for 10.5%, up from 8%, and distribution accounting for 27%, down from 29%. At this stage, CEPA is using the WACC standard error of 0.0101 as fixed in the Commission's 2016 revision to the IMs.

Table 4.7: Overview of New Zealand's electricity transmission and distribution market

	Transmission	Distribution
Market structure	Transpower is a state-owned entity that owns and operates New Zealand's electricity transmission network.	27 lines companies distribute electricity throughout New Zealand.
Share of consumer bills[54]	10.5%	27%
RAB	$4.9bn	$13.5bn
Revenues	$0.8bn	$2.3bn

Price effect

Table 4.8: CEPA's update of the "price effect" (the impact on electricity prices of increasing the allowed return to specified positions on the probability distribution of WACC estimates using NZCC WACC standard error[55]

Percentile*	Increase in WACC relative to midpoint	Approximate cost ($m)	Approximate increase in T&D revenues	Approximate increase in residential price
50%	0.0%	0	0.0%	0.0%
55%	0.1%	25	0.8%	0.3%
60%	0.3%	50	1.5%	0.6%
65%	0.4%	70	2.4%	0.9%
70%	0.5%	100	3.2%	1.2%
75%	0.7%	125	4.1%	1.5%
80%	0.9%	155	5.1%	1.9%
85%	1.0%	195	6.3%	2.4%
90%	1.3%	240	7.8%	2.9%
95%	1.7%	305	10.0%	3.8%

[54] Electricity in New Zealand. Electricity Authority.

[55] We used closing RABs and revenues for EDBs and Transpower in 2021 as provided by the Commission.

**The percentile column refers to the percentiles of the probability distribution of WACC estimates assuming that the WACC estimate is normally distributed with mean 4.92% and standard deviation 0.0101.*

The price effect has increased slightly since Oxera's analysis, mainly driven by an increase in RABs for Transpower and EDBs. This is complemented by the increased share of electricity distribution in consumer electricity bills. A shift in the allowed return from the midpoint to the 75th percentile of the WACC distribution would increase the WACC by 0.7%, costing consumers NZ$125m, while increasing electricity transmission and distribution revenues by 4.1% and increasing the residential price by 1.5%. This is an approximately 20% increase in costs from Oxera's analysis. At the 67th percentile, the cost to consumers is NZ$80m.

Demand effect

Table 4.9 below summarises estimates from recent academic studies of the long term (> 12 month) own-price demand elasticity of electricity for households. The summary focusses on recent studies in the US as well as older studies in Australia and New Zealand. While there is a range of estimates, the following observations can be made from the data:

- Own-price elasticity of demand for electricity is negative and relatively inelastic (-1 < e < 0).
- Own-price elasticity increases in the long-term substantially. Time of use studies found elasticity to be small and negative (-0.1 < e < 0), short term elasticity to be around 50% of long term (> 12 month) elasticity.
- A range of -0.25 to -0.75 as an estimate for long-term own-price elasticity of demand for electricity is reasonable. This is considerably higher and wider than Oxera's -0.2 to -0.4 range.

Table 4.9: Review of recent academic studies into own-price elasticity of demand for electricity

Paper (Year)	Years of study	Country	Estimate	Source
How price-responsive is residential retail electricity demand in the US? (2021)	2005-2019	US	-0.054	Here
Estimating the sectoral demands for electricity using the pooled mean group method (2018)	1997-2011	US	-0.11	Here
Income and price elasticities of electricity demand in Australia: Evidence of state-specific heterogeneity (2019)	1999-2013	Australia	-0.38	Here
Response of residential electricity demand to price: The effect of measurement error (2011)	1995-2007	US	-0.44	Here
Price and income elasticities of residential electricity demand: the Australian evidence (2014)	1970-2011	Australia	-0.75	Here
The Own Price Elasticity of Demand for Electricity in NEW Regions (2007)		Australia	-0.25 to -0.38	Unable to locate.
The price elasticity of electricity demand in South Australia (2011)	1997-2008	Australia	-0.42	Here
Modelling and forecasting the demand for electricity in New Zealand: a comparison of alternative approaches (2003)	1960-1999	New Zealand	-0.44 to -0.59	Here

Using an estimate of -0.25 to -0.75 for own-price elasticity of demand of electricity, 13,463GWh[56] as New Zealand's residential electricity usage, and an average retail price of 32.5c/kWh[57] for residential electricity consumers, the deadweight loss resulting from the demand effect is calculated in the table below.

Table 4.10: Comparison of the price and demand effect at the 67th percentile, CEPA update

	67th percentile
Increase in WACC from the midpoint	0.4%
Transpower's RAB 2021	NZ$4.9bn
Electricity distribution RAB 2021	NZ$13.5
Price effect: Total additional return	**NZ$81.8m**
Increase in consumer bills	1.0%
Increase in residential price	NZ$0.0033/kWh
Decrease in consumption	-0.3% to -0.8%
Total decrease in consumption	100 – 300GWh
Demand effect: Deadweight loss	**-NZ$165,000 to -NZ$490,000**

As illustrated, the magnitude of the demand effect is much smaller than the magnitude of the price effect.

4.5. Indirect financial effects

We have updated Oxera's analysis of the impact on increases in electricity prices in markets where electricity is a substantial input cost. We find the evidence has not shifted.

The industry most impacted by an increase in electricity prices is primary metal and metal product manufacturing, where a shift from the midpoint to the 67th percentile is likely to increase input costs by less than 0.2%.

4.5.1. Summary of Oxera's approach

Oxera considered two indirect effects of electricity prices moving away from the competitive level as a result of choosing a point estimate of the WACC away from the midpoint:

- An investment effect. How will changes in prices distort investment decisions across the supply chain?
- A competitive effect. How will changes in prices affect the competitiveness of New Zealand firms that have high energy consumption and significant exports?

Investment incentives

If the allowed cost of capital is set in excess of the true WACC, regulated firms may have incentives to over-invest or 'gold-plate' in order to benefit from the return being above the company's cost of capital. This risk is mitigated for Transpower through the Commission's ability to evaluate capex plans and ex-ante approve efficient capex. Similarly, the Commission reviews electricity distributor's forecast capex and decides what it will fund and what will not be added to the RAB.

Competitive distortions

Oxera identified the primary metal and metal product manufacturing, pulp, paper and converted paper product manufacturing, and supermarket and grocery stores as the three industries that met their dual criteria of high

[56] This figure is sourced from Statista. The total electricity consumption in New Zealand is around 3 times higher. The focus of the Oxera methodology was on residential customers.

[57] Ministry of Business, Innovation & Employment (2022), Quarterly Survey of Domestic Electricity Prices.

energy consumption (as a proportion of total inputs) and significant exports. It was argued that a 1.3% increase in electricity prices would translate to a roughly 0.25% increase in the cost base for these industries, which would either decrease their profits or decrease their competitiveness on an international scale if they pass through costs. However, Oxera argued that the deadweight loss resulting from this change in price would be relatively small when compared to the direct price effect, and so it did not need to be considered by the Commission.

In conclusion, Oxera decided that indirect effects did not need to be considered by the Commission and did not include them in the remaining analysis.

4.5.2. CEPA's update of evidence

The most recent New Zealand input-output tables[58] suggest that the industries with the highest proportion of electricity input costs are:

- Primary metal and metal product manufacturing
- Gas and water supply
- Supermarket and grocery stores

The industry most impacted by an increase in electricity prices is primary metal and metal product manufacturing, where electricity accounts for 19.4% of total input costs. However, increasing the WACC from the midpoint to the 67th percentile represents a 0.7% increase in the point estimate, using the Commission's fixed WACC standard error, which translates to a <0.2% change in costs in the primary metal and metal product manufacturing industry. This will create a loss of profit or an increase in prices proportional to the change in costs, depending on the firm's ability to passthrough costs and exposure to international markets that do not experience a similar increase in costs. Oxera argue:,[59]

> *The direct price effects resulting from higher charges should be the primary focus of the Commission in determining the appropriate choice of percentile.*

Table 4.11: CEPA's update on the impact of an increase in electricity prices on input costs for different industries

Industry	Electricity cost / total input cost	Impact of an increase in electricity price	
		1%	5%
Primary metal and metal product manufacturing	19.4%	0.2%	1.0%
Gas and water supply	16.2%	0.2%	0.8%
Supermarket and grocery stores	7.2%	0.1%	0.4%
Residential care services and social assistance	6.8%	0.1%	0.3%
Tertiary education	6.0%	0.1%	0.3%
Pulp, paper, and converted paper product manufacturing	5.5%	0.1%	0.3%
Dairy cattle farming	3.9%	0.0%	0.2%
Non-metallic mineral product manufacturing	3.1%	0.0%	0.2%
Hospitals	2.8%	0.0%	0.1%
Accommodation	2.8%	0.0%	0.1%
Food and beverage services	2.1%	0.0%	0.1%

[58] Stats NZ (2021), National accounts input-output tables: Year ended March 2020.

[59] Oxera (2014a)

Industry	Electricity cost / total input cost	Impact of an increase in electricity price	
		1%	5%
Fruit, oil, cereal, and other food product manufacturing	1.9%	0.0%	0.1%
Telecommunications services	1.6%	0.0%	0.1%
Dairy product manufacturing	1.1%	0.0%	0.1%
Construction services	0.3%	0.0%	0.0%

4.6. Wider social and economic effects

We have updated Oxera's analysis of the wider social and economic effects of the choice in WACC. We reviewed several studies but found no evidence to contradicted Oxera's links between underinvestment and a loss of network reliability. Instead, we scaled Oxera's estimate for the cost of network outages if underinvestment were to occur accounting for New Zealand's increase in GDP and the change in the value of lost load in New Zealand, which we consider a proxy for changes in reliance on electricity driven by electrification and decarbonisation. Once these two effects are accounted for, the estimated annualised cost of a loss of network reliability resulting from underinvestment is NZ$1.9bn.

However, we do note concerns that Oxera's approach overestimates the true cost of underinvestment by using the cost of one-off events to estimate the annualised cost of these events. In addition, we believe there would be some probability of a loss of network reliability even in a world of efficient investment, while Oxera assume this probability to be zero.

4.6.1. Summary of Oxera's approach

In assessing wider social and economic effects of the choice WACC percentile, Oxera focussed on medium- to long-term network reliability. Their hypothesis was that the choice of WACC percentile affects regulated companies' incentives to invest, which impacts network reliability and the probability of network failure. For commercial and industrial customers, this may lead to reduced production and a final cost, while for household customers, decreased reliability has a cost in terms of reduced value.

Oxera recognised that deterioration in network reliability and the choice of the WACC are "both difficult to measure and subject to fundamental uncertainty"[60]. As a result, Oxera argued:[61]

> *These are unlikely ever to be measured in a statistically robust manner. However, performing an analysis of what can be established, and understanding the scale of these effects relative to the other impacts, will support the Commission in exercising its judgement on the appropriate percentile.*

The Oxera method requires a certain logical chain to hold. A loss in network reliability is assumed to only occur if underinvestment occurs, and underinvestment is assumed to occur if and only if the allowed cost of capital is sufficiently below the actual WACC. Oxera assumed a linear, perfectly correlated relationship between the probability of an allowed WACC below the true WACC, and the probability of network failure.

[60] Oxera (2014a), page 40

[61] Oxera (2014a), page 40

Figure 4.2: Summary of Oxera's logic

Cost of a loss in network reliability

Oxera calculates the expected cost of a loss of network reliability resulting from underinvestment by first calculating the cost of a loss of network reliability and then multiplying this by the probability of a loss of network reliability given different levels of investment. In estimating the cost of network failure, Oxera notes that New Zealand's estimated Value of Lost Load (VoLL) (NZ$20/kwh) for residential customers is close to the average of VoLLs reported in several academic studies originating in the United States, Canada, Australia, and Europe. Oxera argue:[62]

> *Given that the VoLL for New Zealand seems typical of that for other countries, it is reasonable to use estimates from studies of international outage costs as a first-order proxy to approximate the total cost implied by a power outage in New Zealand.*

Drawing from various academic studies, Oxera find that a loss of network reliability may cost between 0.4 per cent of GDP to 1.8 per cent of GDP per year. In 2013 prices, this implies the cost of outages may range from NZ$0.7 billion to NZ$3.7 billion per year. Oxera concluded that social costs ranging from NZ$1bn to NZ$3bn to be reasonable for their report. The evidence includes one study of the costs of a loss of network reliability event in the US and Canada that was caused by underinvestment in generation and transmission assets after the Canadian electricity market was liberalised in 2002. The estimated cost of this event, which saw 50 million people without power for up to 4 days across Ontario, New York, Ohio, and Pennsylvania, was US$6.3bn to US$12.3bn. Canadian GDP in August of 2006 was down 0.7% from the previous month, some of which can be contributed to the rolling blackouts that occurred.

Oxera decided to use NZ$1bn as their cost of a loss in network reliability. Benefits of choosing a WACC above the midpoint were derived from reducing the probability of consumers bearing this NZ$1bn cost, which reduced the expected cost of a loss in network reliability.

Link between WACC and underinvestment

Next Oxera establish a relationship between WACC and investment, and investment and network failure, arguing that if these relationships exist then it is sensible to model the costs of a loss of network reliability as a function of the choice of WACC percentile. In evidencing the relationship between a loss of network reliability and underinvestment, Oxera draw on case studies from South Africa, Northern and Eastern India, Nigeria, New York, and Ontario. These case studies argue that prolonged underinvestment leads to network deterioration and eventually a loss of network reliability event.

Oxera concluded that:[63]

- *Any impact of underinvestment is more likely to be noticeable in the long term, hence the direct link between WACC and underinvestment is harder to observe and quantify.*
- *The imposition of price caps, considered in isolation, can lead to sub-optimal investment decisions as firms seek to increase short-term cash flows.*

[62] Oxera (2014a), page 43.

[63] Oxera (2014a), page 47.

- *Other parts of the regulatory framework (for instance, incentive mechanisms) can play an important role in mitigating the underinvestment problem.*

4.6.2. CEPA's update of evidence

We reviewed evidence on the cost of a loss of network reliability and the link between underinvestment and a loss of network reliability but found little evidence to build on Oxera's assumptions. Two of the studies used by Oxera have been updated since the last review but the annualised cost of a loss in network reliability remains in a similar range to Oxera's previous estimates. Importantly, we did not find evidence that contradicts Oxera's assumption of a NZ$1bn annualised cost of network failure.

Table 4.12: Updated review of studies into the annualised cost of a loss in network reliability

Study	Event period	Country	Cost	% of GDP
ASCE (2020)	2020-2029	US	US$85bn	0.4
LaCommare et al (2018)	2015	US	US$44bn	0.3
White House Report (2013)	2003-2012	US	US$18-33bn	0.2
Feldman (2015)	2015	US	US$112bn	0.8

To update the cost of a loss of network reliability while accounting for the changing energy use patterns in New Zealand, we

- Deflated current New Zealand GDP to 2013 prices to calculate real GDP growth since the Oxera report.
- Deflated our estimate of VoLL to 2013 prices to calculate a real change in VoLL since the Oxera report.
- Calculated the new cost of a loss of network reliability in 2013 prices as NZ$1bn multiplied by real GDP growth and real VoLL growth.
- Inflated the new cost of a loss of network reliability to 2022 prices.

The resulting estimate of the cost of a loss of network reliability was NZ$1.9bn.

Table 4.13: Summary of CEPA's update on the cost of network failure

Step	Result
Oxera assumed cost of network failure	NZ$1bn
2013-2022 real GDP growth	35.0%
2013-2018 real VoLL growth	16.8%
Growth of cost of network failure	57.7%
Cost of network failure, 2013 prices	NZ$1.6bn
Cost of network failure, 2022 prices	**NZ$1.9bn**

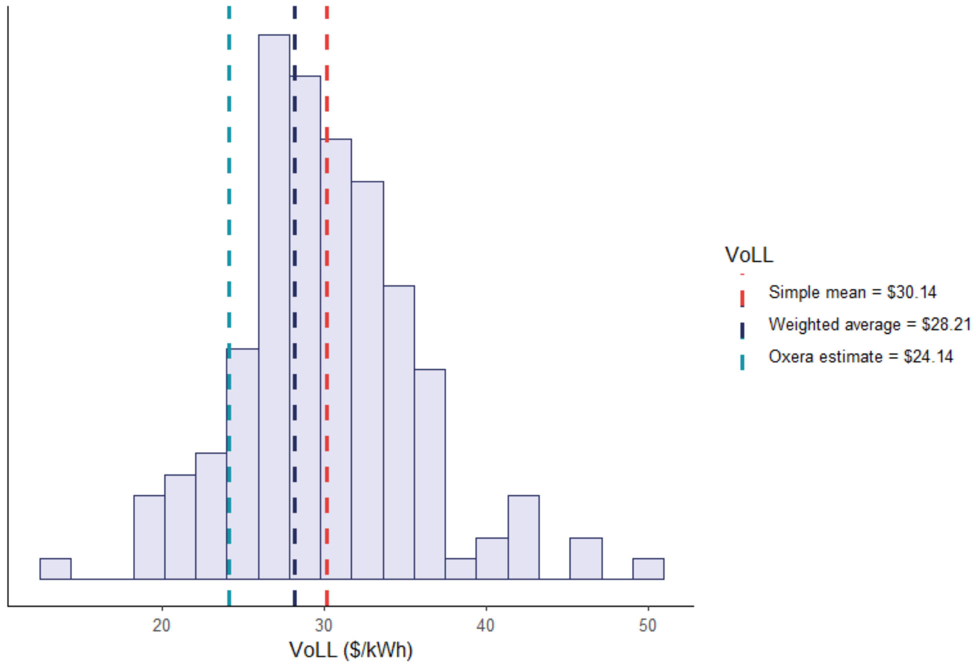
An update on the value of lost load

A 2018 study into VoLL in New Zealand by Transpower found that VoLL varies considerably for different consumers (residential, commercial, industrial) and the time and duration of reliability events.[64] A study of VoLL at different points of supply illustrates this uncertainty. Areas with a higher proportion of residential usage report a lower

[64] Transpower (2018), Value of Lost Load Study.

willingness to pay than areas with high proportions of industrial and commercial usage. Considering these relationships, we have estimated New Zealand's VoLL in 2022 prices to be around $28.21/kwh. This is a 16% increase from Oxera's estimate (in real terms).

Figure 4.3: Distribution of VoLL at different points of supply, Transpower report



To estimate the average VoLL for New Zealand, given the proportion of residential, commercial, and industrial users, we regressed the VoLL estimated by Transpower in 2018 on the proportion of different user types at each point of supply. In general, areas with a higher proportion of industrial and commercial users were expected to have a higher VoLL compared to areas with relatively higher proportion of residential users. We used this model to predict a New Zealand-wide value of lost load.

Justification of using real GDP and real VoLL growth

Oxera's analysis surveyed a range of academic studies investigating the cost of network failures or a loss of network reliability. A number of these studies focussed on specific events, for example the large-scale blackouts that affected Ontario and northeast United States. Other studies investigated the value of power quality by surveying businesses on the cost of hypothetical outages. A study by the American Society of Civil Engineers investigated the potential for a future investment gap in electricity networks, and the cost of this to US GDP over the long run.[65] Oxera extracted the cost of a loss of network reliability in these studies as a percentage of GDP of the affected country, and then multiplied this to New Zealand GDP to find the approximate cost of a similar network event in New Zealand. CEPA has reproduced this methodology using New Zealand's current GDP.

However, since 2014 electricity usage and the New Zealand economy has changed and will continue to change. The change in electricity usage in New Zealand can be proxied by a change in the value of lost load. Since 2014, New Zealand's VoLL has increased significantly, meaning the cost of network outages to the New Zealand economy has also increased significantly. Hence, CEPA has scaled the cost of a loss of network reliability resulting from underinvestment by the real growth in VoLL.

Relevance of this estimate going forward

[65] A full list of studies can be found in Oxera (2014a), Table 4.2.

The evidence presented above uses historic evidence on real GDP and VoLL to update Oxera's estimate. However, network companies are making long-term investments and it can be useful to consider whether the value of electricity network reliability is likely to increase or decrease going forward.

New Zealand has set a goal to decarbonise and is aiming to reduce net greenhouse emissions by 50 percent by 2030.[66] In this context, the Climate Change Commission has recommended steps to eliminate fossil gas use in residential, commercial, and public buildings.[67] This suggests that there will be increased reliance on electricity relative to gas for energy purposes going forward. This increased reliance may mean that the costs of a network outage are more acute and in turn mean that ensuring investment in a reliable network is more important.

On the other hand, the overall electricity system is evolving as customers are more able to affordably purchase distributed energy resources. For example, rooftop solar, battery storage and electric vehicles. It is possible that ownership of such technologies means consumers are less reliant on the network. For example, a battery may be able to provide a sufficient backup for a period of network outage. In an extreme case distributed energy resources may allow a consumer to forego reliance on the network entirely.

Through the remainder of the Cost of Capital 2022/2023 Review the Commission may want to consider the qualitative arguments around the importance of network reliability going forward.

4.7. Probability of loss

We have used Oxera's probability of loss methodology with our updated value for the annualised cost of a loss of network reliability to calculate the potential benefit to consumers of setting a WACC above the midpoint. We find that benefits to consumers are driven by the choice of an appropriate threshold for the difference between the allowed WACC and the true cost of capital required for underinvestment to occur. In the most extreme case this threshold is 0% meaning that underinvestment occurs as soon as the allowed WACC is below the true WACC. In this case, each increase in WACC percentile leads to NZ$19m in benefits for the consumer. On the other hand, if the threshold is 2% a one percentile increase in the WACC above the midpoint only generates around NZ$2m in benefit for consumers.

4.7.1. Summary of Oxera's approach

Oxera define probability of loss as the probability that the allowed return is below the true WACC. At the midpoint this is 50% if the approach to estimating the WACC is unbiased. A key assumption in Oxera's approach is that if the allowed return falls sufficiently below the true WACC, underinvestment will occur. Choosing this threshold requires judgement and the benefit to consumers of a reduction in the probability of underinvestment relies on this choice. Oxera presented four possible candidates for the threshold – 0%, 0.5%, 1% or 2%. At 0% the probability of underinvestment, and hence consumers facing the annualised cost of network failure, is 50% if the allowed return is set at the midpoint. How the probability of underinvestment changes with these thresholds given the WACC percentile is presented in the table below.

Table 4.14: Probability of underinvestment given Oxera's suggested thresholds

	Threshold			
WACC percentile	0%	0.50%	1%	2%
50%	50%	31%	16%	2%
55%	45%	27%	13%	2%
60%	40%	23%	11%	1%
65%	35%	19%	8%	1%

66 New Zealand Government (2021), Govt increases contribution to global climate target.

67 Climate Change Commission, Recommendations from Inaia tonu nei: a low-emissions future for Aotearoa.

		Threshold		
70%	30%	15%	6%	1%
75%	25%	12%	5%	0%
80%	20%	9%	3%	0%
85%	15%	6%	2%	0%
90%	10%	4%	1%	0%
95%	5%	2%	0%	0%

If the threshold for underinvestment is assumed to be greater than 0%, then even at the midpoint the probability of the difference between the true and allowed WACC being greater than this threshold is relatively small. As the threshold increases above 0% there are diminishing returns in increasing the allowed return above the midpoint. For example, if the Commission believes the appropriate threshold is 0.5%, the benefit of increasing the allowed return to the 55th percentile is a 4% decrease in the probability of underinvestment. On the other hand, if 2% is assumed to be the appropriate threshold, the benefit of increasing the allowed return to the 55th percentile falls to only 1%.

Oxera's probability of loss approach allows for the calculation of expected savings from increasing the WACC above the midpoint as

$$(P(U|midpoint) - P(U|percentile)) * Annualised\ cost\ of\ underinvestment$$

Where $P(U|midpoint)$ is the probability of underinvestment given the WACC is set at the midpoint and $P(U|percentile)$ is defined similarly. Given Oxera's NZ$1bn estimated annualised cost of underinvestment, the benefit to consumers of setting a WACC above the midpoint at different thresholds is presented in the table below.

Table 4.15: Approximate benefit to consumers of increasing the allowed return above the midpoint (NZ$ million)

		Threshold		
WACC percentile	**0%**	**0.50%**	**1%**	**2%**
50%	0	0	0	0
55%	50	45	30	5
60%	100	85	55	10
65%	150	120	75	15
70%	200	155	95	20
75%	250	190	115	20
80%	300	220	130	20
85%	350	245	140	25
90%	400	270	150	25
95%	450	295	155	25

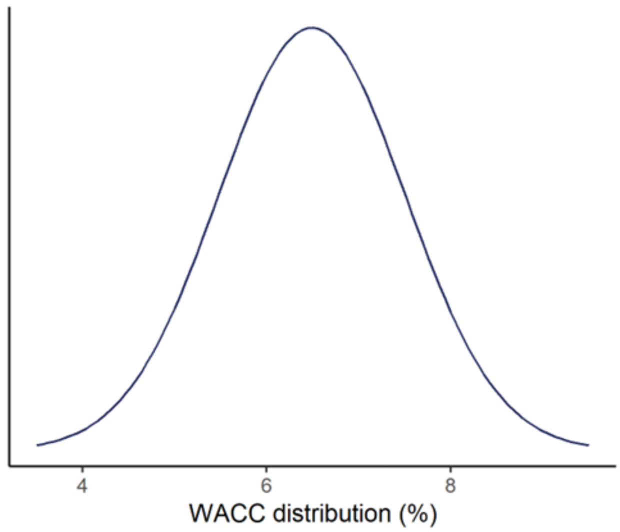
The Commission's WACC distribution

Oxera's analysis was based on WACC parameters from the Commission's 2010 decision on the cost of capital for EDBs and Transpower. The parameter estimates and standard errors are presented in the table below.

Table 4.16: WACC parameters and standard errors from 2010 IMs

Parameter	Point estimate	Standard errors
Leverage	44%	0
Risk-free rate	4.64%	0
Debt premium	2.0%	0.15%
Debt issuance cost	0.35%	0
Asset beta	0.34	0.13
Equity beta	0.61	0.23
TAMRP	7.1%	1.5%
Corporate tax rate	28.4%	0
Investor tax rate	28.2%	0
WACC (post tax)	6.49%	

Figure 4.4: Allowed WACC distribution from the 2010 IMs



4.7.2. CEPA's update of evidence

CEPA has been asked by the Commission to implement Oxera's methodology. We updated the benefits to consumer given the estimated cost of a loss of network reliability has increased to NZ$1.9bn.

Table 4.17: Updated approximate benefit to consumers of setting the WACC above the midpoint (NZ$ million)

	Threshold			
WACC percentile	0%	0.50%	1%	2%
50%	0	0	0	0
55%	95	80	55	10
60%	190	160	105	20
65%	285	230	145	30
70%	380	300	185	35
75%	475	360	215	40
80%	570	420	245	40
85%	665	470	265	45
90%	760	520	285	45
95%	855	560	300	45

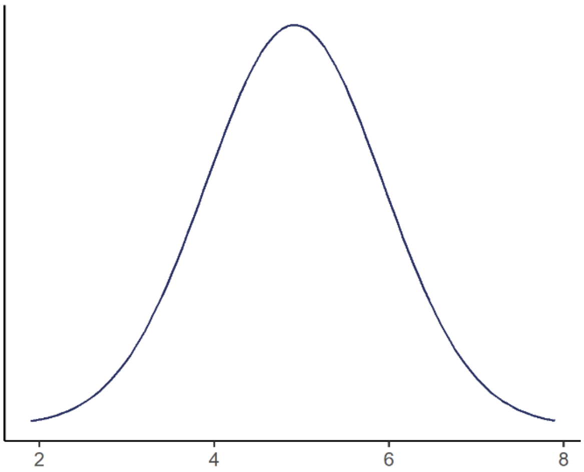
The Commission's WACC distribution

The Commission's WACC distribution shifted downwards but the standard error remained constant at 0.0101 between the 2010 and 2016 IMs.

Table 4.18: WACC parameters and standard errors from 2016 IMs

Parameter	Point estimate	Standard errors
Leverage	42%	0
Risk-free rate	2.60%	0
Debt premium	1.84%	0.15%
Debt issuance cost	0.35%	0
Asset beta	0.35	0.12
Equity beta	0.60	0
TAMRP	7.0%	1.5%
Corporate tax rate	28.0%	0
Investor tax rate	28.0%	0
WACC (post tax)	4.92%	0.0101

Figure 4.5: Allowed WACC distribution from the 2016 IMs



4.8. Conclusion

The hypothesis of Oxera's analytical framework is simple; the investment decisions of regulated companies will be impacted by their allowed return compared to the cost of capital. If the regulator sets the allowed return too low, regulated companies will defer or cancel future investment, leading to a deterioration of network quality over time and an increase in the probability of a loss of network reliability. This will result in a cost to consumers as they will suffer a higher probability of network outages and a decrease in quality of service. The analytical framework asserts that the costs associated with underinvestment are greater than those associated with overinvestment and as a result the regulator (and by extension consumers) should, at least partially, insure against underinvestment.

Since these costs were last estimated in 2014, two main changes have occurred. Firstly, regulators in the UK and Australia have become less likely to set the WACC above the midpoint, instead relying upon quality standards and performance incentives to protect consumers against the risk of underinvestment. That is, there has been a shift away from using the regulatory WACC as a tool to protect consumers against underinvestment. Secondly, the annualised cost of a loss of network reliability has increased significantly due to an increase in the size of New Zealand's economy and the changing patterns of electricity use, proxied by an increase in value of lost load.

A very specific logical chain needs to hold so that the analytical framework can be implemented. It must be assumed that underinvestment only occurs if the true WACC is sufficiently below the allowed WACC, and that underinvestment leads to consumers facing an annualised cost of a loss in network reliability that they would otherwise not face. Further, a reduction in the probability of underinvestment by 1% leads to a reduction in the expected cost to consumers by 1%.

Benefits of setting the WACC above the midpoint

To quantify the wider social benefits using Oxera's probability of loss approach, a judgement must be made on what an appropriate threshold is for underinvestment to occur. Oxera focussed mainly on the 0.5% and 1% thresholds. Adopting this approach, we find that setting the WACC at the 60th percentile may generate benefits in the range of NZ$100m to NZ$160m per year, while costing the consumer approximately NZ$50m. At the 70th percentile this benefit increases to a range of NZ$180m to NZ$300m while the cost is approximately NZ$100m.

Arguments to move towards the midpoint

Regulators in Australia and the UK have shifted towards using the midpoint estimate for WACC except in special cases. The UKRN in their ongoing consultation on common approaches to setting WACC parameters recommend that:

> ***Recommendation 7:*** *Regulators should only deviate from the mid-point of the CAPM cost of equity range if there are strong reasons to do so.*[68]

They also list a range of regulatory tools (i.e., statutory requirements, service delivery incentives, separate treatment of large one-off projects, and pricing freedom for innovative new investments) as alternatives to using the WACC to insure against underinvestment.

Additionally, the AER reviewed selecting a WACC estimate away from the midpoint and observed that any adjustment would be arbitrary and could lead to less efficient outcomes than the midpoint. They argued that if the estimation of the rate of return was not systematically bias, then the probability of the rate of return being too high or too low is symmetrical. This argument implies that over the long run the true rate or return should not be persistently underestimated, leading to persistent underinvestment.

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

Appendix A COMPARATOR DESCRIPTIONS

Energy Sample

Bloomberg Code	Name	Bloomberg Description
KMI US Equity	KINDER MORGAN INC	Kinder Morgan, Inc. of Delaware operates as a pipeline transportation and energy storage company. The Company owns and operates pipelines that transport natural gas, gasoline, crude oil, carbon dioxide, and other products, as well as terminals that store petroleum products and chemicals and handle bulk materials like coal and petroleum coke.
OKE US Equity	ONEOK INC	ONEOK, Inc. is a diversified energy company. The Company is involved in the natural gas and natural gas liquids business across the United States.
AES US Equity	AES CORP	The AES Corporation is an electric power distribution company. The Company acquires, develops, owns, and operates renewable energy power plants. AES serves customers globally.
NG/ LN Equity	NATIONAL GRID PLC	National Grid plc is an investor-owned utility company which is focused on the transmission and distribution of electricity and gas. The Company owns and operates the electricity transmission network in England and Wales, the gas transmission network in Great Britain, and electricity transmission networks in the Northeastern United States and Scotland.
NEW LN Equity	CENTRICA PLC	Centrica PLC operates as an integrated energy company offering a wide range of home and business energy solutions. The Company sources, generates, processes, stores, trades, saves, and supplies energy and provides a range of related services.
NJR US Equity	NEW JERSEY RESOURCES CORP	New Jersey Resources Corporation provides retail and wholesale energy services. The Company's principal subsidiary, New Jersey Natural Gas Co., is a local distribution company serving customers in central and northern New Jersey.
SWX US Equity	SOUTHWEST GAS HOLDINGS INC	Southwest Gas Holdings, Inc. operates as a holding company. The Company, through its subsidiaries, provides natural gas operation, construction, and distribution services. Southwest Gas Holdings serves customers in North America.
EXC US Equity	EXELON CORP	Exelon Corporation is a utility services holding company. The Company, through its subsidiaries, distributes electricity to customers in Illinois and Pennsylvania. Exelon also distributes gas to customers in the Philadelphia area as well as operates nuclear power plants in states that include Pennsylvania and New Jersey.
SJI US Equity	SOUTH JERSEY INDUSTRIES	South Jersey Industries, Inc. is an energy services holding company. The Company provides regulated, natural gas service to residential, commercial, and industrial customers in southern New Jersey. South Jersey also markets total energy management services, including natural gas, electricity, demand-side management, and consulting services throughout the eastern United States.
NFG US Equity	NATIONAL FUEL GAS CO	National Fuel Gas Company is an integrated natural gas company with operations in all segments of the natural gas industry, including utility, pipeline and storage, exploration and production, and marketing operations. The Company operates across the United States.
PEG US Equity	PUBLIC SERVICE ENTERPRISE GP	Public Service Enterprise Group Incorporated is a public utility holding company. The Company, through its subsidiaries, generates, transmits, and distributes electricity and produces natural gas in the Northeastern and Mid Atlantic United States.
SSE LN Equity	SSE PLC	SSE plc generates, transmits, distributes, and supplies electricity to industrial, commercial, and domestic customers in the United Kingdom and Ireland. The Company also stores and distributes natural gas, and operates a telecommunications

Bloomberg Code	Name	Bloomberg Description
		network that offers bandwidth and capacity to companies, public sector organizations, Internet service providers, and others.
VCT NZ Equity	VECTOR LTD	Vector Limited is an energy infrastructure company in New Zealand that provides electricity and gas transmission and distribution along with metering. The Company is also a wholesaler of LPG and natural gas. Vector also delivers broadband voice and data communications in the Auckland and Wellington regions.
NEE US Equity	NEXTERA ENERGY INC	NextEra Energy, Inc. provides sustainable energy generation and distribution services. The Company generates electricity through wind, solar, and natural gas. Through its subsidiaries, NextEra Energy also operates multiple commercial nuclear power units.
OGE US Equity	OGE ENERGY CORP	OGE Energy Corp., through its principal subsidiary Oklahoma Gas and Electric Company, generates, transmits, and distributes electricity to wholesale and retail customers in communities in Oklahoma and western Arkansas. The Company, through Enogex Inc., operates natural gas transmission and gathering pipelines, has interests in gas processing plants, and markets electricity.
CPK US Equity	CHESAPEAKE UTILITIES CORP	Chesapeake Utilities Corporation is a utility company that provides natural gas transmission and distribution, propane distribution, and information technology services. The Company distributes natural gas to residential, commercial, and industrial customers in Delaware, Maryland, and Florida. Chesapeake Utilities’ propane is distributed to customers in Delaware, Maryland, and Virginia.
AGR US Equity	AVANGRID INC	Avangrid, Inc. operates as an energy services holding company. The Company engages in the regulated energy transmission and distribution business through wind and solar power, as well as natural gas utilities. Avangrid serves customers in the United States.
FE US Equity	FIRSTENERGY CORP	FirstEnergy Corp. operates as a public utility holding company. The Company, through its subsidiaries, generates, transmits, and distributes electricity, as well as offers exploration, production, and distribution of natural gas. FirstEnergy provides energy management and other energy related services.
ALE US Equity	ALLETE INC	ALLETE, Inc. provides energy services in the upper Midwest United States. The Company generates, transmits, distributes, markets, and trades electrical power for retail and wholesale customers.
DTE US Equity	DTE ENERGY COMPANY	DTE Energy Company, a diversified energy company, develops and manages energy-related businesses and services nationwide. The Company, through its subsidiaries, generates, purchases, transmits, distributes, and sells electric energy in southeastern Michigan. DTE is also involved in gas pipelines and storage, unconventional gas exploration, development, and production.
BKH US Equity	BLACK HILLS CORP	Black Hills Corporation is a growth-oriented utility company. The Company delivers electricity and natural gas, generates electricity and produces coal to serve onsite generation. Black Hills serves customers in Arkansas, Colorado, Iowa, Kansas, Montana, Nebraska, South Dakota, and Wyoming.
ES US Equity	EVERSOURCE ENERGY	Eversource Energy is a public utility holding company. The Company, through its subsidiaries, provides electric service to customers in Connecticut, New Hampshire, and western Massachusetts. Eversource Energy also distributes natural gas throughout Connecticut.
HE US Equity	HAWAIIAN ELECTRIC INDS	Hawaiian Electric Industries, Inc. is a diversified holding company that delivers a variety of services to the people of Hawaii. The Company’s subsidiaries offer electric utilities, savings banks, and other businesses, primarily in the state of Hawaii.

Bloomberg Code	Name	Bloomberg Description
POR US Equity	PORTLAND GENERAL ELECTRIC CO	Portland General Electric Company is an electric utility involved in the generation, purchase, transmission, distribution, and sale of electricity in Oregon. The Company also participates in the wholesale market by purchasing and selling electricity and natural gas to utilities and energy marketers.
SRE US Equity	SEMPRA ENERGY	Sempra Energy operates as an energy infrastructure company. The Company focuses on delivering sustainable energy to consumers, as well as invests in, develops, and operates transmission and distribution infrastructure in North America including California, Texas, Mexico, and the LNG export market.
ED US Equity	CONSOLIDATED EDISON INC	Consolidated Edison, Inc., through its subsidiaries, provides a variety of energy related products and services. The Company supplies electric service in New York, parts of New Jersey, and Pennsylvania as well as supplies electricity to wholesale customers.
ETR US Equity	ENTERGY CORP	Entergy Corporation is an integrated energy company that is primarily focused on electric power production and retail electric distribution operations. The Company delivers electricity to utility customers in Arkansas, Louisiana, Mississippi, and Texas. Entergy also owns and operates nuclear plants in the northern United States.
D US Equity	DOMINION ENERGY INC	Dominion Energy, Inc. produces and transports energy products. The Company offers natural gas and electric energy transmission, gathering, and storage solutions. Dominion Energy serves customers in the United States.
SO US Equity	SOUTHERN CO/THE	The Southern Company is a public utility holding company. The Company, through its subsidiaries, generates, wholesales, and retails electricity in the southeastern United States. The Company also offers wireless telecommunications services, and provides businesses with two-way radio, telephone, paging, and internet access services, as well as wholesales fiber optic solutions.
CMS US Equity	CMS ENERGY CORP	CMS Energy Corporation is an energy company. The Company, through its subsidiaries, provides electricity and natural gas to its customers. CMS Energy also invests in and operates non-utility power generation plants in the United States and abroad.
SR US Equity	SPIRE INC	Spire Inc. is a public utility company involved in the retail distribution of natural gas. The Company serves an area in eastern Missouri and parts of several other counties. Spire also operates underground natural gas storage fields and transports and stores liquid propane.
LNT US Equity	ALLIANT ENERGY CORP	Alliant Energy Corporation provides public-utility services. The Company supplies electricity, natural gas, and water to residential and commercial customers. Alliant Energy serves customers in the States of Illinois, Iowa, Minnesota, and Wisconsin.
NWN US Equity	NORTHWEST NATURAL HOLDING CO	Northwest Natural Holding Company operates as a holding company. The Company, through its subsidiaries, builds and maintains natural gas distribution system, as well as invests in natural gas pipeline projects. Northwest Natural Holding serves residential, commercial, and industrial customers in the United States, Canada, and Service Territory.
PNM US Equity	PNM RESOURCES INC	PNM Resources Inc. is a holding company. The Company, through its subsidiaries, generates, transmits, and distributes electricity. PNM Resources serves customers in the State of New Mexico.
CNP US Equity	CENTERPOINT ENERGY INC	CenterPoint Energy, Inc. is a public utility holding company. The Company, through its subsidiaries, conducts activities in electricity transmission and distribution, natural gas distribution, interstate pipeline and gathering operations, and power generation.

Bloomberg Code	Name	Bloomberg Description
DUK US Equity	DUKE ENERGY CORP	Duke Energy Corporation is an energy company located primarily in the Americas that owns an integrated network of energy assets. The Company manages a portfolio of natural gas and electric supply, delivery, and trading businesses in the United States and Latin America.
PNW US Equity	PINNACLE WEST CAPITAL	Pinnacle West Capital Corporation is a utility holding company. The Company, through its subsidiary, provides retail and wholesale electric service to most of the State of Arizona. Pinnacle West Capital through a subsidiary, also is involved in real estate development activities in the western United States.
WEC US Equity	WEC ENERGY GROUP INC	WEC Energy Group, Inc. operates as an electric and natural gas delivery company. The Company manages electric and natural gas distribution and transmission lines, as well as power plants. WEC Energy Group serves customers in Wisconsin, Illinois, Michigan, and Minnesota.
XEL US Equity	XCEL ENERGY INC	Xcel Energy, Inc. provides electric and natural gas services. The Company offers a variety of energy-related services including generation, transmission, and distribution of electricity and natural gas throughout the United States. Xcel Energy serves customers in portions of Colorado, Michigan, Minnesota, New Mexico, North Dakota, South Dakota, Texas, and Wisconsin.
IDA US Equity	IDACORP INC	IDACORP, Inc. operates as a holding company. The Company, through its subsidiaries, generates, purchases, transmits, distributes, and sells electric energy in southern Idaho, eastern Oregon, northern Nevada, and Wyoming. IDACORP maintains electricity and natural gas marketing operations, as well as manages affordable housing projects and other real estate investments.
MGEE US Equity	MGE ENERGY INC	MGE Energy, Inc. is a public utility holding company. The Company's principal subsidiary generates and distributes electricity to customers in Dane County, Wisconsin. MGE also purchases, transports, and distributes natural gas in several Wisconsin counties.
AEE US Equity	AMEREN CORPORATION	Ameren Corporation is a public utility holding company. The Company, through its subsidiaries, generates electricity, delivers electricity, and distributes natural gas to customers in Missouri and Illinois.
AEP US Equity	AMERICAN ELECTRIC POWER	American Electric Power Company, Inc. (AEP) operates as a public utility holding company. The Company generates, transmits, distributes, and sells electricity to residential and commercial customers. AEP serves customers in the United States.
ATO US Equity	ATMOS ENERGY CORP	Atmos Energy Corporation distributes natural gas. The Company provides natural gas marketing and procurement services to large customers, as well as manages storage and pipeline assets. Atmos Energy serves clients in the United States.
AVA US Equity	AVISTA CORP	Avista Corporation operates as an energy company. The Company generates, transmits, and distributes electric and natural gas. Avista serves business and residential customers in the United States.
EIX US Equity	EDISON INTERNATIONAL	Edison International, through its subsidiaries, develops, acquires, owns, and operates electric power generation facilities worldwide. The Company also provides capital and financial services for energy and infrastructure projects, as well as manages and sells real estate projects. Edison provides integrated energy services, utility outsourcing, and consumer products.
NI US Equity	NISOURCE INC	NiSource Inc. is an energy holding company. The Company's subsidiaries provide natural gas, electricity, and other products and services to customers located within a corridor that runs from the Gulf Coast through the Midwest to New England.

Bloomberg Code	Name	Bloomberg Description
NEW US Equity	NORTHWESTERN CORP	NorthWestern Corporation, doing business as NorthWestern Energy, provides electricity and natural gas in the Upper Midwest and Northwest. The Company serves customers in Montana, South Dakota, and Nebraska.
PCG US Equity	P G & E CORP	PG&E Corporation is a holding company that holds interests in energy based businesses. The Company's holdings include a public utility operating in northern and central California that provides electricity and natural gas distribution, electricity generation, procurement, and transmission, and natural gas procurement, transportation, and storage.
PPL US Equity	PPL CORP	PPL Corporation is an energy and utility holding company. The Company, through its subsidiaries, generates electricity from power plants, as well as markets wholesale and retail energy and natural gas. PPL serves electric and gas sectors in the United States.
EVRG US Equity	EVERGY INC	Evergy, Inc. provides electricity generation, transmission, and distribution services. The Company offers its services in the United States.
OGS US Equity	ONE GAS INC	ONE Gas, Inc. is a regulated natural gas utility. The Company distributes natural gas to customers in Oklahoma, Kansas, and Texas. ONE Gas serves the residential, commercial, industrial, transportation, and wholesale industries.
RGCO US Equity	RGC RESOURCES INC	RGC Resources, Inc. and its subsidiaries distribute and sell natural gas and propane. The Company serves residential, commercial, and industrial customers in the Roanoke Valley and Bluefield areas of southwestern Virginia, as well as southern West Virginia.
UTL US Equity	UNITIL CORP	unitil Corporation, a public utility holding company, conducts a combination electric and gas utility distribution operation in north central Massachusetts and electric utility distribution operations in the seacoast and capital city areas of New Hampshire. The Company is also involved in energy planning, procurement, marketing, and consulting activities.

Source: CEPA analysis of Bloomberg Data

Airport Sample

Bloomberg Code	Name	Bloomberg Description
000089 CH Equity	Shenzen Airport Co	Shenzhen Airport Co., Ltd. provides airport terminal ground passenger transportation and cargo delivery services. The Company also leases airport lounge, designs and publishes advertisements, and offers air ticket agency services.
357 HK Equity	HAINAN MEILAN INTERNATIONA-H	Hainan Meilan International Airport Company Limited provides airports operating services. The Company offers airfield services, terminal facilities, ground handling services, passenger and cargo handling services, and other services. Hainan Meilan International Airport also provides advertising, car parking, tourism services, duty-free consumable goods sells services.
600004 CH Equity	Guangzhou Baiyun International	Guangzhou Baiyun International Airport Co.,Ltd. provides airport support services. The Company offers ground cleaning, airplane maintenance, airplane repairing, and other services. Guangzhou Baiyun International Airport also provides catering, space rental, advertising, and other services.

Bloomberg Code	Name	Bloomberg Description
600009 CH Equity	Shanghai International Airport	Shanghai International Airport Co., Ltd. operates Pudong Airport and Hongquiao airport in Shanghai. The Company provides a full range of services including air traffic control, terminal management, cargo handling, advertising, space rental, and other related services.
600897 CH Equity	Xiamen International Airport Co.	Xiamen International Airport Co.,Ltd operates and maintains airports. The Company provides passenger transportation, terminal transportation service, maintains airport waiting halls, operates airport shopping malls, advertising, and airport mechanical engineering services. Xiamen International Airport conducts businesses worldwide.
694 HK Equity	Beijing Capital International Airport Company	Beijing Capital International Airport Company Limited operates both aeronautical and non-aeronautical business in the Beijing airport. The Company provides aircraft movement and passenger service facilities, safety and security services, fire-fighting services, and ground handling services. In addition, Beijing Capital operates duty free and other retail shops and leases properties.
ADP FP Equity	Aeroports de Paris	Aeroports de Paris (ADP) manages all the civil airports in the Paris area. The Company also develops and operates light aircraft aerodromes. ADP offers air transport related services, and business services such as office rental.
AERO SG Equity	Aerodrom Nikola Tesla	Aerodrom Nikola Tesla AD Beograd operates an international airport near Belgrade, Serbia. The airport serves passengers traveling to European and Middle Eastern destinations. The Company offers ground handling of aircraft, passengers, goods and mail; runway maintenance; advertising space rental; and maintenance of airport utilities and power infrastructure.
AIA NZ Equity	Auckland International Airport	Auckland International Airport Limited owns and operates the Auckland International Airport. The Airport includes a single runway, an international terminal and two domestic terminals. The Airport also has commercial facilities which includes airfreight operations, car rental services, commercial banking center and office buildings.
AOT TB Equity	Airports of Thailand Public Company Limited	Airports of Thailand Public Company Ltd. operates the Bangkok International Airport (Don Muang) and the New Bangkok International Airport (Suvarnabhumi).. The Company also operates provincial airports in Chiang Mai, Chiang Rai, Hat Yai, and Phuket.
ASURB MM Equity	Grupo Aeroportuario del Sureste	Grupo Aeroportuario del Sureste S.A.B. de C.V. operates airports in Mexico. The Company holds 50 year concessions, beginning in 1998, to manage airports in Cancun, Cozumel, Merida, Oaxaca, Veracruz, Huatulco, Tapachula, Minatitlan, and Villahermosa.
FHZN SW Equity	Flughafen Zürich	Flughafen Zurich AG operates the Zurich Airport. The Company constructs, leases, and maintains airport structures and equipment.
FLU AV Equity	Flughafen Wien	Flughafen Wien AG manages, maintains, and operates the Vienna International Airport and the Voslau Airfield. The Company offers terminal services, air-side and land-side cargo handling, and the leasing of store, restaurant, and hotel airport building space to third party operators and businesses.
FRA GR Equity	Fraport	Fraport AG Frankfurt Airport Services Worldwide offers airport services. The Company operates the Frankfurt-Main, the airport in Lima, Peru, and the international terminal in Antalya, Turkey. Fraport also provides services to domestic and international carriers including traffic, facility and terminal management, ground handling, and security.
GAPB MM Equity	Grupo Aeroportuario del Pacífico	Grupo Aeroportuario del Pacifico SAB de CV operates and maintains airports in the Pacific and central regions of Mexico.

Bloomberg Code	Name	Bloomberg Description
GMRI IN Equity	GMR Infrastructure	GMR Airports Infrastructure Limited is an infrastructure company with interests in airports, power, and road projects. The Company focuses on developing a greenfield international airport at Hyderabad, and is also operating, managing, and developing the Delhi airport. GMR Airports Infrastructure also involves in construction and operation of power plants and road projects in India.
KBHL DC Equity	Københavns Lufthavne	Kobenhavns Lufthavne A/S (Copenhagen Airports A/S - CPH) owns and operates Kastrup, the international airport in Copenhagen, and Roskilde airport. The Company provides traffic management, maintenance, and security services, as well as manages the Airport Shopping Center and airport projects.
MAHB MK Equity	Malaysia Airports Holdings	Malaysia Airports Holdings Berhad is an investment holding company. The Company, through its subsidiaries, provides management, maintenance, and operation of designated airports. Malaysia Airports also operates duty-free and non-duty free stores as well as provides food and beverage outlets at the airports.
MIA MV Equity	Malta International Airport	Malta International Airport PLC operates the Malta International airport.
OMAB MM Equity	Grupo Aeroportuario del Centro Norte	Grupo Aeroportuario del Centro Norte, S.A.B. de C.V. (OMA) operates international airports in the northern and central regions of Mexico. The airports serve Monterrey, Acapulco, Mazatlan, Zihuatanejo and several other regional centers and border cities.
TYA IM Equity	Toscana Aeroporti	Toscana Aeroporti S.p.A. is the management company for Florence and Pisa airports. The Company offers flights around the world.
AENA SM Equity	AENA	Aena SME, S.A. operates as a holding company. The Company, through its subsidiaries, engages in operation and management of airports and heliports. Aena SME also manages commercial spaces. Aena SME offers its services worldwide.
ACV VN Equity	Airports Corporation of Vietnam	Airports Corporation of Vietnam JSC provides airport operations. The Company is involved in investment, construction, management, and maintenance of airports. Airports Corporation of Vietnam operates in Vietnam.
ADB IM Equity	Aeroporto Guglielmo Marconi di Bologna	Aeroporto Guglielmo Marconi Di Bologna SpA provides various airport services in Italy.

Source: CEPA analysis of Bloomberg Data

CEPA economics matters

Appendix B ASSET BETA

Energy sample – 5 year

Code	Sub-sample	Included in 2016	2017-2022			2012-2017			2007-2012		
			Daily	Weekly	4 Weekly	Daily	Weekly	4 Weekly	Daily	Weekly	4 Weekly
EVRG US Equity	Electricity	no	0.42	0.39	0.34						
AEP US Equity	Electricity	yes	0.30	0.30	0.27	0.32	0.27	0.23	0.32	0.30	0.28
AES US Equity	Electricity	yes	0.39	0.44	0.44	0.33	0.37	0.33	0.45	0.44	0.47
ALE US Equity	Electricity	yes	0.52	0.45	0.41	0.40	0.37	0.35	0.42	0.41	0.45
EIX US Equity	Electricity	yes	0.39	0.43	0.42	0.29	0.26	0.26	0.41	0.40	0.36
ETR US Equity	Electricity	yes	0.34	0.36	0.33	0.26	0.23	0.23	0.37	0.32	0.31
HE US Equity	Electricity	yes	0.56	0.40	0.33	0.46	0.40	0.40	0.38	0.44	0.42
IDA US Equity	Electricity	yes	0.47	0.41	0.41	0.43	0.38	0.39	0.35	0.33	0.30
NEE US Equity	Electricity	yes	0.52	0.55	0.51	0.33	0.29	0.25	0.39	0.37	0.33
PNM US Equity	Electricity	yes	0.37	0.37	0.33	0.34	0.29	0.22	0.35	0.38	0.40
PNW US Equity	Electricity	yes	0.39	0.39	0.29	0.35	0.34	0.31	0.32	0.33	0.32
SO US Equity	Electricity	yes	0.36	0.35	0.31	0.23	0.18	0.11	0.27	0.21	0.20
ATO US Equity	Gas	yes	0.44	0.39	0.35	0.41	0.37	0.33	0.33	0.32	0.31
CNA LN Equity	Gas	no	0.67	0.73	0.82	0.61	0.64	0.75	0.53	0.44	0.41
CPK US Equity	Gas	yes	0.54	0.35	0.35	0.54	0.42	0.35	0.57	0.46	0.34
KMI US Equity	Gas	yes	0.49	0.55	0.53	0.64	0.77	0.63	0.40	0.39	0.48
NFG US Equity	Gas	no	0.43	0.41	0.41	0.66	0.71	0.63	0.81	0.84	0.83
NJR US Equity	Gas	yes	0.56	0.50	0.44	0.50	0.43	0.35	0.50	0.43	0.28
NWN US Equity	Gas	yes	0.47	0.30	0.26	0.36	0.31	0.24	0.39	0.30	0.21
OGS US Equity	Gas	no	0.47	0.37	0.33	0.46	0.37	0.20			
OKE US Equity	Gas	yes	0.84	1.03	1.17	0.74	0.76	0.62	0.49	0.50	0.54
RGCO US Equity	Gas	no	0.36	0.14	0.01	0.08	0.06	0.08	0.07	0.14	0.15
SR US Equity	Gas	yes	0.38	0.30	0.23	0.32	0.29	0.25	0.45	0.34	0.16
SWX US Equity	Gas	yes	0.43	0.38	0.25	0.44	0.38	0.36	0.45	0.41	0.41

Code	Sub-sample	Included in 2016	2017-2022			2012-2017			2007-2012		
AEE US Equity	Integrated	yes	0.40	0.34	0.29	0.33	0.30	0.32	0.37	0.36	0.36
AGR US Equity	Integrated	no	0.39	0.36	0.34	0.35	0.06	-0.10			
AVA US Equity	Integrated	yes	0.36	0.27	0.25	0.36	0.31	0.29	0.34	0.34	0.35
BKH US Equity	Integrated	yes	0.41	0.40	0.33	0.49	0.41	0.47	0.45	0.43	0.50
CMS US Equity	Integrated	yes	0.31	0.29	0.22	0.27	0.23	0.17	0.26	0.25	0.22
CNP US Equity	Integrated	yes	0.47	0.55	0.54	0.43	0.42	0.38	0.28	0.30	0.27
D US Equity	Integrated	yes	0.38	0.31	0.29	0.32	0.30	0.24	0.36	0.33	0.28
DTE US Equity	Integrated	yes	0.41	0.43	0.43	0.33	0.26	0.21	0.32	0.33	0.32
DUK US Equity	Integrated	yes	0.31	0.29	0.26	0.25	0.19	0.15	0.33	0.30	0.27
ED US Equity	Integrated	yes	0.27	0.21	0.17	0.21	0.13	0.07	0.27	0.24	0.21
ES US Equity	Integrated	Yes	0.39	0.37	0.32	0.31	0.26	0.22	0.30	0.30	0.28
EXC US Equity	Integrated	yes	0.44	0.43	0.38	0.34	0.26	0.25	0.57	0.52	0.41
FE US Equity	Integrated	yes	0.34	0.31	0.26	0.23	0.20	0.12	0.37	0.33	0.27
LNT US Equity	Integrated	yes	0.38	0.39	0.36	0.38	0.33	0.31	0.45	0.44	0.40
MGEE US Equity	Integrated	yes	0.64	0.41	0.52	0.61	0.44	0.33	0.46	0.36	0.27
NG/ LN Equity	Integrated	yes	0.32	0.26	0.24	0.37	0.38	0.39	0.28	0.24	0.23
NI US Equity	Integrated	yes	0.34	0.34	0.26	0.36	0.36	0.24	0.31	0.31	0.31
NWE US Equity	Integrated	yes	0.44	0.37	0.28	0.36	0.29	0.27	0.35	0.34	0.33
OGE US Equity	Integrated	yes	0.45	0.52	0.48	0.53	0.55	0.52	0.48	0.46	0.47
PCG US Equity	Integrated	yes	0.36	0.45	0.47	0.31	0.27	0.30	0.32	0.24	0.24
PEG US Equity	Integrated	yes	0.41	0.49	0.49	0.40	0.33	0.30	0.52	0.45	0.37
POR US Equity	Integrated	no	0.42	0.35	0.38	0.35	0.29	0.23	0.33	0.35	0.33
PPL US Equity	Integrated	yes	0.41	0.46	0.46	0.30	0.27	0.23	0.40	0.33	0.29
SJI US Equity	Integrated	yes	0.37	0.31	0.28	0.42	0.40	0.40	0.48	0.39	0.29
SRE US Equity	Integrated	yes	0.44	0.49	0.45	0.42	0.41	0.43	0.47	0.46	0.43
SSE LN Equity	Integrated	yes	0.56	0.54	0.49	0.52	0.53	0.46	0.41	0.37	0.32
UTL US Equity	Integrated	yes	0.41	0.31	0.19	0.35	0.25	0.22	0.13	0.14	0.16
VCT NZ Equity	Integrated	yes	0.27	0.27	0.30	0.30	0.29	0.28	0.21	0.18	0.26
WEC US Equity	Integrated	yes	0.36	0.30	0.23	0.33	0.23	0.12	0.29	0.27	0.24

Code	Sub-sample	Included in 2016	2017-2022			2012-2017			2007-2012	
XEL US Equity	Integrated	yes	0.36	0.32	0.26	0.28	0.22	0.18	0.29	0.25	0.23
Average	**Electricity**		**0.42**	**0.40**	**0.37**	**0.34**	**0.31**	**0.28**	**0.37**	**0.36**	**0.35**
Average	**Gas**		**0.51**	**0.45**	**0.43**	**0.48**	**0.46**	**0.40**	**0.45**	**0.42**	**0.37**
Average	**Integrated**		**0.39**	**0.37**	**0.34**	**0.36**	**0.31**	**0.27**	**0.36**	**0.33**	**0.31**
Average	**All**		**0.42**	**0.40**	**0.37**	**0.38**	**0.34**	**0.30**	**0.38**	**0.36**	**0.33**
APA AU Equity	Integrated	yes	0.33	0.34	0.31	0.41	0.37	0.41	0.27	0.22	0.27
Average (including APA)	Integrated		0.39	0.37	0.34	0.36	0.31	0.27	0.36	0.33	0.31
Average (including APA)	All		0.42	0.40	0.37	0.38	0.35	0.30	0.38	0.35	0.33

Source: CEPA analysis of Bloomberg Data

Airport sample – 5 year

Code	Included in 2016	2017-22			2012-17			2007-12		
		Daily	Weekly	4 Weekly	Daily	Weekly	4 Weekly	Daily	Weekly	4 Weekly
000089 CH Equity	yes	0.65	0.66	0.48	0.87	0.90	0.96	0.85	0.76	0.68
357 HK Equity	yes	0.91	1.01	1.02	0.52	0.51	0.49	0.74	0.96	1.51
600004 CH Equity	yes	1.12	0.97	0.85	1.17	1.05	1.07	0.88	0.82	0.77
600009 CH Equity	yes	0.93	0.83	0.52	1.05	0.96	0.88	0.87	0.86	0.88
600897 CH Equity	yes	0.94	0.91	0.70	1.25	1.23	1.25	0.94	0.78	0.73
694 HK Equity	yes	0.65	0.83	0.82	0.48	0.50	0.64	0.63	0.68	0.62
ADP FP Equity	yes	0.70	0.85	0.83	0.40	0.41	0.43	0.58	0.62	0.57
AIA NZ Equity	yes	1.01	1.06	0.99	1.00	0.97	0.90	0.76	0.69	0.67
AOT TB Equity	yes	1.26	1.11	1.00	1.21	1.22	1.20	0.55	0.63	0.75
ASURB MM Equity	yes	0.93	1.08	1.13	0.79	0.81	0.73	0.63	0.60	0.66
FHZN SW Equity	yes	0.70	0.86	0.86	0.51	0.54	0.62	0.35	0.53	0.65
FLU AV Equity	yes	0.57	0.59	0.55	0.20	0.22	0.30	0.31	0.40	0.41
FRA GR Equity	yes	0.46	0.57	0.58	0.32	0.34	0.33	0.51	0.59	0.60
GAPB MM Equity	yes	1.14	1.40	1.43	0.78	0.92	0.89	0.64	0.64	0.73
GMRI IN Equity	yes	0.37	0.38	0.44	0.30	0.31	0.37	0.62	0.65	0.74

Code	Included in 2016		2017-22			2012-17			2007-12	
KBHL DC Equity	yes	0.22	0.30	0.26	0.31	0.44	0.51	0.09	0.16	0.30
MAHB MK Equity	yes	0.87	0.89	1.13	0.69	0.92	1.20	0.68	0.66	0.79
MIA MV Equity	yes	0.90	1.09	1.36	0.30	0.50	1.01	0.41	0.58	0.71
OMAB MM Equity	yes	1.10	1.31	1.44	0.69	0.82	1.07	0.61	0.69	0.89
TYA IM Equity	yes	0.24	0.40	0.50	0.07	0.15	0.34	0.14	0.19	0.32
AENA SM Equity	no	0.78	0.79	0.84						
ACV VN Equity	no	0.75	0.86	0.91						
ADB IM Equity	no	0.57	0.71	0.89						
Average		**0.77**	**0.85**	**0.85**	**0.65**	**0.69**	**0.76**	**0.59**	**0.62**	**0.70**
SYD AU Equity[69]	Yes	0.52	0.69	0.67	0.37	0.32	0.24	0.45	0.41	0.48
Average (including SYD)		0.76	0.84	0.84	0.63	0.67	0.74	0.58	0.61	0.69

Source: CEPA analysis of Bloomberg Data

Airport sample – 2 year

Code	Included in 2016		2020-22			2018-20	
		Daily	Weekly	4 Weekly	Daily	Weekly	4 Weekly
000089 CH Equity	yes	0.51	0.80	0.38	0.85	0.69	0.59
357 HK Equity	yes	1.14	1.41	1.58	0.41	0.53	0.68
600004 CH Equity	yes	0.83	0.87	0.34	1.18	0.98	1.04
600009 CH Equity	yes	0.81	0.87	0.60	0.92	0.83	0.55
600897 CH Equity	yes	0.67	0.76	0.27	0.97	0.90	0.66
694 HK Equity	yes	0.58	0.85	0.89	0.71	0.83	0.85

[69] Regression year ending 30th January

Code	Included in 2016		2020-22			2018-20	
ADP FP Equity	yes	0.74	0.88	0.93	0.50	0.63	0.56
AIA NZ Equity	yes	1.05	1.22	0.94	0.91	0.78	0.60
AOT TB Equity	yes	1.35	1.18	1.14	1.09	1.05	0.97
ASURB MM Equity	yes	0.99	1.22	1.13	0.84	0.98	1.08
FHZN SW Equity	yes	0.67	0.91	0.56	0.73	0.78	0.58
FLU AV Equity	yes	0.77	0.80	0.85	0.25	0.37	0.23
FRA GR Equity	yes	0.45	0.54	0.49	0.45	0.54	0.44
GAPB MM Equity	yes	1.28	1.61	1.29	0.93	1.33	1.51
GMRI IN Equity	yes	0.31	0.32	0.35	0.47	0.41	0.54
KBHL DC Equity	yes	0.31	0.44	0.17	0.18	0.27	0.18
MAHB MK Equity	yes	0.95	0.98	1.27	0.59	0.71	0.81
MIA MV Equity	yes	1.00	1.19	1.27	1.09	0.95	1.04
OMAB MM Equity	yes	1.27	1.61	1.41	1.01	1.26	1.41
TYA IM Equity	yes	0.28	0.50	0.49	0.26	0.35	0.30
AENA SM Equity	no	0.85	0.84	0.88	0.55	0.57	0.60
ACV VN Equity	no	0.89	0.92	1.07	0.59	0.77	0.61
ADB IM Equity	no	0.61	0.74	1.23	0.55	0.62	0.65
Average		**0.80**	**0.93**	**0.85**	**0.72**	**0.76**	**0.73**
Average not including new airports		0.80	0.95	0.82	0.72	0.76	0.73

Source: CEPA analysis of Bloomberg Data

Airport sample setting leverage to zero – 5 year

Code	In 2016	2017-22			2012-17			2007-12		
		Daily	Weekly	4 Weekly	Daily	Weekly	4 Weekly	Daily5	Weekly	4 Weekly
000089 CH Equity	yes	0.65	0.66	0.48	0.87	0.90	0.96	0.81	0.72	0.65
357 HK Equity	yes	0.91	1.01	1.02	0.52	0.51	0.49	0.60	0.78	1.23
600004 CH Equity	yes	1.12	0.97	0.85	1.06	0.95	0.97	0.88	0.82	0.77
600009 CH Equity	yes	0.91	0.81	0.51	0.91	0.84	0.76	0.87	0.86	0.88
600897 CH Equity	yes	0.77	0.74	0.57	1.08	1.07	1.08	0.88	0.73	0.68
694 HK Equity	yes	0.65	0.83	0.82	0.48	0.50	0.64	0.63	0.68	0.62
ADP FP Equity	yes	0.70	0.85	0.83	0.40	0.41	0.43	0.58	0.61	0.57
AIA NZ Equity	yes	1.01	1.06	0.99	1.00	0.97	0.90	0.77	0.69	0.67
AOT TB Equity	yes	1.24	1.09	0.99	1.20	1.21	1.18	0.55	0.63	0.75
ASURB MM Equity	yes	0.93	1.08	1.13	0.79	0.81	0.73	0.59	0.56	0.62
FHZN SW Equity	yes	0.70	0.86	0.86	0.51	0.54	0.62	0.35	0.53	0.65
FLU AV Equity	yes	0.57	0.59	0.55	0.20	0.22	0.30	0.31	0.40	0.41
FRA GR Equity	yes	0.46	0.57	0.58	0.32	0.34	0.33	0.51	0.59	0.60
GAPB MM Equity	yes	1.14	1.40	1.43	0.78	0.92	0.89	0.61	0.61	0.69
GMRI IN Equity	yes	0.37	0.38	0.44	0.30	0.31	0.37	0.62	0.65	0.74
KBHL DC Equity	yes	0.22	0.30	0.26	0.31	0.44	0.51	0.09	0.16	0.30
MAHB MK Equity	yes	0.87	0.89	1.13	0.69	0.92	1.20	0.68	0.66	0.79
MIA MV Equity	yes	0.90	1.09	1.36	0.30	0.50	1.01	0.41	0.58	0.71
OMAB MM Equity	yes	1.10	1.31	1.44	0.69	0.82	1.07	0.61	0.69	0.89
TYA IM Equity	yes	0.24	0.40	0.50	0.07	0.15	0.34	0.14	0.19	0.32
AENA SM Equity	no	0.78	0.79	0.84						

Code	In 2016		2017-22			2012-17			2007-12	
ACV VN Equity	no	0.70	0.79	0.83						
ADB IM Equity	no	0.57	0.71	0.89						
Average		**0.76**	**0.84**	**0.84**	**0.62**	**0.67**	**0.74**	**0.57**	**0.61**	**0.68**
Average not including new airports		0.84	0.89	0.86	0.64	0.70	0.77	0.60	0.63	0.69
SYD AU Equity	yes	0.52	0.69	0.67	0.37	0.32	0.24	0.45	0.41	0.48
Average (including Sydney Airport)		0.81	0.87	0.85	0.63	0.68	0.74	0.59	0.62	0.69

Source: CEPA analysis of Bloomberg Data

CEPA economics matters

Appendix C LEVERAGE

Energy sample

Code	Subsample	In 2016	2017-22	2012-17	2007-12
EVRG US Equity	Electricity	no	41%		
AEP US Equity	Electricity	yes	42%	42%	51%
AES US Equity	Electricity	yes	61%	69%	64%
ALE US Equity	Electricity	yes	31%	34%	32%
EIX US Equity	Electricity	yes	47%	37%	45%
ETR US Equity	Electricity	yes	51%	51%	42%
HE US Equity	Electricity	yes	3%	22%	28%
IDA US Equity	Electricity	yes	25%	34%	47%
NEE US Equity	Electricity	yes	27%	39%	44%
PNM US Equity	Electricity	yes	47%	49%	62%
PNW US Equity	Electricity	yes	41%	35%	48%
SO US Equity	Electricity	yes	45%	40%	39%
ATO US Equity	Gas	yes	28%	34%	45%
CNA LN Equity	Gas	no	31%	27%	13%
CPK US Equity	Gas	yes	28%	25%	31%
KMI US Equity	Gas	yes	47%	45%	40%
NFG US Equity	gas	no	33%	26%	19%
NJR US Equity	Gas	yes	34%	28%	26%
NWN US Equity	Gas	yes	38%	37%	37%
OGS US Equity	Gas	no	34%	31%	
OKE US Equity	Gas	yes	34%	44%	49%
RGCO US Equity	Gas	no	33%	24%	23%
SR US Equity	Gas	yes	45%	37%	34%
SWX US Equity	Gas	yes	41%	34%	45%
AEE US Equity	Integrated	yes	36%	40%	51%

Code	Subsample	In 2016	2017-22	2012-17	2007-12
AGR US Equity	Integrated	no	31%	27%	
AVA US Equity	Integrated	yes	43%	42%	49%
BKH US Equity	Integrated	yes	48%	43%	47%
CMS US Equity	Integrated	yes	42%	47%	62%
CNP US Equity	Integrated	yes	46%	45%	60%
D US Equity	Integrated	yes	40%	39%	41%
DTE US Equity	Integrated	yes	42%	39%	52%
DUK US Equity	Integrated	yes	48%	45%	39%
ED US Equity	Integrated	yes	44%	40%	43%
ES US Equity	Integrated	Yes	38%	39%	50%
EXC US Equity	Integrated	yes	46%	44%	27%
FE US Equity	Integrated	yes	51%	59%	48%
LNT US Equity	Integrated	yes	34%	35%	35%
MGEE US Equity	Integrated	yes	16%	17%	29%
NG/ LN Equity	Integrated	yes	48%	41%	53%
NI US Equity	Integrated	yes	49%	48%	59%
NWE US Equity	Integrated	yes	42%	42%	48%
OGE US Equity	Integrated	yes	34%	31%	40%
PCG US Equity	Integrated	yes	57%	39%	41%
PEG US Equity	Integrated	yes	36%	31%	33%
POR US Equity	Integrated	no	39%	41%	49%
PPL US Equity	Integrated	yes	44%	47%	39%
SJI US Equity	Integrated	yes	50%	36%	30%
SRE US Equity	Integrated	yes	40%	37%	37%
SSE LN Equity	Integrated	yes	38%	29%	29%
UTL US Equity	Integrated	yes	40%	42%	55%
VCT NZ Equity	Integrated	yes	43%	45%	54%
WEC US Equity	Integrated	yes	33%	35%	42%
XEL US Equity	Integrated	yes	39%	42%	47%

Code	Subsample	In 2016	2017-22	2012-17	2007-12
Average	**Electricity**		**38%**	**41%**	**46%**
Average	**Gas**		**35%**	**33%**	**33%**
Average	**Integrated**		**41%**	**40%**	**45%**
Average	**All**		**39%**	**38%**	**42%**
APA US Equity	Integrated	Yes	46%	45%	59%
Average (including APA)	Integrated		41%	40%	45%
Average (including APA)	All		39%	38%	43%

Source: CEPA analysis of Bloomberg Data

Airport sample

Code	In 2016	2017-22	2012-17	2007-12	2020-22	2018-20	2016-18
000089 CH Equity	yes	-2%	4%	-6%	20%	-17%	-16%
357 HK Equity	yes	22%	17%	-29%	4%	31%	40%
600004 CH Equity	yes	1%	-12%	1%	2%	0%	4%
600009 CH Equity	yes	-3%	-15%	5%	5%	-8%	-12%
600897 CH Equity	yes	-24%	-17%	-7%	-40%	-17%	-7%
694 HK Equity	yes	13%	29%	34%	20%	8%	11%
ADP FP Equity	yes	31%	24%	28%	40%	28%	19%
AIA NZ Equity	yes	16%	21%	28%	11%	18%	20%
AOT TB Equity	yes	-2%	-1%	42%	5%	-6%	-5%
ASURB MM Equity	yes	8%	1%	-7%	6%	10%	6%
FHZN SW Equity	yes	16%	15%	33%	22%	15%	8%
FLU AV Equity	yes	9%	26%	41%	9%	9%	12%
FRA GR Equity	yes	49%	41%	35%	62%	45%	34%
GAPB MM Equity	yes	7%	1%	-4%	9%	7%	4%
GMRI IN Equity	yes	62%	80%	38%	57%	68%	66%

Code	In 2016	2017-22	2012-17	2007-12	2020-22	2018-20	2016-18
KBHL DC Equity	yes	16%	15%	21%	17%	16%	12%
MAHB MK Equity	yes	25%	28%	-2%	28%	25%	23%
MIA MV Equity	yes	1%	7%	19%	3%	1%	1%
OMAB MM Equity	yes	4%	6%	2%	5%	3%	5%
TYA IM Equity	yes	18%	9%	5%	28%	13%	9%
AENA SM Equity	no	24%			26%	23%	25%
ACV VN Equity	no	-9%			-12%	-9%	-2%
ADB IM Equity	no	3%			9%	-2%	-1%
Average		**13%**	**14%**	**14%**	**14%**	**14%**	**11%**
SYD AU Equity[70]	yes	35%	42%	51%	35%	36%	34%
Average (including SYD)		13%	15%	16%	15%	14%	11%

Source: CEPA analysis of Bloomberg Data

[70] Regression year ending 30th January

Appendix D **ASSET BETA STANDARD ERRORS**

Energy sample – 5 year

Code	Subsample	2017-2022			2012-2017			2007-2012		
		Daily	Weekly	4 Weekly	Daily	Weekly	4 Weekly	Daily	Weekly	4 Weekly
EVRG US Equity	Electricity	0.018	0.041	0.079						
AEP US Equity	Electricity	0.016	0.038	0.075	0.020	0.049	0.112	0.010	0.023	0.046
AES US Equity	Electricity	0.014	0.033	0.064	0.015	0.033	0.072	0.014	0.031	0.061
ALE US Equity	Electricity	0.022	0.047	0.089	0.023	0.058	0.134	0.014	0.034	0.068
EIX US Equity	Electricity	0.019	0.045	0.090	0.023	0.054	0.127	0.011	0.025	0.049
ETR US Equity	Electricity	0.014	0.033	0.065	0.019	0.044	0.105	0.012	0.031	0.058
HE US Equity	Electricity	0.030	0.071	0.125	0.030	0.072	0.164	0.016	0.045	0.104
IDA US Equity	Electricity	0.021	0.048	0.089	0.023	0.056	0.129	0.009	0.023	0.050
NEE US Equity	Electricity	0.021	0.049	0.096	0.020	0.049	0.109	0.012	0.031	0.060
PNM US Equity	Electricity	0.016	0.040	0.077	0.021	0.048	0.108	0.013	0.035	0.069
PNW US Equity	Electricity	0.017	0.044	0.086	0.023	0.055	0.127	0.009	0.023	0.052
SO US Equity	Electricity	0.016	0.035	0.068	0.019	0.045	0.104	0.010	0.024	0.049
ATO US Equity	Gas	0.020	0.045	0.080	0.023	0.055	0.130	0.010	0.025	0.047
CNA LN Equity	Gas	0.034	0.081	0.160	0.028	0.063	0.140	0.024	0.052	0.107
CPK US Equity	Gas	0.025	0.053	0.097	0.038	0.085	0.181	0.020	0.047	0.079
KMI US Equity	Gas	0.018	0.043	0.083	0.033	0.078	0.181	0.032	0.080	0.195
NFG US Equity	gas	0.020	0.044	0.085	0.031	0.076	0.174	0.021	0.053	0.114
NJR US Equity	Gas	0.026	0.052	0.098	0.031	0.074	0.170	0.015	0.037	0.078
NWN US Equity	Gas	0.024	0.052	0.096	0.023	0.055	0.127	0.012	0.031	0.059
OGS US Equity	Gas	0.021	0.045	0.086	0.031	0.076	0.168			
OKE US Equity	Gas	0.034	0.078	0.157	0.041	0.099	0.234	0.011	0.027	0.057
RGCO US Equity	Gas	0.026	0.052	0.093	0.052	0.089	0.160	0.035	0.054	0.082
SR US Equity	Gas	0.018	0.038	0.078	0.020	0.047	0.106	0.016	0.038	0.077
SWX US Equity	Gas	0.021	0.049	0.098	0.024	0.063	0.155	0.010	0.025	0.050
AEE US Equity	Integrated	0.018	0.039	0.074	0.022	0.051	0.115	0.010	0.025	0.057

Code	Subsample	2017-2022			2012-2017			2007-2012		
AGR US Equity	Integrated	0.021	0.049	0.088	0.061	0.152	0.350			
AVA US Equity	Integrated	0.019	0.042	0.077	0.024	0.059	0.134	0.009	0.025	0.054
BKH US Equity	Integrated	0.017	0.039	0.074	0.023	0.057	0.138	0.012	0.031	0.063
CMS US Equity	Integrated	0.016	0.037	0.068	0.018	0.044	0.096	0.007	0.019	0.041
CNP US Equity	Integrated	0.018	0.043	0.078	0.021	0.047	0.108	0.008	0.021	0.049
D US Equity	Integrated	0.017	0.039	0.068	0.020	0.049	0.104	0.010	0.024	0.052
DTE US Equity	Integrated	0.016	0.038	0.069	0.020	0.048	0.110	0.009	0.021	0.045
DUK US Equity	Integrated	0.014	0.033	0.063	0.019	0.045	0.107	0.011	0.024	0.047
ED US Equity	Integrated	0.016	0.039	0.072	0.021	0.051	0.119	0.009	0.022	0.048
ES US Equity	Integrated	0.018	0.043	0.082	0.021	0.050	0.111	0.010	0.024	0.048
EXC US Equity	Integrated	0.015	0.033	0.067	0.025	0.063	0.149	0.017	0.042	0.079
FE US Equity	Integrated	0.016	0.040	0.078	0.018	0.043	0.100	0.012	0.031	0.072
LNT US Equity	Integrated	0.018	0.041	0.079	0.022	0.053	0.117	0.013	0.033	0.064
MGEE US Equity	Integrated	0.030	0.066	0.105	0.034	0.079	0.169	0.013	0.031	0.056
NG/ LN Equity	Integrated	0.016	0.037	0.074	0.017	0.038	0.089	0.011	0.024	0.048
NI US Equity	Integrated	0.015	0.034	0.066	0.019	0.045	0.098	0.008	0.019	0.038
NWE US Equity	Integrated	0.019	0.041	0.083	0.020	0.049	0.114	0.010	0.027	0.057
OGE US Equity	Integrated	0.018	0.044	0.079	0.025	0.062	0.145	0.013	0.030	0.052
PCG US Equity	Integrated	0.037	0.093	0.179	0.022	0.052	0.114	0.012	0.029	0.055
PEG US Equity	Integrated	0.017	0.041	0.076	0.027	0.062	0.139	0.015	0.038	0.076
POR US Equity	Integrated	0.019	0.043	0.087	0.021	0.051	0.109	0.010	0.023	0.042
PPL US Equity	Integrated	0.016	0.040	0.072	0.018	0.043	0.090	0.014	0.034	0.067
SJI US Equity	Integrated	0.022	0.053	0.103	0.025	0.062	0.147	0.014	0.035	0.069
SRE US Equity	Integrated	0.018	0.043	0.082	0.021	0.049	0.097	0.012	0.029	0.063
SSE LN Equity	Integrated	0.023	0.050	0.101	0.022	0.051	0.104	0.017	0.036	0.072
UTL US Equity	Integrated	0.022	0.051	0.101	0.022	0.050	0.117	0.011	0.026	0.045
VCT NZ Equity	Integrated	0.022	0.037	0.071	0.031	0.054	0.083	0.021	0.043	0.069
WEC US Equity	Integrated	0.020	0.048	0.086	0.023	0.056	0.133	0.009	0.023	0.047
XEL US Equity	Integrated	0.016	0.039	0.076	0.019	0.045	0.101	0.008	0.020	0.039

Source: CEPA analysis of Bloomberg Data

Airport sample – 5 year

Code	2017-22			2012-17			2007-12		
	Daily	Weekly	4 Weekly	Daily	Weekly	4 Weekly	Daily	Weekly	4 Weekly
000089 CH Equity	0.031	0.126	0.069	0.026	0.058	0.087	0.021	0.042	0.076
357 HK Equity	0.062	0.671	0.188	0.037	0.086	0.174	0.045	0.109	0.241
600004 CH Equity	0.052	0.265	0.120	0.031	0.062	0.099	0.024	0.051	0.104
600009 CH Equity	0.054	0.247	0.117	0.038	0.077	0.125	0.025	0.055	0.102
600897 CH Equity	0.038	0.153	0.075	0.045	0.099	0.137	0.034	0.076	0.134
694 HK Equity	0.042	0.185	0.090	0.040	0.075	0.136	0.020	0.046	0.096
ADP FP Equity	0.028	0.108	0.061	0.018	0.041	0.096	0.017	0.039	0.075
AIA NZ Equity	0.042	0.145	0.079	0.048	0.100	0.160	0.035	0.066	0.096
AOT TB Equity	0.035	0.128	0.076	0.051	0.105	0.219	0.021	0.043	0.072
ASURB MM Equity	0.039	0.152	0.086	0.044	0.082	0.191	0.037	0.083	0.167
FHZN SW Equity	0.039	0.172	0.087	0.024	0.049	0.116	0.023	0.048	0.093
FLU AV Equity	0.035	0.102	0.057	0.023	0.047	0.101	0.016	0.033	0.063
FRA GR Equity	0.022	0.090	0.042	0.016	0.033	0.072	0.019	0.037	0.071
GAPB MM Equity	0.043	0.160	0.096	0.047	0.097	0.224	0.035	0.075	0.140
GMRI IN Equity	0.021	0.080	0.045	0.016	0.034	0.077	0.022	0.047	0.088
KBHL DC Equity	0.035	0.128	0.067	0.035	0.078	0.178	0.042	0.081	0.179
MAHB MK Equity	0.053	0.202	0.100	0.060	0.117	0.221	0.059	0.103	0.182
MIA MV Equity	0.070	0.195	0.137	0.058	0.126	0.290	0.052	0.094	0.140
OMAB MM Equity	0.045	0.160	0.095	0.050	0.101	0.228	0.033	0.077	0.140
TYA IM Equity	0.024	0.070	0.041	0.033	0.061	0.105	0.030	0.053	0.085
AENA SM Equity	0.024	0.073	0.045						
ACV VN Equity	0.047	0.163	0.090						
ADB IM Equity	0.034	0.124	0.067						

Source: CEPA analysis of Bloomberg Data

Appendix E PROPORTION OF REGULATED REVENUE

Code	Name	Regulated Electricity	Regulated Gas	Regulated Energy Total
AEE US Equity	AMEREN CORPORATION	84%	16%	100%
AEP US Equity	AMERICAN ELECTRIC POWER	100%		100%
AES US Equity	AES CORP	28%		28%
AGR US Equity	AVANGRID INC	83%		83%
ALE US Equity	ALLETE INC	84%		84%
ATO US Equity	ATMOS ENERGY CORP		100%	100%
AVA US Equity	AVISTA CORP	69%	31%	100%
BKH US Equity	BLACK HILLS CORP	39%	49%	87%
CMS US Equity	CMS ENERGY CORP	66%	27%	93%
CNA LN Equity	CENTRICA PLC		37%	37%
CNP US Equity	CENTERPOINT ENERGY INC	49%	49%	98%
CPK US Equity	CHESAPEAKE UTILITIES CORP	6%	75%	80%
D US Equity	DOMINION ENERGY INC	79%	12%	91%
DTE US Equity	DTE ENERGY COMPANY	62%	24%	86%
DUK US Equity	DUKE ENERGY CORP	91%	7%	98%
ED US Equity	CONSOLIDATED EDISON INC	71%	19%	90%
EIX US Equity	EDISON INTERNATIONAL	100%		100%
ES US Equity	EVERSOURCE ENERGY	73%	14%	87%
ETR US Equity	ENTERGY CORP	89%	1%	91%
EVRG US Equity	EVERGY INC	100%		100%
EXC US Equity	EXELON CORP	46%	4%	50%

Code	Name	Regulated Electricity	Regulated Gas	Regulated Energy Total
FE US Equity	FIRSTENERGY CORP	84%		84%
HE US Equity	HAWAIIAN ELECTRIC INDS	88%		88%
IDA US Equity	IDACORP INC	100%		100%
KMI US Equity	KINDER MORGAN INC		67%	67%
LNT US Equity	ALLIANT ENERGY CORP	85%	11%	96%
MGEE US Equity	MGE ENERGY INC	73%	27%	100%
NEE US Equity	NEXTERA ENERGY INC	72%		72%
NFG US Equity	NATIONAL FUEL GAS CO		60%	60%
NG/ LN Equity	NATIONAL GRID PLC	27%	6%	33%
NI US Equity	NISOURCE INC	67%	33%	100%
NJR US Equity	NEW JERSEY RESOURCES CORP		37%	37%
NWE US Equity	NORTHWESTERN CORP	78%	22%	100%
NWN US Equity	NORTHWEST NATURAL HOLDING CO		97%	97%
OGE US Equity	OGE ENERGY CORP	77%		77%
OGS US Equity	ONE GAS INC		100%	100%
OKE US Equity	ONEOK INC			0%[71]
PCG US Equity	P G & E CORP	72%	28%	100%
PEG US Equity	PUBLIC SERVICE ENTERPRISE GP	61%		61%

[71] We were unable to determine an exact figure for the percentage of regulated revenues, noting that approximately 80% of their revenue comes from gas of which an undetermined amount is under FERC and state regulation.

Code	Name	Regulated Electricity	Regulated Gas	Regulated Energy Total
PNM US Equity	PNM RESOURCES INC	97%		97%
PNW US Equity	PINNACLE WEST CAPITAL	99%		99%
POR US Equity	PORTLAND GENERAL ELECTRIC CO	88%		88%
PPL US Equity	PPL CORP	100%		100%
RGCO US Equity	RGC RESOURCES INC		100%	100%
SJI US Equity	SOUTH JERSEY INDUSTRIES		54%	54%
SO US Equity	SOUTHERN CO/THE	75%	17%	92%
SR US Equity	SPIRE INC		96%	96%
SRE US Equity	SEMPRA ENERGY	41%	48%	88%
SSE LN Equity	SSE PLC	46%		62%
SWX US Equity	SOUTHWEST GAS HOLDINGS INC		41%	41%
UTL US Equity	UNITIL CORP	54%	46%	100%
VCT NZ Equity	VECTOR LTD			64%
WEC US Equity	WEC ENERGY GROUP INC	58%	42%	99%
XEL US Equity	XCEL ENERGY INC	85%	14%	99%

Source: CEPA analysis of Bloomberg Data and annual reports

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