Report prepared for Vector

Proposed amendment to the WACC percentile - Commerce Commission's draft decision

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29 August 2014

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1. Executive summary

To reduce the probability that its estimate of the Weighted Average Cost of Capital (WACC) is below the true WACC, the Commission adds a margin to its point estimate calculated from estimates of the market parameters which determine WACC. In the past this margin has been set such that the probability of the augmented estimate being less than the true WACC was approximately 25%.

In its Draft Decision,[1] the Commission proposes to amend the WACC Input Methodology (IM) so the probability of its estimate of WACC underestimating the true WACC increases to 33%. The Commission describes the proposed change as setting the WACC at the '67th percentile' rather than at the '75th percentile'.

In describing the reasons for its draft decision, the Commission appears to have applied a different test to the WACC IM than it applied in developing the other IMs. In its Reasons Paper, the Commission committed to interpreting and applying the purpose of Part 4 by inquiring 'whether outcomes consistent with outcomes produced in workably competitive markets are being promoted such that section 52A(1)(a) to (d) requirements are met'.[2] This is a comparatively precise test, and involves assessing the outcomes of the IM explicitly against the requirements of the purpose statement. By contrast, the Commission's characterisation of its approach in the Draft Decision as adopting 'both consumer welfare and total welfare approaches' is imprecise. The Commission's experts adopt very different objective functions in support of their advice to the Commission, either recommending a consumer benefits test or a total welfare approach.

In reaching its draft decision, the Commission places weight on the empirical analysis by Oxera using loss probabilities to estimate the expected costs to consumers from under or overestimation of WACC. In calculating its loss probabilities, Oxera fail to recognise that not only is the true (actual) WACC unknown but the standard error of the estimate adopted by the Commission is also unknown. The consequence is that the probabilities reported in Table 7.3 of the Oxera report are incorrect. We show that the loss probabilities for the 67th percentile calculated following the Oxera approach are much the same as the corrected loss probabilities for the 75th percentile. Therefore, consideration of loss probabilities does not provide a persuasive basis for reducing the estimate of WACC to the 67th percentile.

Oxera focuses its quantitative estimates on the increased payments by consumers and the benefits of improved reliability as the WACC percentile increases. Under this consumer benefits approach, the benefits to consumers would be maximised at the point which minimises the sum of the expected value of the additional payments by consumers and the expected cost of outages to consumers. We replicate the Oxera analysis to show that the quantification does not support a reduction in the WACC percentile as it would leave consumers worse off. These estimates factor in the cost to consumers of additional

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1 Commerce Commission, *Proposed amendment to the WACC percentile for electricity lines services and gas pipeline services*, (Draft Decision) 22 July 2014.

2 Commerce Commission (2010) *Input methodologies (electricity distribution and gas pipeline services): reasons paper*. (Reasons Paper) December 2010, paragraph 2.4.6.

investment, as recommended by Professor Vogelsang, and use the lower limit of cost of outages assumed by Oxera.

Adopting the Oxera mid-point estimate (rather than the lower limit) for the cost of loss of reliability shows that consumers would be substantially worse off – by $63 million per annum – should the WACC percentile be reduced from 75th to 67th percentile. The quantification suggests that consumers would better off, by $29 million per annum, from an increase in the WACC percentile to the 80th percentile.

As an alternative to loss probabilities, Oxera suggest calculating the expected loss to investors resulting from underestimating the true WACC. While expected loss to investors is a useful alternative to loss probabilities, Oxera's calculations are all in error. If Oxera had calculated correctly the expected loss at the 75th percentile, they would have estimated that customers would potentially be willing to pay a margin of 0.84% (with the calculation accounting for additional variability). This margin compares to the increment to WACC under the 75th percentile of 0.78%; that is, this comparison suggests increasing, rather than decreasing, the WACC percentile.

In support of its draft decision, the Commission refers to Professor Vogelsang's advice that if investment at the margin is optimal, the impact of changes in investment are likely to be relatively minor. The Commission admits it does not know if investment levels at the margin are optimal. Economic theory suggests that it is highly unlikely that investment at the margin is optimal, where a single entity is providing a common service to multiple customers, as is the case with electricity and gas networks. This theoretical finding accords with evidence describing decision-making in practice and anecdotal evidence on the welfare impact of investments at the margin. We are not aware of any empirical evidence provided to the Commission that would suggest a reduction in investment would have other than an asymmetric impact on consumer welfare.

The Commission draws comfort for its draft decision from the market values of Powerco and Vector being higher than their regulatory asset base values. We show a number of reasons for doubting the validity of the Commission's conclusion.

Finally, the Commission compares its IM estimates of WACC with current independent estimates of WACC for Transpower, Vector and Horizon. The Commission bases its comparison on incorrect 'standardised' versions of the independent estimates. Comparison of the correct independent estimates with the Commission's IM estimates shows that all of the independent estimates exceed the Commission's proposed IM 67th percentile estimate of 6.57% and that all the independent estimates other than the PwC estimate for Vector exceed the Commission's current 75th percentile estimate of 6.82%. Thus, contrary to the Commission's conclusion that comparison with independent estimates supports a move from the current 75th percentile to the 67th percentile, a properly based comparison suggests that the move should be to a higher percentile than the current 75th percentile.

2. Introduction

The Commerce Commission (the Commission) has released its draft decision on the percentile estimate of the weighted average cost of capital (WACC) that will apply to energy businesses regulated under Part 4 of the Commerce Act (Draft Decision).[3] In this report we review the analysis and reasoning provided by the Commission in support of its Draft Decision.

We structure our review into 6 sections as follows:

- section two summarises the Commission's interpretation of the statutory purpose of Part 4
- section three assesses the approach adopted by the Commission in its Draft Decision, and the approaches used by its experts, against the Commission's interpretation of the Part 4 purpose statement; this analysis shows that neither the Commission nor its experts applied the same test as was used in assessing the other IMs
- section four reviews the analysis relied on in the Draft Decision and shows that:
  - acceptance by the Commission's expert, Oxera, of the Commission's estimate of the standard error as being the standard error of the sampling distribution, results in failure to recognise the full variability of the augmented estimator and hence understates the loss probabilities in assessing the consumer benefits and costs of different WACC percentiles; correcting the probability calculations for the additional variability of the estimator results in the loss probabilities for the 67th percentile calculated following the Oxera approach being much the same as the corrected loss probabilities for the 75th percentile. Therefore, consideration of loss probabilities does not provide a persuasive basis for reducing the estimate of WACC to the 67th percentile.
  - that the expected loss to investors calculations undertaken by Oxera, are in error; the corrected calculation would support increasing, rather than decreasing, the WACC percentile
  - replicating the Oxera quantifications under its approach shows that consumers would be worse off by reducing the WACC percentile, substantially so if the mid-point (rather than bottom) of their range for the cost of system failure is used.
- section five summarises the evidence available to the Commission showing that investment at the margin is actually unlikely to be optimal, and hence a reduction in investment would likely impact on welfare adversely
- section six discusses why the WACC multiple analysis presented by the Commission does not support its contention that the 75th percentile is too high
- section seven discusses why the reasonableness analysis presented by the Commission does not support its contention that the 75th percentile is too high.

[3] Commerce Commission, (Draft Decision), 22 July 2014.

3. Statutory purpose and WACC

3.1 No change to interpretation of the statutory purpose

The Commission is currently reviewing one aspect of one IM - the WACC percentile.[4] Consistent with this limited review the Commission has not signalled an intent to revise its interpretation of the statutory purpose of Part 4 of the Commerce Act 1986 (the Act). A change to how the Commission interprets the purpose of Part 4 would necessarily require all IMs to be reviewed for consistency with the revised interpretation and increase uncertainty.

The Commission set out its interpretation of the purpose statement in its December 2010 Reasons Paper.[5] It concludes that the central purpose is to promote the long-term benefit of consumers in markets where there is little or no competition and little or no likelihood of a substantial increase in competition.[6] The Commission holds that the objectives in paragraphs 52A(1) (a) to (d) are integral to promoting the long-term benefit of consumers, and reflect the key areas of supplier performance that characterise workable competition.[7]

The requirements of paragraphs (a) to (d) mean that not all possible outcomes that occur in workably competitive markets are to be promoted, and neither are all possible benefits to consumers.[8] The Commission explained the test it applies in evaluating an IM as follows:

> *Unison submitted that 'in order to determine whether the central purpose (long-term benefit of consumers) is to be fulfilled, one has to inquire whether outcomes consistent with outcomes produced in workably competitive markets are being promoted such that section 52A(1)(a) to (d) requirements are met'. The Commission agrees. This is in fact how the Commission has interpreted and applied the purpose of Part 4.*[9]

Where it faces practical constraints (for example, limits on available information) on the ability to design IMs, the Commission considers the extent to which each option is likely, over time, to move outcomes closer towards, rather than further away from, outcomes

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4 The Commission states that: 'the submissions we have received to date have not convinced us that the appropriate percentile cannot be considered separately from a full review of the cost of capital IMs', Commerce Commissioner (2014) *Further work on the cost of capital methodologies: process update and invitation to provide evidence on the WACC percentile*, 31 March 2014, paragraph 21.

5 Commerce Commission (2010) *Input methodologies (electricity distribution and gas pipeline services): reasons paper*. (Reasons Paper) December 2010.

6 Commerce Commission (2010), Reasons Paper, paragraph 2.4.2. 'Competition' is defined to mean 'workable or effective competition' (s 3(1) of the Act).

7 Commerce Commission (2010), Reasons Paper, paragraph 2.4.6.

8 Confiscation of investor assets by setting a return on existing assets at zero would benefit consumers (at least initially) but would not meet the requirements of section 52A(1)(a) to (d).

9 Commerce Commission (2010), Reasons Paper, paragraph 2.4.6.

consistent with workably competitive markets.[10] That is, whether the IM would move outcomes closer to the requirements of section 52A(1)(a) to (d) being met.

3.2 The WACC IM and the statutory purpose

The Commission's regulatory challenge is to determine a regulated WACC that is 'neither too high, nor too low, such that the objectives in s 52A(1)(a) to (d) are achieved.'[11]

> *In the context of price control, if the cost of capital is set too low, regulated suppliers might have insufficient incentives to innovate and invest and might be unable to attract sufficient capital to undertake efficient investment, which would be inconsistent with s 52A(1)(a) of the Act. If the regulator sets the allowed rate of return too high, i.e. inappropriately above the rate of return of an investment of equal risk suppliers ability to extract excessive profits will not be limited, which would be inconsistent with s 52A(1)(d) of the Act.*[12]

The High Court similarly referred to the need balance the requirements of 52A(1)(a) and (d):

> *… what is clear is that the overall purpose of Part 4 is to protect the long-term interests of consumers and that, in seeking to do that, the paragraph (a) and (d) outcomes need to be balanced. Reflecting that, the various statements made by the Minister, both in the House and publically, sometimes refer first to the need to protect consumers from excessive profits while providing for incentives to invest: on other occasions, that order is reversed.*[13]

When faced with the 'natural tension between providing suppliers with incentives to invest and limiting their ability to extract excessive profits,'[14] the Commission gives greater weight to incentives to invest, because of the implications for dynamic efficiency:

> *That is, the Commission is acknowledging that where there is a potential trade-off between dynamic efficiency (i.e. incentives to invest) and static allocative efficiency (i.e. higher short-term pricing), the Commission will always favour outcomes that promote dynamic efficiency. The reason is that dynamic efficiency promotes investment over time and ensures the longer-term supply of the service, which thereby promotes the long-term benefit of consumers (consistent with the outcomes in workably competitive markets).*[15]

> *Incentives for dynamic efficiency can have significant benefits for consumers over the long term, so it is important to preserve incentives to invest and innovate. Accordingly, this consideration has been given greater weight than limiting suppliers' ability to extract excessive profits.*[16]

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10 Commerce Commission (2010), Reasons Paper, paragraph 2.4.19.

11 Commerce Commission (2010), Reasons Paper, paragraph H 1.23.

12 Commerce Commission (2010), Reasons Paper, paragraph H 1.25.

13 *Wellington International Airport Ltd & Ors v Commerce Commission* [2013] NZHC [December 2013], paragraph 684.

14 Commerce Commission (2010), Reasons Paper, paragraph 2.4.7.

15 Commerce Commission (2010), Reasons Paper, paragraph H1.31.

16 Commerce Commission (2010), Reasons Paper, paragraph 6.7.12.

4. Applying the purpose statement to the WACC percentile

4.1 Statutory purpose does not change

Conceptually, the intent of the WACC IM is straightforward. To comply with the statutory purpose, the Commission would aim to determine a regulatory WACC no lower than the market's view of the cost of capital for the regulated services, but not so high as to not limit the regulated firm in its ability to extract excessive profits.

The fundamental difficulty, however, is that the financial return required by investors, the 'true WACC' (or 'actual WACC'), is not observable. It can be estimated but there is no way of knowing how that estimate compares with the true WACC. This uncertainty - that the Commission may under or overestimate WACC - must therefore be considered in the WACC IM.

The existence of this uncertainty does not alter the Part 4 purpose statement or the Commission's interpretation of that purpose statement. The test is still whether the WACC IM, in combination with the other IMs, will promote outcomes consistent with outcomes produced in workably competitive markets such that the section 52A(1)(a) to (d) requirements are met.[17]

In its Draft Decision the Commission refers to the Part 4 purpose statement in broadly similar terms to its Reasons Paper:

> *We agree that the investment and profitability limbs of section 52A are particularly relevant when setting the WACC percentile, and must be balanced. The High Court understandably queried the basis upon which we were compromising the interests of consumers in lower prices. But, as emphasised in supplier submissions, we are also very aware of the longer-term benefit to consumers of incentivising the continued supply of reliable, efficient infrastructure services, as well as innovations in the supply of those services.*[18]

While the paragraph above is expressed in broadly similar terms to its Reasons Paper, the Commission appears to have shifted its balancing point; the Commission no longer refers to giving weight to 52A(1)(a) given the importance it attaches to dynamic efficiency. This change in the balancing point (if there is a change) is not explained in the Draft Decision.

17 Commerce Commission (2010), Reasons Paper, paragraph 2.4.16.

18 Commerce Commission, (2014, Draft Decision, paragraph 2.11.

4.2 An increment to the mid-point is necessary to meet the purpose statement

After gathering further evidence, and conducting further analysis, the Commission remains of the view that a WACC above the mid-point estimate (being the estimate calculated from estimates of the market parameters which determine WACC) best meets the purpose statement.[19] Our reading of the expert reports prepared for the Commission, and the expert reports attached to submissions, is that there is no serious challenge to the concept that the WACC should be set above the mid-point estimate.

We agree with the Commission that the "available evidence provides substantial support for adopting a WACC above the mid-point estimate." We also agree that "none of the submissions received to date provide compelling evidence or reasons for using a WACC at (or below) the mid-point estimate for energy businesses."[20]

The central question is whether a percentile above the mid-point, but below the current 75th percentile, would better meet the purpose statement. In addressing this question, the Commission says it adopts both consumer welfare and total welfare approaches:

> *Our analysis, and that of our experts, therefore adopts both consumer welfare and total welfare approaches. This means that in reaching our draft decision as to what will best promote the long term benefit of consumers by promoting outcomes consistent with outcomes produced in competitive markets, we have had regard to transfers from suppliers to consumers, but have also had regard to aggregate efficiency considerations.*[21]

This statement suggests three methodological concerns.

4.2.1 Neither total welfare nor consumer welfare is the appropriate test

The first difficulty raised by the Commission's statement is the Commission appears to be applying a different test to the WACC IM than it applied in developing the other IMs. The Commission committed to interpreting and applying the purpose of Part 4 by inquiring 'whether outcomes consistent with outcomes produced in workably competitive markets are being promoted such that section 52A(1)(a) to (d) requirements are met'.[22] This is a comparatively precise test, and involves assessing the outcomes of the IM and whether those outcomes would provide suppliers with incentives such that the requirements of (a) to (d) are met.

By contrast, the phrase 'adopts both consumer welfare and total welfare approaches' is imprecise and risks returning to a debate that the purpose statement was intended to resolve. The Explanatory Note to the Commerce Amendment Bill addressed whether total welfare or

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19 Commerce Commission (2014), Draft Decision, paragraph 5.41.

20 Commerce Commission (2014), Draft Decision, paragraphs 5.48 and 5.49.

21 Commerce Commission (2014), Draft Decision, paragraph 2.17.

22 Commerce Commission (2010) Reasons Paper, paragraph 2.4.6.

consumer welfare is the appropriate test, making the point that neither adequately addresses the regulatory objectives:

> *There has been debate around whether Part 4 requires consideration of economic efficiency only, or whether consumer protection/distributional considerations should also be taken into account in the context of regulating firms and, if so, what the relative weighting between these objectives should be. There is also debate about whether the current purpose statement is appropriate given there is no explicit reference to a key regulatory objective of providing for incentives to invest. Such debate and uncertainty does not fit well with the key regulatory objectives of clarity, certainty, transparency, and predictability.*[23]

The Explanatory Note thus indicates that an objective function comprising some (unspecified) merging of the broad economic concepts of consumer and total surplus would lack clarity, certainty, transparency, and predictability. Such a test would allow considerations which the Commission ruled out in its Reasons Paper. For example, the Reasons Paper found that not all outcomes of workably competitive markets are to be promoted under Part 4. Similarly, not all benefits to consumers are to be promoted, for instance if the benefit is not consistent with outcomes produced in competitive markets. Hence the necessity to inquire as to whether the outcomes being promoted are such that section 52A(1)(a) to (d) requirements are met.

4.2.2 Experts do not adopt both consumer and total welfare approaches

The second methodological concern raised by the Commission's explanation of its approach is that its experts, in the reports released by the Commission in July, do not adopt analysis incorporating both consumer welfare and total welfare approaches. The Commission's experts that recommend an approach to setting the percentile, adopt *either* a consumer welfare approach or a total welfare approach, not a weighting of both approaches:[24]

- Oxera discuss the implications of a total welfare approach,[25] but apply a consumer welfare approach in their analysis[26]
- Professor Vogelsang provides a conceptual analysis of the consequences of a higher allowed WACC from a consumer welfare perspective (with an additional paragraph

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23 Explanatory Note to the Commerce Amendment Bill, p.17.

24 Professor J Franks and Economic Insights do not recommend an approach. Professor Franks provides further explanation for his previous recommendations, and Economic Insights reviews overseas regulatory decisions.

25 Oxera (2014) *Input methodologies: review of the '75th percentile' approach*. Prepared for the New Zealand Commerce Commission, 23 June 2014, p.29.

26 Professor Vogelsang observes that Oxera leave out of its consumer welfare calculations the cost to consumers of the additional investment – Professor I Vogelsang, *Review of New Zealand Commerce Commission 'Proposed amendment to the WACC percentile for electricity lines services and gas pipeline services"*, July 31, 2014, paragraph 18; *Review of Oxera's Report, Input methodologies - Review of the '75th percentile' approach*, July 10, 2014, paragraph 18.

commenting on the differences between a consumer welfare and total welfare approaches)[27]

- Dr Martin Lally argues that the percentile should be determined on the basis of total welfare.[28]

The difference in outcomes between adopting a consumer welfare approach and a total welfare approach can be huge, as Professor Vogelsang observes in his review of the Commission's Draft Decision.[29] If the Commission were to adopt the approach of Dr Lally, for instance, it would arrive at a WACC percentile higher than the 75th and thus a very different WACC percentile than it would following the Oxera recommendation.

In recommending approaches that would lead to very different outcomes the Commission's experts cannot therefore have had the same objective function in mind. In arguing for a total surplus approach, Dr Lally refers explicitly to section 52A(1).[30] However, Oxera and Professor Vogelsang do not make explicit reference to the purpose statement when explaining why they prefer their recommended approaches, but refer in general terms to the long-term benefit of consumers. However, the purpose statement is not exclusively concerned with consumer benefit.

None of the Commission's experts directly assesses their recommendations against the core test for an IM established by the Commission in its Reasons Paper; that is, whether the approach would promote outcomes consistent with outcomes produced in workably competitive markets such that the section 52A(1)(a) to (d) requirements are met.

4.2.3 The Commission has not been explicit in its weighting

The third conceptual concern raised by the Commission's statement is that it does not say how it weighs the two approaches it adopts – consumer and total welfare – when different weights could lead to hugely different outcomes being promoted. As Professor Vogelsang observes, the Commission is very circumspect about the weight it assigns to consumer welfare and the weight it assigns to total welfare.[31] Indeed, it is not clear how the Commission has incorporated total welfare into its evaluation, as it refers extensively to the Oxera approach which applies a consumer welfare approach.

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27 Professor Vogelsang (2014) *On the economic effects of allowing a WACC above the midpoint* June 12, 2014.

28 Dr M Lally argues that "WACC uncertainty implies that a WACC margin may be necessary to encourage socially desirable investment, and the usual meaning of 'socially desirable' is positive total surplus"; *The Appropriate Percentile for the WACC estimate*, 19 June 2014, page 21.

29 Vogelsang, *Review of New Zealand Commerce Commission 'Proposed amendment to the WACC percentile for electricity lines services and gas pipeline services",* July 31, 2014, paragraph 18.

30 Lally (2014), *The Appropriate Percentile for the WACC estimate*, page 4.

31 Vogelsang, *Review of New Zealand Commerce Commission 'Proposed amendment to the WACC percentile for electricity lines services and gas pipeline services"*, July 31, 2014, paragraph 18.

5. Assessing the Draft Decision against the purpose statement

5.1 Interpreting the Draft Decision

5.1.1 The Commission's language

The Commission describes its decision as follows:[32]

> *the 67th percentile of our estimated WACC distribution should be used for the price-quality path regulation (the 75th percentile is currently used); and*
>
> *a range from 33rd to 67th percentile of our estimated WACC distribution should be used for information disclosure regulation (the 25th to 75th percentile is currently used).*

In this section we set out our understanding of these draft decisions.

5.1.2 "67th percentile of our estimated WACC distribution"

In footnote 11 of the Draft Decision, the Commission concedes that the language it uses to describe its decision is "short-hand only" and not the correct use of statistical terms. In our view, the language used by the Commission is in part unhelpful, in part misleading, and the concession does not go far enough.

The description of an estimate in the first part of the statement of the decision as being 'the [x] percentile' is harmless if it is widely understood as code for something completely different; that is, if the phrase is understood to be a short-form expression which refers to an estimate formed by:

- calculating a point estimate of the 'true WACC' or 'actual WACC' from estimates of the market parameters which determine WACC
- adding a margin to the point estimate such that there is a (100 - x)% probability that the augmented estimate of WACC is less than the true WACC.

This meaning is not at all obvious from the language used by the Commission but this is clearly the meaning understood by the Commission's expert, Oxera.[33] Footnote 11 indicates the Commission understands that it is using the phrase 'WACC percentile' as short-hand but the Commission has in the past provided incorrect explanations.

However, the expression "our estimated WACC distribution" is misleading as it suggests that the Commission has an estimate of a WACC distribution when in fact there is no WACC distribution; the true WACC is a fixed point. The process of generating estimates of the

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32 Commerce Commission (2014), Draft Decision, paragraph 5.41.

33 Oxera (2014) *Input methodologies: review of the '75th percentile' approach*. Prepared for the New Zealand Commerce Commission, 23 June 2014, for example, footnote 1, p1.

parameters that form an estimate of WACC can result in a different value of WACC each time an estimate is made. The Commission assumes that its estimator of WACC is unbiased - that is, the estimates are on average equal to the true WACC. It also assumes that the point estimates are normally distributed around the true WACC. Thus, in statistical terms it has a sampling distribution which is assumed to be normal.[34]

However, the parameters of this sampling distribution are unknown. The calculated point estimate is a single point on this distribution and it is at an unknown location relative to the true WACC. If the calculated point estimate was adopted as the value of the regulatory WACC for price-quality path regulation there would be a 50% probability that it would underestimate the true WACC.

To reduce this probability, the Commission adds a margin to the calculated point estimate such that the probability of underestimation using this augmented estimator is (approximately[35]) x%. Thus "the x percentile of our estimated WACC distribution" actually means an estimate such that the probability of underestimation is (approximately) (100-x)% and the probability is based on the true WACC being at the (100-x) percentile of the sampling distribution of the augmented estimator. In the past the margin has been set such that the probability of the augmented estimate being less than the true WACC was (approximately) 25%; with the proposed 67th percentile the margin would be set such that the probability of underestimation is 33%.

5.1.3 "33rd to 67th percentile of our estimated WACC distribution"

The language used in the second part of the statement of the decision in relation to the range for information disclosure regulation is misleading. The Commission refers to "a range from 33rd to 67th percentile of our estimated WACC distribution". It could be expected that the range would refer to the interval between the relevant percentiles of the sampling distribution of the augmented estimator of WACC, as in the first statement in relation to price-quality path regulation as discussed above. Not so: the calculation specified for the range indicates that the distribution this time is the sampling distribution of the estimator of WACC formed by calculation from estimates of the market parameters determining WACC.

The Commission's statement could then be understood to mean a range such that the probability of its estimate of WACC being less than the lower point of the range is 33% and the probability of being greater than the upper point of the range is 33%. Again, this is not so. The range required by the Commission is in fact what is normally described as a 'confidence interval', in this case a confidence interval with a confidence coefficient of 34% (the difference between the probabilities associated with the upper and lower limits).

This means that it is unknown whether a particular interval obtained encloses the true WACC or not (that is, the interval spans an unknown section of the distribution of the estimator of WACC), but there is a 34% probability of obtaining an interval that does

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34 A sampling distribution refers to the probability distribution of a statistic which is obtained through a large number of samples drawn from a defined data set.

35 The source of the approximation is explained in section 4.3.2.1 below.

enclose the true WACC and a 66% probability of obtaining an interval that does not enclose the true WACC.

With the current practice of requiring a "range from the 25th to 75th percentile of our estimated WACC range" the Commission requires a 50% confidence interval, that is, there is a 50% probability of obtaining an interval that encloses the true WACC and a 50% probability of obtaining an interval that does not enclose the true WACC. The meaning of the Commission's range is thus completely different from the meaning suggested by the language used to describe the range.

The Commission could easily shift to standard language by describing the requirement for disclosure regulation as being an x% confidence interval and the requirement for price-quality path regulation as an estimate equal to the upper limit of that x% confidence interval.

The current use of a 50% confidence coefficient is extremely unusual, but use of a 34% confidence interval would be even more unusual. We are not aware of any empirical paper ever published in the finance/capital markets literature that has used a 50% or a 34% confidence coefficient for estimation. The normal choice of confidence coefficient is 95% or 99%. The choice of confidence coefficient has a significant effect on the size of the interval (range). For example an interval width of 1.5 at 50%, translates to 0.98 at 34%, 4.36 at 95% and 5.73 at 99%.

We find it difficult to understand how the purpose of information disclosure can be achieved when there would be a 66% probability that the range that the Commission requires to be published does not enclose the true WACC; that is, there is 66% probability that the true WACC lies below or above the range specified by the Commission. The Draft Decision offers no explanation.

However, in this report, we focus on the analysis and reasoning provided by the Commission to support its draft decision to set WACC for the purposes of price-quality path regulation at the 67th percentile.

5.2 Conceptual steps in assessing WACC IM

Conceptually, the analysis required to assess the IM against the purpose statement can be summarised as consisting of the following steps:

- identify the outcomes that might be promoted if the WACC is under or overestimated
- determine which of the outcomes that might be promoted are relevant considerations in terms of the purpose statement and which (if any) are not relevant or should be given less weight
- estimate the probability of the relevant outcomes occurring
- estimate the magnitude of the relevant outcomes should they occur
- determine, in light of the above factors, whether the IM meets the purpose statement.

The first step is uncontroversial. However, as we show below:

- the Oxera analysis which informs the Commission's judgement incorrectly estimates the probabilities and expected loss

- the Commission does not explicitly assess the outcomes against the purpose statement and excludes relevant outcomes from its assessment
- the magnitude of effects following the Oxera approach support increasing, rather than decreasing, the percentile, even if the Oxera estimates are adjusted for the cost to consumers of additional investment as proposed by Professor Vogelsang.

5.3 Outcomes promoted in over or underestimating WACC

The first of these conceptual steps – the list of potential outcomes which might be promoted should the regulatory WACC be an underestimate or overestimate – are well understood. If WACC is *underestimated* some or all of the following outcomes might be promoted:

- economic efficiency losses (so-called deadweight losses) from prices being set too low
- less investment than would be economically efficient
- lower quality of services (including system failure) due to less investment
- wealth transfers from investors to consumers.

If WACC is *overestimated* some or all of the following outcomes might be promoted:

- economic efficiency losses (so-called deadweight losses) from prices being set too high
- more investment than would be economically efficient
- higher quality of services[36]
- wealth transfers from consumers to investors.

All of these outcomes are discussed in the various expert reports made available to the Commission, though not all outcomes are discussed in all reports given different assumptions made by the authors as to which outcomes are relevant.

5.4 Probabilities of outcomes incorrectly calculated

5.4.1 The Commission does not apply a 'loss function approach'

The Commission says that in reaching its judgement it has explored quantification of the loss analysis framework supported by the Court, discussed in submissions, and developed by its expert advisers, particularly Oxera and Dr Lally.[37]

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[36] The value of this increase in quality will depend on whether investment at the margin is optimal from society's perspective, as discussed further below.

[37] Commerce Commission (2014), Draft Decision, paragraph 3.14.

> *… the High Court indicated that we should consider loss analysis when we review the choice of WACC percentile under the IMs.*[38]
>
> *We have therefore focused our further work on testing the extent to which a loss analysis can give us a robust basis for a WACC percentile decision, and on comparing this to other expert analysis and factual evidence before us.*[39]

The Commission describes its approach in the following terms:

> *The loss function approach considers the cost of under-estimating WACC (eg under-investment which results in lower reliability, and/or deadweight loss from under-pricing) against the cost of over-estimating WACC (eg, over-investment, deadweight loss from over pricing, and possibly transfers).*[40]

The approach described by the Commission, and the analysis undertaken by Oxera, do not involve the application of a loss function. Loss functions provide a conceptual basis for choice of the probability level for the estimator of WACC in terms of the consequences of error in estimation. The process of estimating the loss function starts with considering the costs of making incorrect decisions based on an estimate of the WACC. This is the step in the analysis attempted by Oxera, but neither Oxera nor the Commission take that analysis into a loss function to estimate the WACC percentile.

In our May report,[41] we showed that the current 75th percentile is consistent with minimising expected loss under the assumption that a simple asymmetric linear loss function appropriately describes the response to loss and, specifically, that the loss from underestimation would be regarded as three times greater than the loss from overestimation. There are many alternative forms of loss function that could be applied. We showed, for example, that the greater relative loss of welfare for underestimation can be modelled as occurring only where there is significant underestimation.

5.4.2 Loss probabilities and expected loss

Rather than apply a loss function, Oxera propose two approaches for quantifying the impact of underestimating WACC, viz, loss probabilities and expected loss.

The loss probability approach proposed by Oxera calculates for any given percentile the probability that the estimate of WACC is less than the actual WACC by the margins of 0.5% and 1%. Oxera regard these margins as appropriate as "… it is instinctively consistent with the workings of financial markets and competition for capital…"[42] Oxera provide no evidence to support their contention that setting a regulatory WACC up to 0.5% below actual WACC would have no impact on investment. The Commission offers no explanation as to why it adopts Oxera's instinctive approach and drops its presumption to date that

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38 Commerce Commission (2014), Draft Decision, paragraphs 3.12.2 and 3.13.

39 Commerce Commission (2014), Draft Decision, paragraph 2.13.

40 Commerce Commission (2014), Draft Decision, paragraph 3.15.

41 Kieran Murray and Tony van Zijl, *Setting the WACC percentile for Vector's price quality path*, 5 May 2014

42 Oxera (2014), *Input methodologies: review of the '75th percentile' approach*, page 6.

setting the regulatory WACC below the actual WACC would have adverse incentives for investment.

Oxera's calculation of the loss probabilities do not fully reflect variability in the augmented estimator of WACC

In calculating its loss probabilities, Oxera follows the Commission's practice of failing to recognise that not only is the true (actual) WACC unknown but the standard error of its estimator of WACC is also unknown.

Use of a point estimate of the standard error in setting the augmented estimator of the true WACC, W, at any percentile level results in greater variability in the sampling distribution of the estimator. The consequence is that the probabilities reported in Table 7.3 of the Oxera report are incorrect.

As explained more fully in our report of 4 May 2014, the estimator of the true WACC, W, denoted by $\hat{Y}$, is obtained by adding a fixed margin, K, to the value of the observed mid-point estimate, $\hat{W}$; that is:

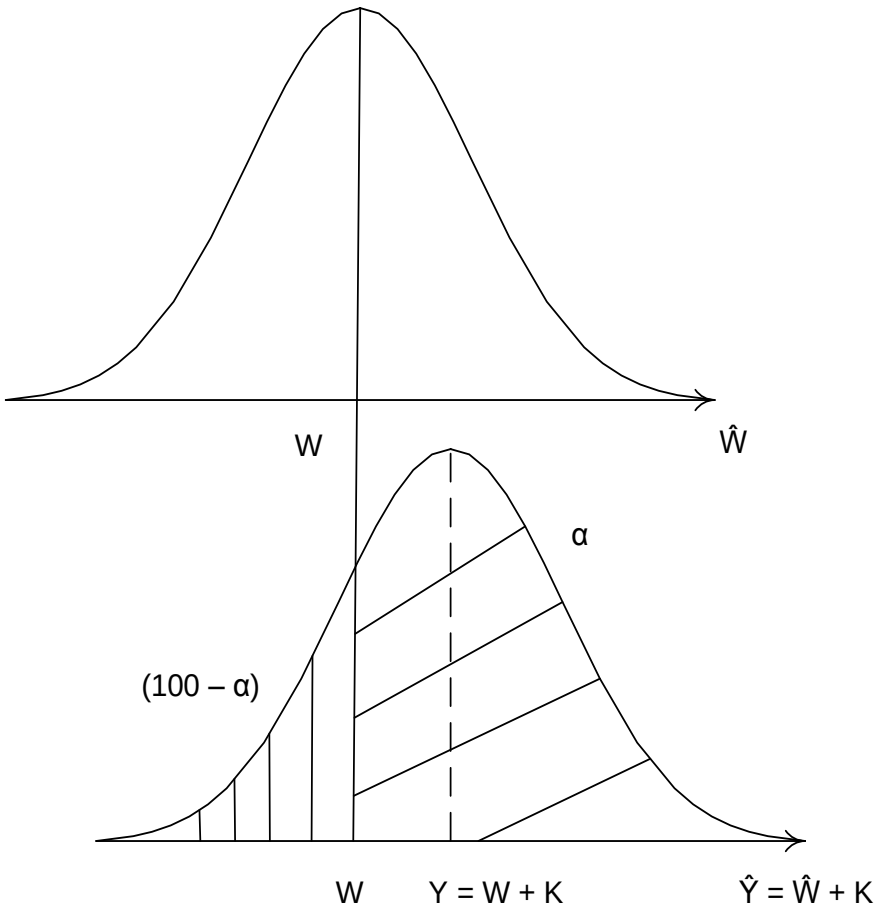
$$\hat{Y} = \hat{W} + K$$

As the sampling distributions of $\hat{W}$ is normal, and the margin K is fixed, the sampling distribution of $\hat{Y}$ is also normal; the two distributions have the same standard deviation, that is:

$$\sigma(\hat{Y}) = \sigma(\hat{W}).$$

The relationship between these two distributions is shown in Figure 1 below.

Figure 1 The sampling distributions of $\hat{W}$ and $\hat{Y}$



The vertically shaded region to the left of W in Figure 1 shows the probability of under-estimating W (the true WACC); that is, the probability of $\hat{Y}$ (the estimate of WACC plus a margin) being less than the true WACC, W, is (100 - α)%. The choice of the value of the percentile, α, determines the size of the margin, K (and vice versa).

Hence, if the margin is expressed as $K = Z\,\sigma(\hat{W})$, where Z is the standard normal deviate corresponding to α, then the percentile can be calculated for different margins, or vice versa. For example: if $K = 0.6745\,\sigma(\hat{W})$ the percentile, α, is 75%.

However, $\sigma(\hat{W})$ is unknown and therefore the estimator actually used by the Commission to estimate W is $\hat{\hat{Y}}$, the value of the observed estimate, $\hat{W}$, plus the variable margin $Z\hat{\sigma}(\hat{W})$, that is:

$$\hat{\hat{Y}} = \hat{W} + Z\hat{\sigma}(\hat{W})$$

where $\hat{\sigma}(\hat{W})$ is an estimator of $\sigma(\hat{W})$ and different values of $\hat{\sigma}(\hat{W})$ are observed simultaneously with different values for $\hat{W}$. The Commission effectively assumes that its point estimate of 1.07 for $\sigma(\hat{W})$ is equal to $\sigma(\hat{W})$ and that it therefore estimates W by $\hat{Y}$. However, the point estimate will actually vary and therefore the Commission actually estimates W by $\hat{\hat{Y}}$.

Assuming (reasonably) that $\hat{W}$ and $\hat{\sigma}(\hat{W})$ are independent, then

$$\sigma(\hat{\hat{Y}}) = [\sigma^2(\hat{W}) + Z^2\hat{\sigma}^2(\hat{W})]^{0.5}$$

and therefore

$$\sigma(\hat{\hat{Y}}) > \sigma(\hat{Y})$$

that is, there is additional variability – the sampling distribution of $\hat{\hat{Y}}$ is 'flatter' than that of $\hat{Y}$.

The consequence is that for any value of W and any given percentile level associated with $\hat{Y}$, the probability of under-estimation of W is actually greater than indicated by the choice of percentile. This can be illustrated as follows. As also explained in our report of 5 May 2014, based on a simple market model regression using T observations (R_i, R_m), the standard error of $\hat{\hat{Y}}$ can be estimated to a good level of approximation as:

$$\sigma(\hat{\hat{Y}}) = \sigma(\hat{W}) + 2Z\left(\frac{1-L}{T}\right)\frac{\phi\beta\sigma_i^2}{V}$$

where

$$\sigma(\hat{W}) = \frac{1-L}{\sqrt{T}}\sqrt{V}$$

$$V = \sigma_i^2\frac{\phi^2}{\sigma_m^2} + \beta_e^2\sigma_m^2$$

Then, using the WACC parameter estimates currently adopted by the Commission (ϕ=7%, L=.44, β_e = 0.61) and additionally assuming that T = 60, σ_m = 20%, and σ_i = 30%, the result is that for the Commission's 75th percentile estimator, the probability of underestimation of W is actually 28.1% rather than 25%. Similarly, Table 1 below shows the impact on the probabilities of underestimation of W at W – m or less, for m = 0.5% and 1%, at the 60th, 65th, 70th and 75th percentiles (as per Oxera's Table 7.3) and also at the Commission's proposed 67th percentile.

Table 1 Oxera probabilities and corrected probabilities

Probabilities reported in Table 7.3 of Oxera report	0.5% loss	1.0% loss
60th percentile	23.6	11.8
65th percentile	19.7	9.4
67th percentile	18.2	8.5
70th percentile	16.1	7.3
75th percentile	12.7	5.4
Corrected probabilities	**0.5% loss**	**1.0% loss**
60th percentile	26.0	14.7
65th percentile	22.8	12.7
67th percentile	21.6	12.0
70th percentile	19.8	10.9
75th percentile	17.1	9.3

It is evident that at all the tabled percentile levels the loss probabilities as reported by Oxera are less than the corrected probabilities based on $\hat{\hat{Y}}$. Furthermore, the loss probabilities for the 67th percentile calculated following the Oxera approach are much the same as the corrected loss probabilities for the 75th percentile. Therefore, consideration of loss probabilities does not provide a persuasive basis for reducing the estimate of WACC to the 67th percentile.

Oxera's expected loss calculations are in error

As an alternative to loss probabilities, Oxera suggest calculating the expected loss to investors resulting from underestimating the true WACC:

As described above, the expected loss could be comparable to the 'insurance' premium that customers would be required to pay to insure the companies against any losses.[43]

While expected loss to investors is a useful alternative to loss probabilities, Oxera's calculations are all in error.[44]

The error in Oxera's calculation is immediately evident from the simple example provided on page 54 of their report to illustrate the concept of expected loss. In this example, Oxera calculate an expected loss of 0.35% which is smaller than the only two possible loss values given in the example of 0.5% and 1.0%. The error arises because the expected value is calculated by weighting the possible loss values by unconditional probabilities when the weights should have been the probabilities conditional on incurring a loss.[45]

Oxera state on page 55 that the expected loss from underestimation of W by at least 0% at the 50th percentile is 0.42% and at the 75th percentile 0.17%. Figure 6.3 of the report shows the expected loss at the 50th through to 95th percentiles. The stated expected loss values are all reflect the same error.

The expected loss from underestimation of W by m% or more is given by:

$$\text{W- expected value of X given } X \leq W - m$$

$$= W - \int_{-\infty}^{W-m} X \frac{1}{P(X \leq W - m)} f(X)dX$$

where X is the augmented estimator and $f(X)$ is the normal density function of X.

Then, using the Commission (and Oxera's) approach of assuming that the point estimate of 1.07 for $\sigma(\hat{W})$ equals $\sigma(\hat{W})$ (thus using $X = \hat{Y}$), the expected loss from underestimation of W by 0% or more at the 50th percentile is 0.85% - not 0.42% as stated by Oxera. Similarly, for the 75th percentile, the expected loss is 0.64%, not 0.17% as stated by Oxera. Corrected

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43 Oxera (2014), *Input methodologies: review of the '75th percentile' approach*, page 55.

44 The error made in calculating the expected loss is clearly significant. There are also frequent lapses in exposition on matters of statistics. For example there is continual confusion between the meaning of "midpoint estimate" as the actual value of WACC, W, at the centre of the sampling distribution of $\hat{W}$, and as the midpoint of the possible range constructed in calculating the point estimate of W from the estimates of the parameters that determine WACC. In Figure 2.1 (which has also been included as Figure 5.1 in the Draft Decision) it appears to indicate W, but in the same figure there is the statement that the distribution is likely to be symmetrical around the point estimate. In fact the distribution is of the estimator and is assumed to be symmetrical around W. On p17 there is the statement that "the Commission's WACC range is estimated so that the midpoint is the best estimate of the median of the WACC distribution". In Table 4.3, midpoint means the point estimate. On page 51 there is discussion of a "central estimate". This appears to be W. There is no need to assume a particular value for W in order to calculate the probability of an estimate falling outside certain limits in respect of W. The stated probability of falling more than 2% away from W is incorrect – it is actually the probability of underestimating W by more than 2% (as correctly stated on page 52). The actual WACC is unknown but fixed, the estimates of W vary. Thus, for example, statements such as "the risk that the actual WACC is above the estimated WACC is 25% (p 53) should be restated as "the risk that the estimated WACC is less than W is 25%".

45 In the example, the probability of incurring a loss is 0.5 and thus the conditional probabilities are 0.3/0.5 and 0.2/0.5. Hence the correct expected loss = 0.5%x (0.3/0.5) + 1.0%x (0.2/0.5) = 0.7%.

for the additional variability, the corresponding expected losses at the 50th and 75th percentiles are 0.93% and 0.84% respectively.

Table 2 below shows for the 50th through to the 75th percentile the expected loss based on the Commission and Oxera's approach of assuming that the point estimate of 1.07 for $\sigma(\hat{W})$ equals $\sigma(\hat{W})$. Table 2 also shows the expected loss with correction for the additional variability through use of $X = \hat{\hat{Y}}$.

Table 2 Expected loss (%)

Based on standard error = 1.07			
Percentile	**0.0%**	**0.5%**	**1.0%**
50%	0.85	1.20	1.58
60%	0.76	1.13	1.52
65%	0.72	1.09	1.50
67%	0.70	1.08	1.49
70%	0.68	1.06	1.48
75%	0.64	1.03	1.45

Corrected for additional variability			
Percentile	**0.0%**	**0.5%**	**1.0%**
50%	0.93	1.27	1.65
60%	0.88	1.25	1.64
65%	0.87	1.24	1.63
67%	0.86	1.23	1.63
70%	0.85	1.23	1.63
75%	0.84	1.22	1.63

Oxera's miscalculation of the expected loss from underestimation of W by 0% or more is in error by a factor of 2 at the 50th percentile, 4 at the 75th percentile and 20 at the 95th percentile. The expected loss would be in error by a factor of 3 at the 67th percentile. Oxera may well have reached a different recommendation had they recognised the extent of their error in the calculations of expected loss. When the calculation of expected loss is adjusted to reflect full variability in the estimator the extent of the error is even greater: error factors of 2.2, 3.7, 5.2 and 35.5 at the 50%, 67th, 75th and 95th percentiles respectively.

Oxera characterises the expected loss as "the amount that customers should potentially be willing to pay" to compensate investors for the expected loss from under estimates of WACC. If Oxera had calculated correctly the expected loss at the 75th percentile, they would have estimated that customers would potentially be willing to pay a margin of 0.64%, not 0.17% as stated in their report.[46] This margin compares to the current increment to WACC under the 75th percentile of 0.72%.[47] If the calculation is corrected for additional variability, the margin consumers would be willing to pay is 0.84%, as shown in Table 2 above, compared to an increment under the 75th percentile of 0.78%.

On an expected loss basis, this comparison therefore suggests increasing, rather than decreasing, the WACC percentile.

5.4.3 Cost and benefit relationship in Oxera report

Oxera focuses its quantitative estimates on the increased payments by consumers and the benefits of improved reliability as the WACC percentile increases. Oxera form the view that all other policy costs are of negligible size.[48]

If we accept (for the moment) Oxera's view that these are the only two effects that are material, and if we apply a consumer welfare test (which Oxera says it applies), then the WACC percentile should be set at the point which minimised the sum of the expected value of the additional payments by consumers and the expected cost of outages to consumers; this would be the point that maximised the benefit to consumers.

Oxera reports its estimates of the payments that consumers can expect to make, on average, at each WACC increment, at table 7.3.[49] They suggest the cost of outages from under investment is likely to have an annualised cost to consumers of $1billion to $3billion.[50] Oxera suggest that the reduction in the risk of the outage can be approximated by the change in the risk that WACC will be underestimated.[51] Their logic is that reducing the risk of underestimating WACC, reduces the risk of under investment, and reducing the risk of under investment reduces the risk of outages.

While there are many reasons why the relation between the risk of under estimating WACC and the risk of outages may not hold in the manner assumed by Oxera, this assumption allows Oxera to comment on the gains and costs to consumers from incremental changes in the WACC percentile. In box 7.1, Oxera calculate that, with underestimation by 0.5% or more, reducing the WACC percentile from the 75th percentile to the 70th saves consumers

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46 Oxera (2014), *Input methodologies: review of the '75th percentile' approach*, p.55.

47 See Oxera, (2014), *Input methodologies: review of the '75th percentile' approach,* Table 7.3.

48 I Vogelsang (2014) *Review of Oxera's report, Input methodologies – review of the '75th percentile' Approach.* 10 July 2014. Paragraph (7), page 7.

49 Oxera (2014), *Input methodologies: review of the '75th percentile' approach*, p.39.

50 Oxera (2014), *Input methodologies: review of the '75th percentile' approach*, p.50.

51 Oxera (2014), *Input methodologies: review of the '75th percentile' approach*, box 7.1, p 70, appendix 1.

$24 million from lower charges and imposes additional costs of $34 million in reduced reliability.[52]

The assumption made by Oxera would also allow reporting of whether different WACC percentiles would improve outcomes for consumers (within the confines of its methodology), though Oxera do not provide this quantification. We produce these calculations in Table 3 below.

Professor Vogelsang observes that the Oxera quantification does not provide for the cost to consumers of the additional investment, a point emphasised by the Commission in its Draft Decision.[53] Professor Vogelsang suggests that an additional cost of estimate of $100 million would be reasonable, and thus adding this number to Oxera's estimate of the additional payments by consumers would make "Oxera's cost-benefit calculation looks already much less favourable than before".[54]

We agree that an estimate of cost of the investment to achieve the improved quality should be factored into Oxera's quantification.[55] This estimate of investment costs should be probability adjusted as the cost would not be incurred if actual WACC were below the regulated WACC (following the Oxera assumption). We add this adjustment to the Oxera quantification in Table 3.

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52 3.4% increase in probability of underestimating WACC multiplied by $1 billion.

53 Commerce Commission (2014), draft decision, paragraphs 5.45, 6.7.1.

54 Ingo Vogelsang (2014) Review of Oxera's report, Input methodologies – review of the '75th percentile' Approach. 10 July 2014. Paragraph (7), page 7.

55 Presumably an adjustment should also be made for the short term savings to consumers when investment is not made because WACC is underestimated – Oxera assess the effect on consumers from the reduced investment in terms of more frequent outages, but do not account for this.

Table 3 Oxera probability adjusted quantitative estimates

	A	B	C	D	E	F	G	H
Percentile	Increase in charges ($m)	Additional investment (Vogelsang) ($m)	Probability of overestimation by 0.5% or more	Expected cost	Annualised reliability loss ($m)	Probability of underestimation by 0.5% or more	Expected reliability loss ($m)	Total cost to consumers ($m)
65th	$61	100	46.7%	$108	1000	19.7%	197	$305
67th	$69	100	48.9%	$118	1000	18.2%	182	$300
70th	$83	100	52.3%	$135	1000	16.1%	161	$296
75th	$107	100	58.2%	$165	1000	12.7%	127	$292
80th	$133	100	64.6%	$198	1000	9.6%	96	$293
Notes								
A	Oxera, Table 7.3, page 69							
B	Vogelsang, Review of Oxera, p 19							
C	Probabilities set out in Appendix 1							
D	A + (B x C)							
E	Oxera, page 50, range $1 billion to $3 billion							
F	Probabilities set out in Appendix 1							
G	F x E							
H	G + D							

These quantitative estimates do not support a reduction in the WACC percentile, as it suggests that the reduction would leave consumers worse off by $8 million per annum.

The quantification shown above follows Oxera's illustration in Box 7.1, and takes the bottom of the range of loss to consumers from a fall in reliability. Oxera estimate a range of $1 billion to $3 billion. In Table 4 we show the effect on Oxera's quantification of using a mid-point value of $2 billion, rather than the bottom of the range.

Table 4 Oxera probability adjusted quantitative estimates – using mid-point of reliability loss value

	A	B	C	D	E	F	G	H
Percentile	Increase in charges ($m)	Additional investment (Vogelsang) ($m)	Probability of overestimation by 0.5% or more	Expected cost	Annualised reliability loss ($m)	Probability of underestimation by 0.5% or more	Expected reliability loss ($m)	Total cost to consumers ($m)
65th	$61	100	46.7%	108	2000	19.7%	394	502
67th	$69	100	48.9%	118	2000	18.2%	364	482
70th	$83	100	52.3%	135	2000	16.1%	321	457
75th	$107	100	58.2%	165	2000	12.7%	254	419
80th	$133	100	64.6%	198	2000	9.6%	193	388
Notes								
A	Oxera, Table 7.3, page 69							
B	Vogelsang, Review of Oxera, p 19							
C	Probabilities set out in Appendix 1							
D	A + (B x C)							
E	Oxera, page 50, range $1 billion to $3 billion							
F	Probabilities set out in Appendix 1							
G	F x E							
H	G + D							

As table 4 shows, adopting the Oxera mid-point estimate for the value of loss of reliability shows that consumers would be substantially worse off – by $63 million per annum – should the WACC percentile be reduced from 75th to 67th percentile. The quantification suggests that consumers would benefit, by $29 million per annum, from an increase in the WACC percentile to the 80th percentile.

5.5 Commission's method excludes relevant outcomes

5.5.1 Commission places weight on Oxera's limited analysis

In reaching its draft decision to reduce the WACC percentile, the Commission explains that it "on balance, places weight on Oxera's view that a percentile below the 75th is appropriate".[56] We have shown above that the empirical results reported by Oxera contained calculation errors, and once corrected, the empirical analysis would support retaining the 75th percentile, if not increasing it.

The Oxera approach to quantification considers only consumer costs, and does not incorporate all factors relevant to a Part 4 analysis. In particular, Oxera do not consider the effects of benefits to consumers from underestimation of true WACC - the 'saving' as a result of investment opportunities forgone with underestimation of true WACC (symmetric with Vogelsang's additional investment from overestimation) and the inefficient wealth transfers from investors to consumers. Oxera also ignore the effects of change to the WACC IM on regulatory certainty.

5.5.2 No adjustment for inefficient wealth transfers

Because Oxera apply a consumer benefits test (and not the Part 4 purpose statement), they exclude from their quantitative analysis the potential for *inefficient* wealth transfers from investors to consumers. An inefficient wealth transfer from investors to consumers would occur if the regulatory WACC on existing efficient investments was set below the true cost of capital. This would not be an outcome consistent with workably competitive markets, it would not be in the long-term interests of consumers because it might prevent the supplier from attracting sufficient capital to undertake future investments, and would not meet the requirements of section 52A(1)(a).

To better align the Oxera quantification with the Part 4 purpose statement, the potential for *inefficient* wealth transfers from investors to consumers would need to be factored into the analysis. In table 5 below, we show the expected inefficient transfers from suppliers to consumers, using Oxera's loss probabilities:

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[56] Commerce Commission (2014), Draft Decision, footnote 5.

Table 5 Oxera probabilities - inefficient wealth transfers to consumers

Percentile	Oxera estimate of RAB ($m)	Expected loss from underestimation by 0.0% or more	Inefficient transfers to consumers
65th	$14,700	0.72%	$106
67th	$14,700	0.70%	$103
70th	$14,700	0.68%	$100
75th	$14,700	0.64%	$94
80th	$14,700	0.60%	$88

Hence, the Oxera loss probabilities indicates consumers would be worse off, by $63 million per annum, were the WACC percentile to be lowered from the 75th to 67th percentile *and* would result in an increase in the expected inefficient welfare transfers from suppliers to consumers of $9 million per annum. The result is that the proposed amendment to the WACC IM would move outcomes further away from outcomes consistent with workably competitive markets and the requirements of section 52A(1)(a) to (d).

5.5.3 No consideration of the impact on uncertainty

The Commission considers that the existing IM (75th percentile) does not have 'any special standing as the status quo',[57] and has therefore 'approached the evidence afresh, and re-asked the fundamental questions related to the WACC percentile'.[58]

By not using the status quo as the reference point for its analysis, the Commission has taken an approach inconsistent with standard approaches to regulatory policy analysis, including the guidance in the Treasury's *Regulatory Impact Analysis Handbook*. The standard analytical framework involves considering the costs and benefits of the *marginal* change in policy settings, compared to the costs and benefits associated with the status quo.

The effect of the Commission's approach is to add uncertainty. As Professor Vogelsang points out in his review of the Draft Decision, regulated firms have made investment decisions since 2010 on the expectation that the current WACC regime would be in place until at least the next planned IM review. He cites this as a reason for why the status quo might carry weight.[59]

Giving weight to the status quo increases the certainty and predictability of the regulatory regime because it means a positive case must be made to support a change. Regulatory

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57 Commerce Commission (2014), Draft Decision, paragraph 2.6 and footnote 53.

58 Commerce Commission (2014), Draft Decision, paragraph 2.6 and footnote 53.

59 Ingo Vogelsang (2014) *Review of New Zealand Commerce Commission 'Proposed amendment to the WACC percentile for electricity lines services and gas pipeline services'* 31 July 2012, paragraph 26.

certainty is an important element of ensuring that the requirements of section 52A(1)(a) to (d) are met because economic regulation succeeds by changing behaviour. But investment behaviour will not change in a welfare enhancing manner unless regulation is credible and predictable.[60]

It seems uncontroversial that a purpose for setting the IMs was to 'give greater certainty, transparency, and predictability to businesses… and their customers', with this certainty was 'expected to help improve the climate for investment in infrastructure'.[61] As observed by the High Court:

> *….Overall, the certainty to be provided over time by the new Part 4 is central to the promotion of appropriate incentives to invest.*[62]

[60] For a useful summary of some aspects of this literature, see Giandomenico Majone, 'Strategy and Structure the Political Economy of Agency Independence and Accountability, in Designing Independent and Accountable Regulatory Authorities for High Quality Regulation, OECD Working Party on Regulatory Management and Reform, Proceedings of an Expert Meeting in London, 10-11 January 2005, p 126

[61] Explanatory Note to the Commerce Amendment Bill, p.5.

[62] *Wellington International Airport Ltd & Ors v Commerce Commission* [2013] NZHC [December 2013], paragraph 691.

6. Effects from any reduction in investment unlikely to be small

6.1 Investment at margin unlikely to be optimal for society

Much is known, and can be quantified, about the outcomes should the regulatory WACC be over or underestimated. Estimates of the deadweight losses from prices being inefficiently high or inefficiently low, and the associated wealth transfers from or to consumers, can be obtained from ASEC, Oxera, and our May report. These estimates arrive at similar orders of magnitude.

The primary remaining uncertainty, as the Commission observes, is that:

> *… it is extremely difficult to empirically estimate the link between the WACC allowed by the regulator, the level of investment by regulated suppliers, and how this affects quality of service.*[63]

Though the Commission places weight of the Oxera quantification, it argues that it must still apply its judgement when selecting the WACC percentile. Professor Ingo Vogelsang's report appears to have been influential in guiding the Commission's judgement.[64] The Commission comments:[65]

> *Professor Vogelsang has noted if the current level of investment is optimal, the impacts of changes in investment on reliability are likely to be relatively minor. While we do not know if current investment levels are optimal, strong investment has been occurring (and is forecast to continue to occur) and there is no evidence that it is inadequate to satisfy consumers' needs.*

Evidence of strong investment does not answer the question posed by Professor Vogelsang - whether investment at the margin is optimal, and hence the costs and benefits of a modest increase or decrease in investment levels might be approximately the same. Our reading of the evidence in relation to this question is that investment should not be assumed to be optimal at the margin, and hence the welfare loss from under investment is likely to be sizeable. This evidence is conceptual, descriptions of decision-making in practice, and anecdotal observations of outcomes.

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63 Commerce Commission (2014), Draft Decision, paragraph X 15.

64 Ingo Vogelsang, "On the economic effects of allowing a WACC above the midpoint." June 12 2014.

65 Commerce Commission (2014), Draft Decision, paragraph X20.3.

6.1.1 Single provider unlikely to set optimal quality for shared service

Economic literature holds that a single provider will, in general, not set the optimal level of quality for a service shared by multiple customers with varying demands for quality. In his seminal paper, Spence (1975) considered market problems that arise when a single provider sets some aspect of product quality as well as price.[66] Spence's conclusion that a lack of information on the nature of demand with multiple consumers may cause quality to be set well below optimal levels has provided a basis for subsequent work, particularly in relation to regulated industries. We summarise some of this literature in Appendix 2.

Spence's basic argument is that prices are unable to convey information about the value attached to quality by inframarginal consumers. He explains that this is true in both regulated and unregulated environments, leading to quality choices that are biased away from the social optimum due to differences between marginal and average valuations of quality by consumers. An example in electricity network industries is that a new connection may lower the average quality received by other users because of the additional congestion; hence decisions at the margin (in this case a new connection) may not reflect the social optimum.

In determining the WACC percentile that best meets the Part 4 purpose statement, it is the social optimum that is most relevant, while the single provider responds to the marginal customer. If consumers, on average, value quality at the margin higher than the marginal consumer, then the single provider sets quality too low. If consumers are price inelastic and price elasticity declines with quality, then quality is undersupplied.[67] These are characteristics of electricity and gas distribution network services.

On this basis, the conceptual analysis presented by Professor Vogelsang at figure 6 of his report likely provides a better conceptual representation of the effects of any under investment, rather than the earlier figures which seem to be relied upon by the Commission. As Professor Vogelsang observes:[68]

> *In this case the welfare loss from not granting ⊿WACC can be sizeable even if the MB curve and the MC are not steep. The reason is that one moves from welfare triangles to welfare rectangles. This means that in case optimal investment cannot be assured through other policies nor through a higher WACC then allowing a higher WACC may nevertheless be advisable.*

6.1.2 Investment decision-making

Descriptions of investment decision-making in practice within electricity distribution businesses seem to support the conceptual conclusions that investment at the margin is unlikely to be optimal (from society's perspective). In our 5 May report we referred to the

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66 Spence A M (1975) *"Monopoly, quality and regulation."* Bell Journal of Economics, The RAND Corporation, vol. 6(2), pages 417-429, Autumn.

67 Berges-Sonnou et al (2003) show that when demand is elastic (i.e. there is less market power), the monopoly may over supply quality, regardless of the relationship between average and marginal valuations of quality. IDEI Working Papers 01/2003 http://idei.fr/doc/wp/2003/monopoly.pdf

68 Vogelsang, June 2014, "On the economic effects of allowing a WACC above the midpoint." para 11, p.17.

2010 statement provided to the Commission by Mr Ryno Verster.[69] Mr Verster's statement included a detailed description of network investment decision-making. Reviewing these decision-making processes through the lens of Professor Volgesang's conceptual framework lends support to the findings from the literature discussed above. The average value of quality for all consumers does not appear to be a driver of major investment decisions in any of the investment categories, though for different reasons. Hence, it would be unlikely that investment at the margin was optimal from society's perspective. In Appendix 3 we provide a summary of the decision-processes described by Mr Verster.

Mr Verster also explained why innovative investments would be among the first to be terminated should there be a major curtailment of capital expenditure. While this may seem short-sighted, Mr Verster explained that from a practical and operational perspective it would be difficult to justify expenditure on benefits that occur in the future when existing asset condition is deteriorating, with a more immediate impact on operations.[70] Moreover, not all the benefits of such expenditure are captured by the electricity distribution business.[71]

Both of these situations give rise to justifications for an uplift of WACC, as explained by Vogelsang, as does lumpy network augmentation.[72]

Hence, the description of investment decision-making in practice accords with the conditions in which Professor Volgesang advises might justify an uplift to the WACC.

6.1.3 Anecdotal evidence of investment at the margin

The anecdotal evidence of the outcomes of investment at the margin is consistent with outcomes that theory and decision-making practice would expect. In our 5 May report we:

- Calculated the impact on consumers of scenarios where investment was deferred. These calculations suggest that the loss to a consumer from a reduction/ deferral in investment increases at a faster rate than expenditure falls. This occurs as the minutes lost are non-linear relative to the avoided expenditure and so the lost benefit (of reliability to customers) increases faster than the expenditure savings.
- Reported the results from a Western Power study on the willingness of its customers to pay for a range of options and the cost of those options. The Western Power examples suggest that, at any point in time, a distribution utility is considering a range of incremental investments which have a potential benefit to consumers in excess of the investment cost. Examples cited in our report would produce benefits to consumers 40% and 30% greater than the cost. This is unsurprising as the constraints in the regulated regimes limit the returns to the utility rather than maximize the benefits to consumers.
- Explained that relatively high net benefit to cost ratios for incremental infrastructure projects are not unusual. In the US PJM markets, for example, transmission projects generally need to show a projected benefit to cost ratio of 1.25:1 to be considered for

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69 Statement of Ryno Verster, Manager of Engineering: Asset Investment for Vector Limited, 23 August 2010.

70 Statement of Ryno Verster, paragraph 6.2.

71 In our 5 May report, we referred to several empirical studies which quantified the benefits to consumers from innovation, and hence the loss if these innovations are delayed by poor regulation, see page 31.

72 Commerce Commission (2014), Draft Decision, paragraph 8.

investment. In New Zealand, road projects used to be financed if the estimated benefit-costs ratio was greater than four to one due to a low funding envelope relative to need.

In a report attached to the submission by Transpower, Castalia provided an analysis of the Wairakei Ring project. The Investment Test estimated the cost for this project at $141 million and net market benefits of almost $500 million in present value terms. This means that the impact of not proceeding with the investment would be to forego $500 million in net benefits to electricity consumers. Castalia estimated that there would only need to be a 4 per cent chance that the project did not proceed with a low WACC to make the payment of the 75th percentile in consumers' interests in this case.

These examples are anecdotal but they are also consistent with accepted conceptual literature and decision-making practice outlined above. None of the submissions or expert reports provided to the Commission provided anecdotal or theoretical support for an alternative proposition - that investment at the margin for New Zealand network companies is currently optimal. None of the reports we reviewed provided empirical evidence that a reduction in investment would not have an asymmetric impact on consumer welfare.

7. Investor multiples

At paragraph X20.1 of the Draft Decision, the Commission states what appears to be a key factor in leading it to the view that the current 75th WACC percentile should be reduced to the 67th percentile:

> *The enterprise values for Powerco and Vector (as implied by AMP Capital's acquisition of a minority stake in Powerco, and Vector's equity market valuation plus net debt), are significantly greater than the corresponding regulatory asset base (RAB) values.[4] This strongly suggests that the allowed rate of return, based on the 75th percentile estimate, is more than sufficient to compensate investors for putting their capital at risk.*

The Commission draws on evidence from the purchase by AMP Capital of a 42% stake in Powerco to estimate the ratio of the enterprise value to the corresponding RAB base (the 'RAB multiple') for Powerco in March 2013 as being of the order of 1.33. It draws on market and analyst evidence to estimate the RAB multiple for Vector in 2013-2014 as being of the order of 1.09 to 1.16. As the Commission's estimates of the RAB multiples for these two companies were greater than 1 it concludes that the WACC based on the 75th percentile is more than sufficient compensation for investors in all the regulated energy businesses.

We set out below a number of reasons for doubting the validity of the Commission's conclusion.

7.1 The RAB multiple for a regulated EDB should be expected to be greater than 1

It is easily shown that the RAB multiple for a regulated EDB should be expected to be greater than 1. Assume that a regulated EDB has perpetual expected constant cash flows, C, and thus the market value of the EDB, V:

$$V = C / w$$

where w is the market's required rate of return.

But, denoting the regulator's estimate of WACC by R, then by definition

$$C = R \times RAB$$

thus

$$V = (R \times RAB) / w$$

and the RAB multiple is therefore:

$$V / RAB = R / w$$

The rate 'w' will reflect market participants' concern to obtain a rate of return commensurate with systematic risk. In principle, investors are indifferent between the return risk combination of one entity and the identical risk return combination of any other entity irrespective of the nature of the business conducted by the entities. Investors are ultimately

concerned with a satisfactory trade-off between return and systematic risk without special regard for the economic, social or other aspects of the business. On the other hand, R, the rate set by the regulator, will in addition reflect concern to ensure that the EDB is incentivised to be efficient (out of concern for consumers) and to invest at a level commensurate with low probability of reduction in quality (or, ultimately, system failure). It must therefore be expected that:

$$R > w$$

and, therefore the RAB multiple:

$$V/RAB > 1$$

The model employed for this conclusion is very simple but there is no reason to expect that additional complexity in the structure and assumptions would change the conclusion.

The argument above focusses on the numerator of the RAB multiple. The expectation that the multiple is greater than 1 is strengthened by the fact that the denominator, the RAB, understates the volume of assets actually necessary to conduct the business but which would be included in the value of the business. Working capital items are excluded and utility companies also dispute the exclusion of purchased goodwill.

7.2 The reasonable margin for the RAB multiple over 1

An indication of the margin for the RAB multiple in excess of 1 can be obtained by further analysis of the simple model employed above. Assume that the market is in complete agreement with the regulator as to the methodology for estimation of WACC and that the market and the regulator arrive at exactly the same point estimate. The market could then be assumed to adopt that point estimate as the value for WACC while the regulator would add an increment, d% of that estimate. Thus the RAB multiple:

$$V / RAB = R / w$$
$$= (w + dw) / w$$
$$= 1+d$$

If the New Zealand market was in complete agreement with the Commerce Commission on methodology and arrived at the same point estimate then for the Commission's current 75th percentile estimate of WACC the increment would be:

$$d = 0.72/6.10$$
$$= 12\%$$

and thus the RAB multiple would be

$$V / RAB = 1.12$$

Anecdotal evidence indicates that in Australia the RAB multiples are commonly around 1.3 and therefore a value of 1.12 suggests that the current increment to WACC is low rather than high.

7.3 The RAB multiple is likely to be highly variable

It is of course unlikely that the market and the regulator would actually agree on the WACC methodology and also arrive at exactly the same point estimate. If the market's point estimate was less than the regulator's point estimate, the difference between the point estimates would be greater than d, and conversely. In addition, the market and the regulator may make different estimates of growth in volume.

Applying again the simple model of paragraph 6.1 above, assume that the market now revises upwards the estimate of C and simultaneously makes a lower estimate of w. The ratio of the revised estimate of value, V_1, to the original estimate, V_0, is:

$$V_1 / V_0 = [(C + \Delta C) / (w - \Delta w)] / (C / w)$$

$$= (1 + \Delta C / C) / (1 - \Delta w / w)$$

This ratio is highly sensitive to changes in C and w. For example, assume that:

$$\Delta C / C = 15\% \text{ and that } \Delta k / w = 10\%$$

Then

$$V_1 / V_0 = 1.28$$

For a given value of the RAB, this change in V translates directly to the same increase in the RAB multiple. Given the uncertainties in prediction of future cash flows and estimation of WACC, these assumed changes in C and w are highly plausible and yet they produce a very significant change in the RAB multiple. Furthermore, the RAB itself is, in principle, well defined but in practical implementation is open to debate in significant respects.

Thus the multiple can vary from change in either or both numerator and denominator. Both types of change could be expected to occur quite frequently and therefore the RAB multiple for any entity is likely to be highly variable over time. Hence an estimate of the multiple for comparison with a benchmark should be based on an average taken over a reasonable period of time rather than at a single point in time or over a short period of time.

7.4 The Commission's evidence is not persuasive.

In the case of the Powerco RAB multiple, the Commission has made the assumption that the price paid by AMP Capital in March 2013 for its 42% stake can be simply scaled up to obtain the market value for 100% of Powerco. The reasonableness of this approach depends on the conditions under which the purchase and sale took place.

In circumstances such as that of AMP Capital's purchase, one obvious possibility that would rule out simple scaling is that the purchaser paid an excessive price. This suggestion is not intended to imply criticism of AMP Capital but simply notes that overpayment is not unusual. The finance literature abounds with evidence of overpayment in the context of acquisitions/mergers. Other possibilities that would rule out simple scaling include there

having been a tax benefit to the purchaser (which should be subtracted from the price paid before scaling up), or that aspects of the business environment provide advantages that are specific to the purchaser and thus give the purchaser a higher expected return than available to other entities, or that the purchase provides a toehold which gives the purchaser access to information that can be utilised in later acquisitions. In any combination of such circumstances for the AMP Capital purchase the total value could not be obtained by simple scaling and the correct RAB multiple would be less than that calculated by the Commission.

The Commission's estimate might be correct, and appropriate if, for example, the price paid reflects a realistic expectation that cash flows will exceed regulated cash flows because of factors such as expected operating efficiencies (partly in response to regulatory incentives) and anticipated value adding growth of revenue from existing customers and new connections; or that there are ongoing differences in tax between Australia and New Zealand that result in a lower effective cost of debt and hence cost of capital. As demonstrated in paragraph 6.3 above, the estimate of V is highly sensitive to the assumptions made on cash flow and cost of capital.

In the case of the Vector RAB multiple, estimation is subject to the complication that Vector has both electricity and gas businesses and, in addition, significant non-regulated business (generating 36% of Vector's total revenue in 2012/13). The Commission deals with this problem by relying on DCF estimates of the values of the components of Vector's business as reported in the Deutsche Bank Market Research report dated 21February 2014. Without intending any criticism of the work done by Deutsche Bank, it does seem quite remarkable that the Commission in determining on the appropriate WACC percentile, a matter which is of crucial importance to the regulated companies, should be content to rely on a single source such as this. Deutsche Bank's production of the information was not intended for application by the Commission, was not subject to any control by the Commission, and there is no public production path available for any third party to examine or question the information. Given the relatively low values of the RAB multiples calculated by the Commission for Vector, the allocation of the value of Vector across the components of the business could have made a significant difference to the estimates.

The Commission estimates the RAB multiples by two methods. Firstly it applied the Deutsche Bank DCF estimates of the value of the components of Vector, as published on 21 February 2014, to arrive at a value of the regulated section of the business and then applied this value to estimated RAB amounts as at June and December 2013. The values obtained for the multiples were similar, viz, 1.13 and 1.11. However, it is hardly reasonable to assume that the value of the business remained constant across the June and December dates and, in any case, while the date of Deutsche Bank's estimate of value was not stated it presumably applied as at the date of publication and therefore it is not strictly applicable to either of the dates of the estimated RAB amounts. Furthermore, the estimated RAB amounts are not actual RAB amounts but amounts obtained by (i) assuming constant depreciation across 2013 and 2014, (ii) estimation of revaluations for the gas business on the basis of revaluation for the electricity business, and finally (iii) linear interpolation between opening and closing March year amounts for electricity and June year amounts for gas.

The second method used by the Commission started with share market estimates of the value of the equity of the total business as at June and December 2013 but, for each date, the value of the regulated section of the business was then estimated using the book value of net debt as an estimate of the market value of debt together with the February 2014 estimate of

the value of the unregulated components of the business. Division of the estimates of the value of the regulated section of the business by the RAB amounts (same estimates as described above) resulted in values of 1.16 and 1.09 as the multiples.

The methods used by the Commission to estimate the RAB multiples for Vector thus involve use of external analyst information not produced for the Commission, use of DCF based estimates of market value, use of book value for net debt, estimates of RAB amounts, all coupled with temporal inconsistencies across the various elements entering the estimations. The methods used to estimate the multiples thus suffer from significant deficiencies and hence leave open to question the significance that should be attached to the values obtained by the Commission. ..

As noted above, RAB multiples are likely to be highly variable over time and therefore it seems unreasonable to attach much significance to the Powerco RAB multiple based on the single point in time of the AMP transaction. For Vector there is continuing market evidence on the enterprise value of the company but the Commission's estimates of the RAB multiple are based on just two points in time, June and December 2013. In that regard it should be noted that had the Commission relied on the DCF estimates of value reported in the Deutsche Bank Market Research report dated 10 February 2014, less than two weeks before the 21 February 2014 report, the values for the multiples would have been 4 to 5 point lower at 1.08, 1.06 by the first method and 1.12 and 1.05 by the second method.

The Commission could have estimated the RAB multiple for Horizon, the other listed EDB. However, while it was obvious that the RAB multiple for Horizon was less than 1, the Commission chose not to include this evidence in the base for its Draft Decision, because the company is infrequently traded and has a small share of the market. However, this could be seen as being inappropriately selective. The Commission did include PWC's (low) estimate of the cost of capital for Horizon in Figure B1 (page 107) which was intended to show that the Commission's proposed 67th percentile estimate of WACC meets the reasonableness test.

7.5 No support for extrapolating from Powerco and Vector to the whole sector

In footnote 4 of the Draft Decision, the Commission notes that Powerco and Vector together comprise 40.7% of the total RAB for EDBs. However, even if the Commission's estimates of the RAB multiples for Powerco and Vector were reliable and indicative of a higher than reasonable rate of return for these companies, should the Commission generalise to this same condition holding for all the other regulated energy businesses? Given that the other companies differ at least in terms of size, which has likely implications for unit costs and for cost of capital (ignored by the Commission) this generalisation should only be made if the Commission could provide convincing support for it. The draft decision does not provide any such support.

8. Reasonableness tests

The Draft Decision includes checks that the proposed 67th percentile WACC meets the Commission's notion of reasonable correspondence with certain benchmarks. In doing so the Commission gives greatest weight to comparison with relevant independent estimates of cost of capital. In this regard, the Commission makes comparison of its 67th and 75th percentile estimates of WACC for regulated energy businesses, currently 6.57% and 6.72% respectively, with estimates of the cost of capital for:

1. Transpower, by Forsyth Barr, First NZ Capital. and Northington Partners
2. Vector, by Forsyth Barr, First NZ Capital. Deutsche Bank, Goldman Sachs, UDC, and PWC
3. Horizon, by PWC.

The estimates for Transpower by Forsyth Barr and First NZ Capital were made in November 2011 and by Northington Partners in November 2013. The estimates by PWC for Horizon and Vector were made in December 2013 and published in the June 2014 issue of *Appreciating Value*. The other estimates for Vector were obtained by the Commission from a telephone survey of the firms in mid June 2014 on their current estimate of WACC. It would seem to be highly unacceptable that the Commission has relied on evidence obtained from a telephone survey. There is no trail for third parties to examine and there is no assurance that the response obtained was in fact a representative view of the firm surveyed.

In making the comparisons the Commission first 'standardises' the independent estimates by adjusting for the after tax effect of the difference between the risk free rate used in the independent estimates and the Commission's own current estimate of the risk free rate (4.21%). This adjustment draws on restatement of WACC from a weighted average of the cost of equity (using the after tax form of the CAPM), and the cost of debt to an expression involving the basic elements making up WACC (as shown in our 5 May 2014 report):

$$WACC = (R_f + pL)(1-t) + \phi\beta_e(1-L)$$

where R_f = risk free rate

β_e = the equity beta

L = leverage ratio

t = assumed common personal and corporate tax rates

p = debt premium

ϕ = market risk premium

From this expression for WACC it appears that that if the risk free rate changes by ΔR_f then the impact on WACC is simply:

$$\Delta R_f (1-t)$$

However, this conclusion is clearly only valid if there is no consequential change in p and ϕ. While the relationship between R_f and p is not specified, the after tax form of the CAPM does specify that:

$$\phi = k_m - R_f (1-t)$$

where k_m = the expected rate of return on the market portfolio

Thus a change in R_f should at least impact on ϕ. Some firms, for example, Forsyth Barr, do change their estimate of the market risk premium whenever their estimate of the risk free rate changes. However, some other firms, as a practical matter, do not always change their estimate of the market risk premium.

Thus in standardising the independent estimates of WACC, the Commission should have checked the approach taken by each of the firms in respect of the market risk premium. The Commission did not do so. Furthermore not all the firms use the after tax form of the CAPM to estimate the cost of equity. For example, Deutsche Bank uses the Officer form of the CAPM. In that case, when the risk free rate changes, the adjustment stated above does not apply. The Commission did not check for differences in the form of the CAPM used to estimate the cost of equity.

More importantly, the 'standardisation' should only have been to transform the different estimates to the same point in time. Thus, for example, standardising First New Zealand Capital's estimate of the cost of capital for Transpower, made in November 2011, should have been adjusted for changes that the firm would have made in updating its estimate. Thus, even just in respect of the risk free rate, there should have been an adjustment to the estimate that the firm would have made in June 2014. Similarly for the other firms. Instead, the Commission adjusted the risk free rate estimates of the firms to the estimate of the risk free rate adopted by the Commission.

The result of doing so is to produce a fruit salad style estimate of the cost of capital which is not an estimate that would be adopted by the Commission or by the firm concerned. The Commission's 'standardisation' ignores the fact that the parameter estimates adopted by any entity estimating WACC are a package and that often the resulting estimate of WACC is made subject to a reasonableness test. Thus, changing the value of one parameter in a set of parameter values adopted by one entity, to a different value for that parameter used by some other entity, results in an estimate of WACC that is not an estimate that either of the entities would apply. Accepting that view, the Commission should not have made any adjustment to the WACC estimates for Vector that it obtained from the telephone survey.

Table 3 below shows the Commission's standardised version of the independent estimates of WACC for Transpower, Vector and Horizon, together with the correct independent estimates made by the firms as at June 2014.

Table 6 Independent estimates of WACC

		Current Estimate	
	Original	**Commission**	**Correct**
Transpower			
Forsyth Barr	7.24	5.95	6.97
First NZ Capital	7.60	6.89	7.46
Northington Partners	7.00	6.61	N/A
Vector			
Forsyth Barr	8.11	7.18	8.11
First NZ Capital	7.18	6.61	7.18
Deutsch Bank	7.20	6.70	7.20
Goldman Sachs	7.70	6.41	7.70
UBS	6.98	6.77	6.98
PWC	6.60	6.03	6.60
Horizon			
PWC	6.90	6.33	6.90

Comparison of the correct independent estimates with the Commission's IM estimates shows that all of the independent estimates exceed the Commission's proposed IM 67th percentile estimate of 6.57% and that all the independent estimates other than the PWC estimate for Vector exceed the Commission's current 75th percentile estimate of 6.82%. Thus, contrary to the Commission's conclusion that comparison with independent estimates supports a move from the current 75th percentile to the 67th percentile, a properly based comparison actually suggests that the move should be to a higher percentile than the current 75th percentile.

Appendix 1 : Probabilities of loss

Oxera		
Percentile	P(x<W-0.5)	P(x>W+0.5)
50%	32.01%	32.01%
55%	27.66%	36.63%
60%	23.56%	41.53%
65%	19.69%	46.73%
67%	18.21%	48.91%
70%	16.07%	52.28%
75%	12.68%	58.21%
80%	9.53%	64.59%
85%	6.63%	71.54%
90%	4.02%	79.23%
95%	1.73%	88.05%
Corrected for additional variability		
Percentile	P(Y<W-0.5)	P(Y>W+0.5)
50%	33.37%	33.37%
55%	29.49%	38.39%
60%	25.97%	43.40%
65%	22.77%	48.38%
67%	21.56%	50.37%
70%	19.82%	53.36%
75%	17.07%	58.35%
80%	14.48%	63.43%
85%	11.98%	68.68%
90%	9.49%	74.31%
95%	6.80%	80.88%

Appendix 2 : Optimality of current investment levels – some key insights from the literature

Table 7 Summary of relevant themes

Reference	Area	Relevant theme/s
Clements M (1998) *"Quality of Service and Market Implications of Asymmetric Standards."* National Regulatory Research Institute, NRRI 98-24 (October).	Telecommunications	• Competitive markets may distort quality (i.e. away from the social optimum) due to information asymmetries; regulated environments are unlikely to change this outcome. • The divergence of quality from the socially optimal level depends on the elasticity of demand and the deviation between average and marginal consumer value for quality. • Relevant literature concludes that price-cap regulation would result in a degradation of quality; rate-of-return regulation's influence on quality is ambiguous (i.e. the single provider may be induced to supply a level of transmission quality more consistent with social welfare maximisation), but would likely under supply non-capital dependent quality.
Hazelett T (1995) "Rate Regulation and the Quality of Cable Television" chapter 7 in *Quality and Reliability of telecommunications Infrastructure,* ed William Lehr. Mahwah, NJ: Lawrence Erlbaum Associates, cited in Clements (1998).	Cable television	• In the face of price restraints, cable television firms simply transferred services from regulated to unregulated baskets. Thus, the overall quality of price regulated services declined.
Crawford G S and Shum M (2007) "Monopoly Quality Degradation and Regulation in Cable Television." *Journal of Law and Economics, 50: 181-219*	Cable television	• Due to inability of a single provider to fully discriminate regarding product quality, quality for all but consumers with the highest tastes for quality is distorted downwards.

Reference	Area	Relevant theme/s
Gomez-Lobo (2014) "Monopoly, Subsidies and the Mohring Effect: a Synthesis and Extension." Transport reviews: A Transactional and Transdisciplinary Journal, 34 (3), pp.297-315.	Public transport	• Analysis of public transport provision and the role of subsidies in respect of quality of service (expressed as frequency of services) are just special cases of Spence (1975) with small adjustments for cost structure and demand characteristics. • Where services are provided by a "regulated monopoly" or through "a regulated competition" model, single operators provide quality that is below the social optimum.
Zenger H (2006) "The Optimal Regulation of Product Quality under Monopoly." *Economic Bulletin, 12 (13),*	General	• It has long been known that the provision of product quality under monopoly is distorted away from the social optimum even if quality is observable. A monopolist chooses the level of quality that suits the marginal consumer, while a social planner takes the valuations of all consumers into account. To the extent that inframarginal consumers have a higher (lower) valuation for quality than marginal consumers, a monopolist provides too little (too much) quality, given the size of demand.

Appendix 3 : Drivers of investment decisions

8.1.1 Network performance key factor in investment needs

For utilities like an EDB, investment decisions are based on something of a hierarchy of requirements. EDBs investment decisions are influenced by three high level dimensions of network performance, which are governed by both internal and external (i.e. Commerce Commission) standards:[73]

- *Reliability of supply* – relates to the adequacy and security of supply at any point in time. Implicit in this is the continuity of supply, characterized by the volume and duration of supply interruptions.
- *Commercial quality of supply* – relates to the nature and quality of customer service provided to electricity customers and is directly associated with the transactions between utilities and customers.
- *Voltage quality* – relates to a wide range of disturbances in power systems in terms of characteristics of supply voltage – magnitude, frequency, waveform and phase symmetry.

8.1.2 Five investment categories

There are five broad categories of network investment, each with a differing relationship to regulated revenue.

Table 8 Investment categories

Category	Components	Relationship to regulated revenue
Network Growth	New customer connections; increased consumption by existing customers	New connections largely unaffected (as cost recovered directly), though possibility exists that new connections could be curtailed Capacity investments are re-couped through general means and hence are directly affected.

[73] Statement of Ryno Verster, Manager of Engineering: Asset Investment for Vector Limited, 23 August 2010, paragraph 2.1 and paras 2.12-2.16.

Category	Components	Relationship to regulated revenue
Network Integrity	Asset maintenance and replacement; safety and reliability investments	Directly affected, as cost recovery through general means
New technology and innovation	Technology included in the network as well as connected to the network	Likely to be discontinued first if investment curtailed, as less important relative to safety, reliability, and security of supply needs
Relocations	Various. Assets are required by statute and agreement to be relocated.	No relationship - non-discretionary
Undergrounding	Auckland overhead network being placed underground	No relationship – required by major shareholder

Source: Statement of Ryno Verster, 2010

8.1.3 Quality does not drive investment decisions

The average value of quality for all consumers does not appear to be a driver of major investment decisions in any of the investment categories, though for different reasons. The major asset-based network integrity investments (i.e. renewal, reliability and safety) are network-generated (i.e. not required by specific customers).[74] Moreover, they are based on technical assessments of the condition of assets, with industry-wide standards also providing secondary guidance. Asset replacement is limited to situations where the asset:[75]

- would become unsafe to the public or operators
- no longer meet required technical considerations
- performance has an excessive negative impact on network performance
- has failed
- has become obsolete and can no longer be economically maintained or refurbished.

In the case of growth investments, again the use of broad standards drives decisions. Mass market customer connections are installed at the request of the customer or developer, and are generally designed to Vector's basic technical, reliability and capacity standards.[76]

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74 Statement of Ryno Verster, paragraph 5.4

75 Statement of Ryno Verster, p.18.

76 Statement of Ryno Verster, paragraph 4.4.

While Vector may supply to a customer or developer features or capacity in excess of Vector's standards, there are two limbs to this (very rare) decision test. The first is that Vector is adequately compensated, which is not always possible. The second is that network configuration must allow for higher standards (e.g. in the case of remote parts of the network it would not be possible to provide security and reliability at levels that are similar to more densely populated areas).[77] Network reinforcement investment decisions are driven largely by network security standards, which are again technical in nature.

[77] Ibid, paragraph 4.6 and footnote 27.