Review of expert submissions of the input methodologies

Prepared for
New Zealand Commerce Commission

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Contents

Executive summary

This report provides additional evidence to the Commerce Commission in respect of the choice of percentile for the weighted average cost of capital (WACC) to be applied in regulatory reviews, with specific reference to the current reviews in the electricity sector.

In June, Oxera produced a report for the Commission recommending that it consider evidence on the potential economic cost of severe outages as a measure for the benefit that it is seeking to achieve by setting the WACC above its best estimate of the midpoint of the range.

The thought process which we set out for the Commission was to define the 'problem' which it is seeking to address through the choice of the WACC. In principle, it is seeking to avert an 'under-investment problem', which could arise as follows.

Step 1: Why would there be under-investment?

- The WACC cannot be determined with certainty.
- In addition, there may be financial incentives under the regulatory regime to reduce or defer investment.
- There are limitations on the ability of performance measures to provide incentives for investment.
- There is therefore a risk that the optimal level of investment for the firm is lower than that which is socially desirable, and may not be consistent with the aims of the Commission under Part 4.

Step 2: Why would under-investment be a problem?

- From one perspective, less investment means lower costs to consumers.
- However, it can be assumed that 'under-investment' is relative to a baseline which has been determined to be optimal.
- It can therefore be assumed that under-investment will have a net cost to consumers, through lower service performance or greater whole-life costs than considered optimal.
- The impact needs to be considered over multiple periods. In general, the 'under-investment problem' is likely to have greatest impact in the medium term, and therefore the level of investment will lead to an under-investment problem only if it persists over time.

Step 3: What is the role of the WACC?

In setting price controls, the role of the WACC is to ensure that investments in the network earn a return associated with the risks taken in making those investments.

The WACC is an average figure, and is intended to ensure a fair return across the life of the assets. The risk associated with the cost of the investment will be at the initial construction phase of the investment, beyond which risks are related to the operation of the assets. A core aim of developing a framework for the WACC is to ensure that there is a consistent approach to the returns over the life of the assets.

However, in that sense, the WACC is something of a 'blunt instrument'. It provides incentives for new investment, but also rewards existing investment. Therefore it is important that the WACC continues to be linked to the average returns required across the asset base over the lifetime of the asset. We noted in our report that the role of the WACC in promoting investment would be most relevant where:

- there is a material asymmetric risk if the under-investment problem were to be realised. As such, the choice of a percentile above the 50th is likely to be appropriate if choosing a higher percentile reduces the under-investment problem;
- any under-investment problem is likely to relate to medium-term expectations around investment returns over the lifetime of the asset. As such, an approach that provides medium-term certainty would be more likely to resolve such an under-investment problem than one that sets a premium on a case-by-case basis for each review period;
- applying a premium to new investment only, or reassessing the premium to reflect the investment risk in each period, is therefore less likely to provide sufficient certainty of returns, but may well introduce unnecessary complexity.

Oxera's assessment—the role of the WACC

In the context of the submissions made to the Commission, and the comments about the role of the WACC, we would stress the following points:

- the WACC may not be the most effective mechanism for promoting unusual forms of investment, such as true innovation, given that, in traditional network assets, any premium would also need to be applied to the significant majority of the capital base;
- the choice of a WACC percentile away from the 50th percentile is not designed to promote over-investment, but to offset the risk of under-investment. At the percentiles proposed by Oxera (and the Commission), we would expect that any difference between the incremental costs and benefits of the additional investment which may result from the choice of percentile would be relatively small, and should not have a material effect on the Commission's decision;
- there are limitations on the extent to which any evidence can identify the 'correct' WACC. However, the evidence that exists can provide additional support to the Commission in informing its judgment;
- it should not be necessary to set the percentile at a level based on the potential of the most severe impacts from under-investment, as there is potential flexibility within the wider regulatory framework to help manage such risks that should arise only across multiple periods.

Based on our review of submissions, within the scope of issues covered by our report, we consider that the 60th to 70th percentile remains a suitable focal point for the Commission in coming to its view on the WACC.

We recognise that it is then for the Commission to consider whether any of the effects that we have not reflected within our framework, such as giving greater weight to total welfare, should be taken into consideration in its final decision.

1 Introduction

Following the publication of Oxera's report on the review of the appropriate percentile for setting the cost of capital for gas and electricity services,[1] the New Zealand Commerce Commission (NZCC) received a number of expert submissions from companies and experts. These raised points about the appropriateness of Oxera's methodology in determining a range for the percentile, and consequently concerns around the appropriate choice of percentile within the Commission's consultation, to the extent that the Commission drew on our approach.

The submissions that explicitly responded to Oxera's approach are listed below.

Table 1.1 Expert submissions received by the Commission that addressed Oxera's approach

S.No.	Submitting body	Title
1.	Board of Airline Representatives New Zealand	Submission on proposed amendment to the WACC percentile for energy businesses
2.	Competition Economists Group	Economic Review of Draft Decision on the WACC Percentile: A report for NZ Airports
3.	HoustonKemp Economists	Comment on the Commerce Commission's Proposed WACC Percentile Amendment
4.	Incenta Economics Consulting	Rationale for setting the regulatory WACC above the midpoint value–Response to Draft Decision
5.	NZ Airports	Submission on Commerce Commission's proposed amendment to the WACC percentile for electricity lines services and gas pipeline services
6.	NZIER	Changing the WACC percentile: Advice to MEUG regarding Commerce Commission proposal to amend the regulatory WACC for electricity line & gas pipeline services
7.	Powerco	Proposed amendment to the WACC percentile for electricity lines services and gas pipeline services
8.	Vector	Submission on Draft Determination to amend the WACC percentile
9.	AMP Capital	Submission to Commerce Commission on proposed amendment to the WACC percentile for electricity lines services and gas pipeline services
10.	Sapere	Proposed amendment to the WACC percentile–Commerce Commission's draft decision
11.	PwC	Submission to the Commerce Commission on Proposed amendment to the WACC percentile for electricity lines services and gas pipeline services
12.	Frontier Economics	Application of a loss function simulation model to New Zealand

Note: Direct submissions have also been received from a range of companies. Where not stated above, we considered the points raised in these submissions.

In addition, the Commission received a number of cross-submissions. While there is a range of submissions that comment on the approach taken by Oxera, we comment in particular on the three submissions below.

[1] Oxera (2014), 'Review of the beta and gearing for UCLL and UBA services', 23 June.

S.No.	Submitting body	Title
1.	Covec	Cross Submission on WACC Percentile Issues
2.	NZIER	The WACC uplift question A brief review of the balance between intuition and evidence supporting the WACC uplift
3.	Vector	Amendment to the WACC percentile cross-submission

Oxera has reviewed these submissions and the concerns raised by the various experts. The expert submissions can be categorised into three main challenges to Oxera's approach.

- **Challenges to the assumptions** used in calibrating Oxera's analysis. One challenge made repeatedly is that Oxera should have applied (or given more weight to) a total welfare approach, rather than a consumer welfare approach. Other comments on the assumptions covered, for example, the estimated size of the impact of under-investment.
- **Challenges to the interpretation of Oxera's data**. Our approach was to identify data that we considered would support the Commission in selecting a percentile. Respondents disagreed with how we interpreted that data. In particular, many argued that we should have given more weight to data that would have indicated a higher percentile.
- **Suggestions for alternative approaches**. Frontier for Transpower proposed a version of Dobbs' model that would have resulted in a higher percentile. Other respondents proposed some alternatives for assessing the percentile, including a proposal to give more weight to the potential for innovation. However, most of the comments relating to our approach were in the form of criticisms of the interpretation, rather than of the model itself.

This review of the expert submissions is structured as follows.

- Section 2 summarises Oxera's assumptions and the submissions received.
- Sections 3, 4, and 5 review in detail the responses under the three categories listed above.
- Section 6 considers other points raised in the submissions.

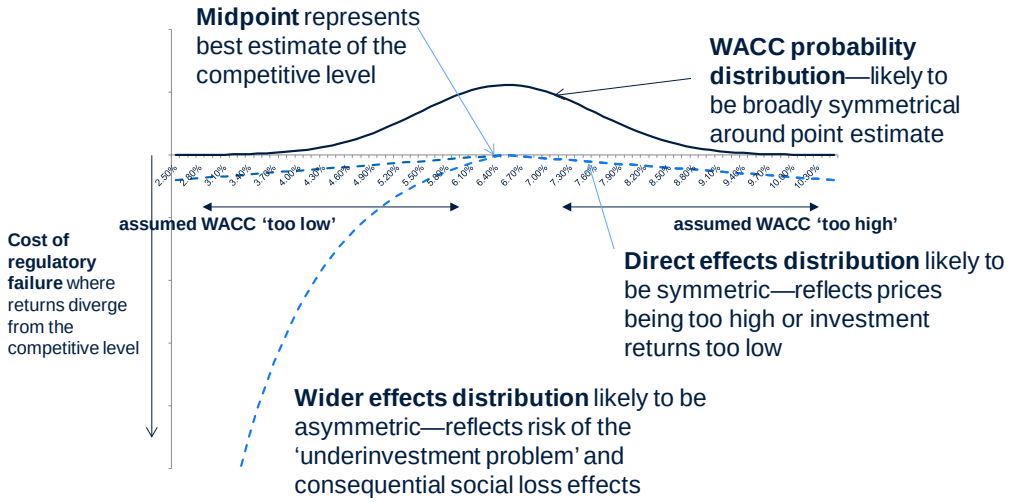
2 Overview of Oxera's assessment of submissions

This section summarises the responses submitted, gives an overview of Oxera's assessment of those submissions, and summarises Oxera's revised assessment on the appropriate approach for the Commission to take.

2.1 Oxera's approach

In designing a model, Oxera created a simplified version of Dobbs' model in order to develop a quantitative form of cost–benefit analysis. This was illustrated in Figure 2.1 in Oxera's report (reproduced below).

Figure 2.1 Potential asymmetric risks of regulatory failure



Source: Oxera.

The main concerns raised about this approach are summarised in Table 2.1, together with Oxera's high-level analysis of those responses.

Table 2.1 Summary of challenges made by experts to Oxera's assumptions in its report

Oxera's assumption	Alternative proposal	Revised assessment
The costs and benefits should be measured using an approach which gives most weight to consumer welfare	Oxera should have used a total welfare approach (or an approach which gives significantly greater weight to total welfare), such as that supported by Dobbs (2011), and the Lally (2014) report for the Commission	A total welfare approach to setting the WACC would be at odds with the intention of RAB/WACC regulation, which is to assume benchmark returns consistent with competitive market outcomes (i.e. where the relevant WACC is a suitable benchmark for assumed returns). Where it is appropriate to diverge from the consumer welfare approach, this would in general be specified in the regulators' duties. In the case of the IMs, such divergence relates to the need to provide incentives to invest, which may result in more investment than would be made in competitive markets. Such an outcome may be appropriate if the regulator considers that the additional investment is consistent with its wider objectives, including longer-term benefits to users of the network. However, this does not imply a total welfare approach; rather, it suggests that there the WACC may need to be adjusted to reflect asymmetric loss effects associated with under-investment. This is the approach taken in Oxera's initial report, and is consistent with the aims of the Commission and its experts in its initial approach of deriving the 75th percentile.
Focus on reliability, not innovation	Oxera should have considered innovation explicitly	Our assessment remains that the more proportionate approach is to focus on reliability, and that, to the extent that this results in a percentile above the 50th, this will also promote innovation. If there is a need for explicit ex ante promotion of innovation, this would arguably be better through specific incentives rather than a general uplift on all assets. The more the Commission believes that innovation is the primary driver of investment for a particular network operator, the more it may be proportionate to consider either an adjustment or the introduction of a targeted mechanism for funding investment in innovation**.** However, the assessment of the evidence provided by respondents suggests that the risks of undermining 'true innovation' are moderate.
Assessment of the WACC is based on a calculation of annual benefits and costs	Oxera should have considered a multi-year analysis	While a multi-year analysis has merits, in the context of the approach applied by the Commission and developed in the Oxera report, we do not consider that this would result in a 'better' outcome. The WACC is in practice applied as part of each year's allowed returns within a regulatory period. Under our assumptions, the use of a multi-year analysis would then increase both the costs and the benefits of additional investment, and would be unlikely to change the choice of the appropriate percentile.
The costs of over-investment were excluded from the analysis as these were assumed to be of second order to the costs and benefits included	The costs associated with over-investment may be material (consistent with a comment by Professor Vogelsang)	Professor Vogelsang's argument on the additional costs associated with over-investment is correct, but his assessment does not explicitly consider the associated benefits. The implication of the RAB regulatory model is that additional investment has benefits for customers. In practice, our assessment is that any net effects would be small, as additional investment is most likely to result in either lower investment in future, or, in the case of innovation investment, in wider externalities/benefits for users.

Oxera's assumption	Alternative proposal	Revised assessment
Oxera's assumptions are unproven (or inappropriate)	Oxera should have identified better evidence for the levels of risk	A number of the responses argue that individual assumptions could not be accurately specified. However, the intention was to identify a suitable framework for the Commission. Unlike technical models, such as Dobbs'/Frontier's, our approach explicitly recognises that to complete the analysis in full requires certain assumptions that are subject to fundamental uncertainty. Our aim was to go as far as we could in supporting the Commission, without suggesting that a full analysis is feasible. Our assessment is that the challenges from respondents do not present a 'better' framework. In some cases, they are arguing that the Commission should give less weight to the evidence that does exist, which appears to imply giving more weight to 'guessing' the answer. In other cases, the recommendation is to give different weight to certain parts of the evidence, which would result in a higher percentile. Our recommendation was that while judgement is still needed, the understanding provided by Oxera's framework of the scale of the key inputs would support the Commission in reaching a view on the appropriate percentile.
Oxera's evidence came to the wrong answer	Oxera should have given more weight to the higher end of the range on the size of a potential event (NZ$1bn–NZ$3bn)	Our judgement, as stated, was that the 60th–70th percentile gave sufficient comfort that there would not be an under-investment problem, and that a higher percentile appeared to give 'too much' weight to protection against under-investment. We considered that the upper end of the range for the size of an event was sufficiently unlikely that this would tend towards overcompensation of investors. This was based on clearly stated judgement and assumptions. The Commission chose to give some weight to our judgement, and some to its own, in coming to the 67th percentile.
Oxera used the wrong standard error and the wrong probability of loss	Oxera got its calculations wrong (by using the Commission's numbers). Oxera wrongly calculated the expected loss (Sapere)	Our analysis clearly stated that we took the Commission's SE as an input assumption. We have not seen any evidence that the Commission calculates the SE in a way that could not be applied in the percentile assessment. Sapere's response on expected loss misinterprets the intention of the expected loss calculation. Our assessment is that the alternative approach proposed by Sapere would be less consistent with calculating the appropriate size of a premium paid on all investment in the RAB across time.

Note: [1] Oxera (2014), 'Input Methodologies: Review of the "75th percentile" approach', prepared for the New Zealand Commerce Commission, 23 June.

Source: Oxera analysis, based on submissions in response to the Commission's call for responses.

2.2 Oxera's revised assessment

Oxera's initial assessment, stated in section 7 of our report, was as follows:

> Given the specific circumstances of electricity transmission and distribution, some recognition of the need for investment is likely to be appropriate in setting the WACC. Based on the Commission's approach, and considering the specific need for investment in electricity distribution and transmission, a point estimate around the 60th to 70th percentile appears to provide a suitable balance between the costs and benefits of the approach of setting a higher percentile in mitigating the risks associated with the under-investment problem, and should therefore achieve the intended benefits of the WACC percentile approach.
>
> An 80th percentile approach would be more conservative, and would imply that customers are paying as much for protection within a seven-year IM period as our analysis indicates could be the potential annualised cost of material outages. Given that the Commission has other regulatory measures in place to offset the risk of under-investment, and is strengthening these measures, this appears to be a potentially excessive level of protection.
>
> We would expect the exact choice of a percentile by the Commission to reflect these considerations, and the Commission's view on the desirability of taking into account other factors that are not explicitly reflected in the current approach to defining the percentile, but which might nevertheless point to a cautious approach in setting the percentile either high or low. These could include, as an example, the risks not currently reflected within the percentile, such as the risk of model error or the incremental risks within regulatory periods around parameters such as the risk-free rate.

In the submissions on behalf of companies, a number of arguments were put forward on what would drive a higher percentile. We find that, in most cases, submissions provide an alternative case to the Commission for interpretation of the evidence. We do not consider that these submissions provide additional evidence in favour of their alternative approaches that would reduce the role of judgment for the Commission in coming to its view.

- A number of submissions appear to suggest that there are errors in the Oxera analysis and that a 'corrected' version would provide a different (and, generally, higher) percentile. In practice, all of these suggestions are based around giving more weight to different sources of evidence (for example, different weights on the use of consumer and total welfare standards) that would point to a different choice of percentile. They are not errors as such, but differences in interpretation of the data.

- A number of submissions also suggest that the Oxera analysis is insufficiently well-developed to support the Commission in reaching a view on the appropriate percentile. However, none of these submissions provides an alternative methodology that would reduce the uncertainty in the assessment. The alternative methodology proposed by Frontier is also subject to major uncertainty, and the sources of that uncertainty are less transparent. We continue to consider that it would be better for the Commission to base its determination on the evidence that does exist than to rely on 'guesswork', especially given the fundamental uncertainty surrounding the key relationships within the loss function.

- Submissions that discuss the impact of a severe event agreed, in general, that our range was suitable, although they did not all agree with our interpretation; namely, that the low end of the range should be given most weight. The submissions also highlighted reasons why the level applied by Oxera might overstate the relevant impact on users, since it was on a GDP effect.

- We continue to conclude that, at the proposed percentile levels (around the 60th to the 70th), the impacts of over-investment and innovation will be secondary to the primary effects considered in our report. The examples provided do not appear to support a change to the choice of percentile.

Our review of the submissions suggests that the primary sources of evidence remain the same as they were at the Draft Determination. The key decision for the Commission remains as to the best way to interpret that evidence. In our initial report, discussed above, we concluded that the appropriate percentile would be likely to be in the 60th to 70th percentile range.

The submissions argue for either a higher or lower range. A lower range would be identified if:

- the investment made by the companies is not directly related to the reliability and outage effects that drive asymmetric risks. Our assessment of the responses is that, while not all investments are designed to ensure network reliability and resilience, a material proportion relate to a range of types of such investment in the network. This proportion appears to be sufficiently large that it will not be practical to separate and treat other forms of investment separately. The Commission could in future consider differential forms of regulation for reactive investment which does not justify a premium, but this would result in additional complications;

- the companies are already likely to invest heavily at the 50th percentile, the 60th to 70th percentile drives material additional investment with benefits well below the costs, and there is limited ability for the regulator to respond; or

- the downside risks are overstated, either because they are lower in New Zealand or because GDP is not an appropriate measure.

By contrast, a higher range could be identified if:

- there is a material shortfall in ‘true innovation’, this cannot be offset elsewhere within the regulatory regime, and there is evidence that the choice of WACC is an influencing factor within this shortfall; or

- it is more appropriate to give weight to the higher estimates of the impact identified in studies of the potential costs of outages and other forms of service failure, in particular where the Commission has no other mechanism to address severe and prolonged under-investment.

Overall, we continue to consider that the 60th to 70th best balances these effects. We recognise that this gives limited weight to the top end of the range of severe events. Our assessment was that extreme under-investment can be mitigated elsewhere in the regime. We acknowledge that some weight could be given to the risk of such more material events of over NZ$1 billion, but do not consider that this would be consistent with the main intention of the WACC adjustment.

We also acknowledge that not all the impact of such events should necessarily be mitigated through the WACC, where any impact from the events is not directly felt by users of the network. We continue to conclude that the Commission should give most weight to the impact of a NZ$1 billion event, on the basis that this reflects the most appropriate balance on what can be realistically at risk in a single period, given the IMs more generally.

There does appear to be a greater risk of over-investment under the distribution (EDB) regime than for Transpower. While this could indicate a stronger argument to mitigate the RAB premium, it may be offset by the greater uncertainty under this regime, which makes it harder to apply other mechanisms to under-investment.

Our assessment remains that the impact of 'true innovation' and over-investment will be relatively small at this level. Investment should be close to optimal levels, and true innovation is limited. We recognise that, at other percentiles, these effects could be more material, and potentially should be included in the assessment, which arguably strengthens our conclusion.

We also note Professor Vogelsang's point that even optimal investment above the 50th percentile may have an impact on our analysis, to the extent that long-term benefits are already reflected in our analysis. This represents another argument for caution against a higher percentile, but we would not expect it to be a material effect around the 60th to 70th percentile.

In the remainder of this report, we provide greater detail on our assessment of the challenges to our report, and our review of those responses.

3 The appropriate welfare standard

- Many respondents argued for greater weight to be given to a total welfare approach, such as that recommended in the original Dobbs (2011) paper.
- The choice of welfare standard in setting regulation is ultimately a policy decision for the Commission (and in setting the supporting legal framework).
- However, in making the WACC assumption within any regulatory framework, the aim is to estimate the benchmark return to provide incentives to invest relative to alternative markets with comparable risks.
- It therefore seems most appropriate for the starting point of any WACC assessment to be an estimate of the level which investors in competitive markets would apply, consistent with the approach of Oxera's framework.

3.1 Oxera's approach

In assessing the impact of using a higher percentile of the WACC range, an assumption has to be made about the relative value of consumer and producer surpluses. In our report, we defined the welfare function as $TW = \alpha CS + (1-\alpha)PS$, where TW is total welfare, CS is the consumer surplus, PS is the producer surplus and α is the weight that society gives to each of these surpluses.

Since the deadweight welfare loss that is expected to arise from using a higher WACC percentile is relatively small, differing assumptions about the extent to which a transfer of wealth from consumers to producers is deemed to be a welfare loss (i.e. the value assigned to α) will have a fundamental impact on the estimated costs of such an increase. The choice of welfare standard is therefore particularly important in this case.

Our report included a discussion of the choice of welfare standard and the potential impact of adopting a different assumption.

> The direct price effect results in a transfer of wealth from end-users to investors in the transmission and distribution companies. This could be considered a redistribution of wealth as opposed to an overall welfare loss, particularly where, as with Transpower, the business is not privately owned. However, to the extent that one of the aims of the Commission in designing regulation is to protect end-users from overpricing, the transfer of wealth away from consumers could still be seen to be a welfare loss within the Commerce Commission's considerations.[2]

We recognised that there were potentially competing arguments, and stated that:

> The consumer welfare approach is... a conservative approach to assessing the impact of a WACC uplift, and thus a lower estimate [of the costs of increasing the WACC percentile] could be provided if a different approach were taken.[3]

However, we ultimately adopted a consumer welfare approach (with α=1) as being that which is most consistent with the aims of setting a WACC within the regulatory model. At the same time, the approach to defining the social loss function (illustrated in Figure 2.1 above) implies that the choice of WACC is giving weight to factors other than a pure consumer surplus approach.

[2] Oxera (2014), 'Input Methodologies: Review of the "75th percentile" approach', prepared for the New Zealand Commerce Commission, 23 June, p. 29.
[3] Oxera (2014), 'Input Methodologies: Review of the "75th percentile" approach', prepared for the New Zealand Commerce Commission, 23 June, section 4, Box 4.1, p. 29.

Specifically. the choice of WACC reflects the need to provide incentives to invest.

3.2 Summary of submissions

A number of submissions commented on Oxera's use of a consumer welfare approach as opposed to a total welfare approach in assessing the direct cost of using a higher WACC percentile. The respondents' views were broadly split into users and consumer groups, which favoured the consumer welfare approach, and providers, which preferred a total welfare approach. This is perhaps not surprising, given that adopting a total welfare approach inevitably leads to a higher optimal WACC percentile.

Respondents that criticised the consumer welfare approach could further be split into two groups:

- those that (implicitly or explicitly) advocated setting α=0.5 (such that $1 of producer surplus is equivalent to $1 of consumer surplus); and
- those that argued that α should be between 0.5 and 1 (i.e. a $1 of producer surplus should be worth less than a $1 of consumer surplus).

One argument used to support these approaches over a consumer welfare approach was that consumers and producers may be one and the same—particularly given that some of the regulated businesses are government-owned—and, consequently, the impact of a transfer from consumers to producers was unclear. CEG also suggested that all of the Commission's experts 'caution against the application of a consumer welfare standard'. While we agree that caution is appropriate, Professor Vogelsang follows Oxera's approach in adopting a consumer welfare approach in his analysis.

Box 3.1 outlines the main arguments raised by respondents in respect of the choice welfare standard.

Box 3.1 Summary of responses on the welfare approach

CEG

'The Commission appears to have determined its WACC range by taking Oxera's range and increasing the "upper limit" to account for certain shortcomings. The problem with this approach is that Oxera's range is based on the application of a pure consumer welfare standard. Had Oxera placed less weight on bare wealth transfers this would have materially increased the upper limit of its WACC range – potentially well above the 75th percentile.

... all of the Commission's experts whom opined on the appropriate welfare standard clearly caution against the application of a consumer welfare standard – and rightly so. However, Oxera then disregards its own counsel and erroneously applies a consumer welfare standard to arrive at its recommended WACC range. As we explain below, this has almost certainly had an effect upon the Commission's Draft Decision.'

HoustonKemp

'the structure of Oxera's model is compromised because it...is based on a consumer (rather than total) welfare standard.'

Incenta

'Oxera's results – and its recommendations with respect to the WACC percentile – would have been materially different if it had applied an efficiency objective rather than the consumer welfare objective.

... even under Oxera's more conservative assumptions, moving from the 75th percentile to the 95th percentile will generate a benefit (in terms of a reduced expected cost of outages) of $49 million.'

NZ airports

'[Oxera's report] does not properly apply the Part 4 purpose statement. In particular, it does not balance consumer welfare and total surplus considerations, which its own analysis points out should occur (albeit to an undefined extent). Vogelsang points out that Oxera's use of a consumer welfare approach tilts the evidence against using a higher WACC percentile.1 As discussed by CEG, if Oxera had applied an appropriate welfare standard, the upper limit of its WACC range would have been significantly higher.'

NZIER

'Does the welfare measure really matter – yes it most certainly does. Under Part 4, producer surplus is always subordinate to consumer welfare. This is why producers are being regulated.'

Powerco

'[the Oxera framework] is limited to a consumer welfare analysis, whereas the Commission has said it will consider both a consumer and total welfare analysis.'

Vector

'As Sapere finds, Oxera omits from its analysis consideration of the potential for inefficient wealth transfers from investors to consumers (which would occur if the regulatory WACC was below the true WACC). Such an outcome would not be consistent with workably competitive markets and needs to be added to Oxera's and the Commission's assessment of potential outcomes from over- or under-estimating the WACC. If this is not done, Oxera's loss function analysis will consistently under-state the WACC percentile range.'

3.3 Oxera's analysis of submissions

The treatment of welfare is a key assumption in the assessment of the optimal WACC percentile. In defining the welfare function as $TW = \alpha CS + (1-\alpha)PS$, Oxera considers that there are four alternative approaches to the treatment of welfare, only two of which should be adopted in practice:

- $\alpha<0.5$ would suggest that society places greater value on producer surplus than consumer surplus (approach I);

- α =0.5 would suggest that society places equal value on $1 of producer and $1 of consumer surplus (approach II);
- 0.5< α<1 would imply that consumer surplus is worth more than producer surplus with each $α of consumer surplus equal to $(1-α) of producer surplus (approach III);
- α =1 would suggest that any reduction in consumer surplus results in an equivalent reduction in overall welfare, even if there is an increase in producer surplus (approach IV).

We note that no respondents argued for approach I in their submissions, but also there is little logical support for its adoption. It is therefore not considered in detail here.

Approach II was advocated by a small number of respondents. However, it does not appear to be a credible option for the Commission. Incenta's analysis—which suggests that a move from the 75th to the 95th percentile generates a net benefit of $49m—highlights the consequence of such an approach. Given the small deadweight loss associated with increasing the price of electricity transmission and distribution, and the large cost associated with network failure, the logical extension of such an approach would be to set the WACC very close to the 100th percentile (indeed, this is the finding of Frontier in a number of the scenarios within its application of Dobbs' model). This does not appear to be in line with what regulation is intended to achieve in setting a rate of return that is consistent with 'workably competitive markets', as referenced in Part 4 of the Commerce Act.[4]

This approach could imply that regulation is not necessary in the first place—if the increased producer profits directly offset the costs to consumers of a higher price then, under this approach, the only cost associated with monopoly pricing would be the deadweight loss. Given that this loss is very small, the costs of regulation would be likely to outweigh the benefits of removing this deadweight loss, and regulation would not be introduced. The fact that regulation has been introduced dictates that it is accepted that consumer surplus is of greater value than producer surplus (as noted by NZIER).

Approach III places some positive weight on the value of producer surplus, but less than the weight placed on the consumer surplus. This is consistent with regulation being necessary (since producer surplus is subordinate to consumer surplus), but acknowledges that producer surplus is not value-less. As we noted in our report:

> In reality it would be reasonable to expect that that the value of α which the Commission is expected to take into consideration in setting a price path lies between 0.5 and 1 (given its duties to protect customers from monopoly pricing). The consumer welfare approach is therefore a conservative approach to take to assessing the impact of a WACC uplift and thus a lower estimate [of the costs of increasing the WACC percentile] could be provided if a different approach were taken.[5]

One argument to support this is that the premise that consumers and producers may be one and the same has some validity. Noting that some of the regulated businesses are government-owned and some consumers will also be investors

[4] Commerce Act, 1986.
[5] Oxera (2014), op. cit., p. 29.

in private companies, CEG used this to argue that the impact of a transfer from consumers to producers was unclear. However, consistent with the approach generally taken by regulators, and, for example, given the different ownership of different groups, it was agreed with the NZCC to ignore the effects of ownership in our analysis.

While approach III is valid, it is not possible to observe directly the weights that should be applied to different types of surplus and thus any values assigned to α will necessarily reflect a subjective assessment of welfare.

The consumer welfare approach (IV) is supported if one believes that the foremost duty of a regulator is to protect consumers from excessive pricing and that any transfer of wealth away from consumers should be seen as a cost in the eyes of the regulator.

3.4 Oxera's assessment

The treatment of welfare is fundamentally driven by a judgement about the value that should be placed on different types of surplus. Our assessment is that the analysis above indicates that there are only two credible options:

- a consumer welfare standard (α=1), to direct effects (wealth transfers), which would be most consistent with the outcomes of workably competitive markets;

or

- a balanced approach (0.5< α<1), with producer surplus being given more weight, in the context of the need to provide incentives to invest.

Given the subjectivity involved in choosing a value for α, and our assessment that the use of a consumer welfare approach better reflects the NZCC's role in regulating energy prices than a pure total welfare approach, we chose to base our analysis on the consumer welfare standard. In our model this is adjusted for an estimate of the asymmetric loss benefits (indirect effects), which effectively results in some weight being given to producer surplus and to provide incentives to invest. The level of the producer surplus effect is therefore determined by reference to the scale of the potential adverse impacts of under-investment.

In reality, the NZCC may choose to place some weight on producer surplus to the extent that it is proportionate to do so to create incentives to invest. Its consultation provided an uplift to our range, in part to reflect this. Arriving at the weights to place on each type of surplus is invariably a subjective process. We chose to base our analysis on the consumer welfare standard, while openly stating the potential limitations of such an approach.

We note that, with the exception of the specific case of α=0.5—which appears to us to be clearly inconsistent with the wider duties of the regulator under Part 4 (notably the need to have regard to outcomes consistent with workably competitive markets)—none of the respondents has provided an estimate of what weight should be placed on the producer surplus. Consequently, we continue to consider that the only appropriate assumption to take in undertaking our analysis was a consumer welfare standard. It may also be appropriate, where the Commission sees fit, for an upwards adjustment to be made to the WACC percentile to take account of the value of producer surplus. The Commission is best placed to make the assessment and has, in fact, taken this into consideration in its proposed level for the WACC percentile (the 67th percentile).

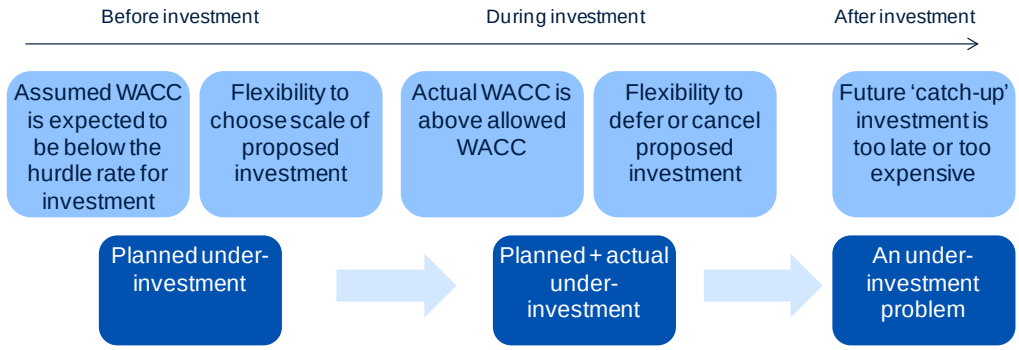
4 Challenges to the interpretation of Oxera's data

- A number of responses disagreed with Oxera's interpretation of the data provided within the report. In particular, respondents queried the use of different percentiles for the shortfall in WACC, and the focus in Oxera's conclusions on the NZ$1 billion figure, which represented the lower end of our range for the impact of failures on the network.
- In this section we recap on the approach taken in developing Oxera's framework, and how the need to provide incentives to invest can be translated into the choice of WACC percentile.
- On the basis, we explain the rationale between Oxera's interpretation of the data available, how it appears to differ from that expressed in submissions, and what considerations should be reflected by the Commission in coming to its final decision.

4.1 Oxera's approach

Oxera's approach to the choice of percentile was first to define the 'under-investment problem', and then to compare the potential scale of effect of under-investment to the comparable level of costs for each choice of percentile. Figure 7.1 of Oxera's report (replicated as Figure 4.1 below) illustrated the nature of the under-investment problem.

Figure 4.1 Identifying the under-investment problem



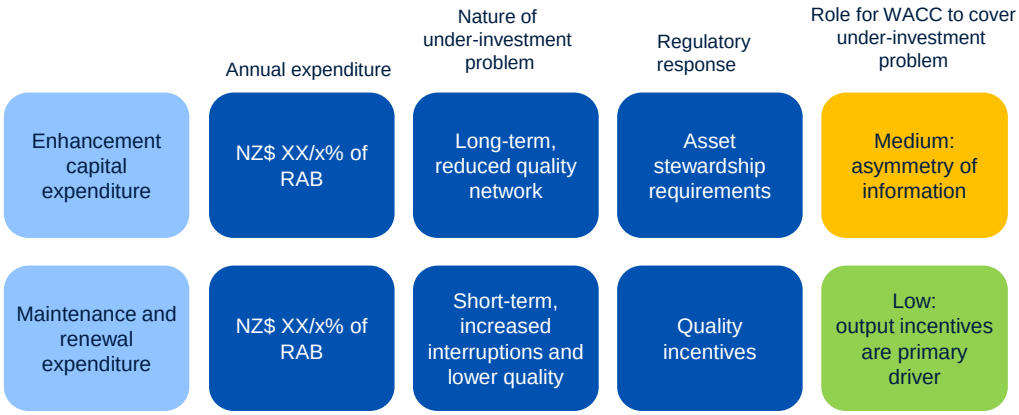
Source: Oxera.

We noted that this 'under-investment problem' was likely to be consistent with the following conditions:

- **there is flexibility to choose the level of investment** and the company has the ability to reflect the level of the WACC (actual and assumed) in its decision on the appropriate level of investment;
- **the level of the assumed (investor) WACC is below, or is expected to be below, the company's view of the actual WACC**. Therefore the perceived net present value (NPV) of capital investment is negative;
- **the impact of deferring investment cannot be adequately recovered after the period**. Under-investment translates into an under-investment problem only if the impact of any shortfall in investment cannot be readily rectified after the period.

We also noted, in Figure 7.2 (replicated as Figure 4.2 below), that this was likely to be greatest for larger investments, where the level of asymmetric information was greatest.

Figure 4.2 What is the role of the WACC in resolving the 'under-investment problem'?



Source: Oxera.

On this basis, we provided an analysis of the link between the costs that might arise from the under-investment problem, and the costs that are certain to arise from setting the WACC at a higher percentile (and given the consumer welfare assumption discussed above). Table 4.1 replicates the table applied:

Table 4.1 Outputs of Oxera's analysis—the relationship between the probability of loss and the under-investment problem (NZ$m)

			Impact of a severe loss event		Probability of a WACC shortfall			
Percentile	**WACC impact**	**Cost impact**	**Low**	**High**	**>0% loss**	**>0.5% loss**	**>1% loss**	**>2% loss**
50%	0.00%	0	1,000	3,000	50%	32.1%	17.6%	3.1%
55%	0.13%	20	1,000	3,000	45%	27.7%	14.5%	2.3%
60%	0.27%	40	1,000	3,000	40%	23.6%	11.8%	1.7%
65%	0.41%	61	1,000	3,000	35%	19.7%	9.4%	1.2%
70%	0.56%	83	1,000	3,000	30%	16.1%	7.3%	0.8%
75%	0.72%	107	1,000	3,000	25%	12.7%	5.4%	0.6%
80%	0.90%	133	1,000	3,000	20%	9.6%	3.8%	0.3%
85%	1.11%	164	1,000	3,000	15%	6.7%	2.5%	0.2%
90%	1.38%	203	1,000	3,000	10%	4.0%	1.3%	0.1%
95%	1.77%	261	1,000	3,000	5%	1.7%	0.5%	0.0%

Source: Oxera.

This was based on a combination of factors, but the main factors were:

- the standard error of the WACC, which was assumed to be that determined by the Commission;
- the 'probability of loss' for certain levels of the WACC, which was assumed to be related to the size of the risk of under-investment;
- Oxera assumed a range of 0.5–1% for a shortfall in estimating the WACC. In arriving at an indicative range, Oxera noted the following:

  > One hypothesis is that the under-investment problem will be caused by the size of the differential between the actual and assumed WACC. If some trigger is breached for this differential, investors will have the

> incentive to minimise investment [and] it is for the Commission to decide which trigger to apply—i.e. whether to assume that a 0.5%, 1% or 2% shortfall is the best assumption for the level at which the under-investment problem is likely to arise.

- the potential cost of under-investment, which we estimated to be NZ$1bn–NZ$3bn, based on analysis in section 5.3 of our report, where we stated.

> On the whole, for the purposes of this report, a cost in the order of NZ$1bn–NZ$3bn is considered to indicate the scale of the cost of network outages that could occur as a result of under-investment.

However, we did not convert this analysis in simple mathematics to a conclusion; instead we considered a number of factors. We concluded that the size of the risk for the 50th percentile was material, and that the reduction in risk from moving to the 60th percentile was likely to be clearly beneficial. We focused on the potential to mitigate $1bn effects, with greater weight to the Commission's wider framework to mitigate against any more extreme under-investment. At the 80th percentile, we stated:

> The 80th percentile would represent a prudent approach. The cost is around $133m a year, or potentially equivalent to the impact of one severe event within a seven-year IM period. The reduction in risk is significant. In choosing this level of protection, the Commission would be giving less weight to the intention of asset stewardship and quality obligations to offset some of the risk of the under-investment problem which is designed to minimise the risk of an under-investment problem within the regulatory period.

On this basis, we concluded that the evidence pointed to the 60–70th percentile range.

4.2 Summary of submissions

The submissions that criticised Oxera's approach largely fell into two categories:

- a number argued that Oxera's approach was not robust enough for use in the Commission's decision;
- some criticised the choice of parameters, in particular the focus given to the scale of an event of NZ$1bn, from Oxera's stated range of NZ$1bn–NZ$3bn.

Box 4.2 Responses to consultation: criticisms of Oxera's methodology

HoustonKemp for Powerco:

'The rudimentary state of Oxera's analysis means that it is inappropriate to be given any weight in the Commission's decision-making process'.

'Oxera's inability to provide any support for its assumptions around the fundamental relationships that it examines renders its analysis to be no better than a (weakly informed) guess. Those fundamental but unsupported relationships include:

• the sensitivity of investment decisions with respect to changes in the WACC:

• the value of changes in reliability; and

• the sensitivity of reliability to changes in investment'.

'These results are presented in section 3.5 below but, in short, we find that if benefits are 1.5 times the level assumed by Oxera, this results in an increase in the identified optimal WACC percentile of around 15 percentage points'. Given the difficulties of estimating this relationship, Oxera assumes that a reduction in the probability that investment will be stifled implies a similar reduction in the probability of a reliability failure in any given year. In other words, if the probability of the WACC shortfall exceeding 0.5 (1) percentage point (the trigger for stifling investment) falls by 1 percent, then the probability of failure in that year also falls by 1 percent.

While it is necessary to make an assumption regarding this relationship, there seems to be little (if any) basis for Oxera's assumption. In particular, Oxera has not considered the likelihood of such an event occurring in New Zealand in each year. If the probability of such an event is, say, 2 per cent, then even a 1 per cent reduction in the risk of such an event involves a significant improvement in reliability. Furthermore, as noted above, the relationship between investment and reliability is likely to be such that the extent to which investment is affected (rather than simply whether it is affected) will be the driver of changes in network reliability.

•Which planned investment projects are likely to be dropped or delayed as a result of a WACC shortfall of, for example, the following amounts: 0.5, 1, 1.5 and 2 percentage points?

• What is the estimated cost of those investment projects?

• What would be the implications on system reliability of these investments being delayed or abandoned, both in the short-term and over time?

• Would these investments be expected to yield other benefits to consumers, which would be lost if the investments were not to proceed?'

'Given the difficulties of estimating this relationship, Oxera assumes that a reduction in the probability that investment will be stifled implies a similar reduction in the probability of a reliability failure in any given year. In other words, if the probability of the WACC shortfall exceeding 0.5 (1) percentage point (the trigger for stifling investment) falls by 1 percent, then the probability of failure in that year also falls by 1 percent.

While it is necessary to make an assumption regarding this relationship, there seems to be little (if any) basis for Oxera's assumption. In particular, Oxera has not considered the likelihood of such an event occurring in New Zealand in each year. If the probability of such an event is, say, 2 per cent, then even a 1 per cent reduction in the risk of such an event involves a significant improvement in reliability. Furthermore, as noted above, the relationship between investment and reliability is likely to be such that the extent to which investment is affected (rather than simply whether it is affected) will be the driver of changes in network reliability.'[6]

NZIER

'The local New Zealand network data that we examined is not similar to the US analytics that underpin the Commission's proposal, which suggests to us that this proposal involves more judgement than appears on the surface. (Also it is not clear to us that the failure in the US networks used as examples in the Oxera report would have been avoided by increased reliability investment, nor is it clear that such investment would have been made if regulators allowed a slightly higher return on capital)'

'The use of WACC + uplift is an incomplete model of incentive regulation. Investor incentives from this mechanism can work in opposite directions and it seems to us that the use of uplift is very situation and strategy specific. There are mechanisms other than WACC uplift to manage potential welfare losses.

Marginal benefits from network investments are very much dependent on the relationship between demand and capacity over time. For instance geographic areas with consumers who have high supply costs may be best regulated by WACC + uplift but lower supply cost/higher density areas will likely require less flexibility and may be better regulated using performance standards.

We are especially concerned that the Oxera analysis makes primary assumptions of a loss function which provides a basis for developing an approach, then gather data from US sources and attach it all to a calculation of welfare losses here in New Zealand. In some ways the discussion is now more confused because, in reality there are more assumptions and unknowns than we realised before. We now understand better what we don't know and can clearly see that the Commission is exercising considerable judgement across a wide range of factors when proposing regulatory WACC at the 67th percentile.'

'Little has emerged from submissions to fill this gap and enable real world evidence to inform the Commission's decisions. The Oxera analysis has a well thought out approach but seems to be more improvised than structured, and searches for evidence from international sources to 'join the dots' between investment levels and regulatory WACC'

It seems to us that the quantum of the overall (static and dynamic) welfare loss from under-investment is the critical component in the trade-off the Commission is making. If the loss is small, blanket uplift to the WACC is likely to be an expensive way of avoiding the welfare loss compared with other interventions and may exceed the avoided welfare loss.

The Oxera approach to estimating the static welfare loss and the probability weighted cost to the NZ economy from a major unplanned outage is missing a complete analytical model.[7]

It seems that there are two important matters sitting behind the Oxera analysis and particularly

[6] HoustonKemp (2014), 'Comment on the Commerce Commission's Proposed WACC Percentile Amendment', 29 August, pp. 22–25.
[7] NZIER (2014), 'Changing the WACC percentile', 29 August, p. 22.

whether it is useful in the New Zealand context.

First is the start point regarding investment in the network, by which we mean have the New Zealand networks suffered from the same under-investment that the US networks are alleged to have suffered from that could lead to an increased risk of failure at a cost to consumers and the wider economy.

Second is whether the operators of the network would have contemplated the rare sequence of events that led to the failures and if they had could they have justified the amount of network investment that is able to fully accommodate rare one-off events like hurricanes or cascade failures that were causal in the US blackouts. The two US examples are interesting in this regard – one was due to a rare and extreme weather event that would have required extensive investment to avoid. The other was a cascade failure caused by a series of events that could possibly have been avoided by a reasonably small investment.'

Powerco

'These sensitivity tests present a serious challenge to the Draft Decision. The Draft Decision relies heavily on the Oxera model. For the reasons discussed above, and flagged by Vogelsang, the Oxera model is not actually an empirical model and only amounts to a "(weakly informed) guess". But even if the Commission chooses to rely upon it, the Oxera model does not support the WACC percentile range proposed in the Draft Decision.'

PwC

'The heavy weighting which appears to have been given to Oxera's report seems inappropriate in light of the comment made by Vogelsang, in his peer review, that Oxera's analysis was only weakly suggestive of the outcome.'

Sapere

'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…" 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 setting the regulatory WACC below the actual WACC would have adverse incentives for investment'

'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". 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'

4.3 Oxera's analysis of submissions

As illustrated above, respondents provided a list of examples which queried Oxera's recommendation for the 60th to 70th percentile range. In many cases, the same respondents acknowledged that the Oxera approach was, in general, a valid attempt to describe and quantify the rationale for a WACC premium.

While some respondents queried whether Oxera's evidence was sufficient to come to a recommendation—for example, HoustonKemp argued that the analysis was 'rudimentary'—these responses were not generally accompanied by an alternative proposal for how Oxera could have practically improved the quality of data available other than in the context of the explicit use of innovation investments.

Sapere and HoustonKemp provided alternative interpretations of the appropriate percentile, using Oxera's framework, but giving a different weight to the various potential sources of data, and therefore resulting in a higher percentile.

We address below Sapere's concerns about the numbers applied in the Oxera model, and do not concur that they imply error. We remain unconvinced that any of the respondents provide evidence for a different dataset to be used in coming to a judgment on the range.

Context of the Commission's decision

Our assessment is that the responses fail to take into consideration the full circumstances faced by the Commission in coming to a view on the WACC percentile. These circumstances were the following.

a) The Commission is required to set a WACC that has to provide incentives to invest and reflect outcomes consistent with workably competitive markets.

b) Regulators, including the Commission, usually take this to mean that there are asymmetric risks associated with setting the WACC too low.

c) The exact level of WACC that addresses these asymmetric risks is not readily observable, and regulators tend to use judgement in coming to a decision.

d) The Commission used judgement in coming to a 75th percentile.

e) Following the MEUG challenge, the Commission sought evidence to better inform its judgement. Alongside other experts, Oxera provided some of that evidence.

f) Oxera's review also established that there is a fundamental uncertainty about some of the assumptions (such as the size of the expected adverse impacts of under-investment). Our assessment was that a more detailed model will retain the fundamental uncertainties around the link between the WACC, the level of under-investment, and the risk of an 'under-investment problem'.

g) As such, Oxera's analysis was intended to put the Commission in a position to apply its judgement in coming to a view as to the most appropriate WACC in the context of the evidence that was available. We established that any model will have limitations of the type identified by certain submitters, and acknowledge that there are 'assumptions and unknowns'. However, the Commission is in the position to understand the implications of how it exercises its judgement. Partly on the basis of our evidence, the Commission concluded that a revision to the percentile would be appropriate.

In the context of f), we note that the only attempt to create an alternative model is the Dobbs analysis performed by Frontier, which equally relies on assumptions around the benefits and costs of under-investment. Our assessment is that the Dobbs modelling provides limited additional insight, as it is not explained why the chosen benefits of investment are 'better' than those assumed in the simplified Oxera model. In particular, there is a focus on innovation which appears to us to overstate the realistic benefits of innovation within energy networks. This is discussed further in section 7 below.

The Oxera analysis shows that the Commission needs to be convinced that there is both a material cost from under-investment, and a credible threat of under-investment at the 50th percentile, to be willing to impose a percentile at the 75th (or even in the 60th–70th range). Our recommendation was based on an assessment that the evidence was indicative of an asymmetric risk that justified a premium, but that the assumptions which would imply a larger premium were less likely.

For example, Oxera's estimate of a 0.5–1% shortfall in the WACC being linked to under-investment is based on a reasonable indicative range.

Estimating the likelihood of reliability failure in each year is not straightforward and the results are likely to be imprecise. In any case, the aim of Oxera's report was to identify a relevant framework, make reasonable assumptions (which are

subject to fundamental uncertainty) required to complete the analysis, and inform the Commission's decision.

Focus on the $1bn impact

Many of the responses which proposed a higher percentile, other than being based on total welfare, were based on giving greater weight to the higher end of the range of NZ$1bn–NZ$3bn given for the impact of an adverse event.

Our approach was to give greatest weight to the low end of the range for potential costs of under-investment, in part because we felt that the proposed approach would be sufficient to protect against under-investment over time; that the upper end of the range would represent an extreme event; and that it would be risking 'gold-plating' of the network to protect against the worst possible case.

In general, our finding was that the studies that highlighted higher costs were illustrating a cost related to severe and persistent under-investment.[8] The aim of the percentile adjustment (or, put differently, to err on the side of caution in setting the WACC) is to ensure ongoing investment in the network, and to avert the risk of a structural decline in investment, alongside other measures that can be effective over time, such as quality regulation and asset stewardship.

As identified in Figure 4.1 above, the nature of the 'under-investment problem' is that it would come about as a result of a lack of incentive to invest over the medium term. Our assessment was that the more extreme effects of under-investment would be likely to be felt over the longer term, and hence we suggested that the choice of a percentile in our proposed range would be sufficient within a regulatory period.

Table 4.2 updates our original analysis, in the context of the differential between the approaches taken in the various reports. We continue to assess that the possibility of a NZ$1bn–NZ$3bn effect is a feasible outcome of a severe event. However, the studies that point to the higher end of this range appear to be more likely to be based on approaches that represent a more extreme set of assumptions. At the same time, we have highlighted that there are other studies, particularly those that focus on a subset of effects and/or 'normal course' outages, which indicate a cost well below the bottom of our range.

[8] The EPRI (2001) report was reviewing the ongoing cost of outages, but based on survey evidence that is likely to result in a high estimate for the costs, and in the context of severe outages in parts of the USA. The EPRI study is likely to overestimate the cost of the outage for two reasons. First, it assumes that outage costs experienced on summer weekday afternoons are representative of outage costs experienced at other times during the year. Second, the sectors surveyed were those known to be especially vulnerable to fluctuations in electricity supply. The study assumes that the outage costs experienced by the non-surveyed population are 25–50% of the costs experienced by surveyed firms; however, evidence shows that the costs for the non-surveyed population could be much lower.

Table 4.2 Further analysis of range of studies into the economic cost of power outages[9]

Study	Country	Event period (year)	Cost of outage (US$bn)	GDP in year of study (US$bn)[1]	Cost (% of GDP)	NZ GDP in 2013 (NZ$bn)	Implied cost of outages in NZ (NZ$bn)[2]
Studies (i.e. studies of equivalent annualised effect and/or one-off events)							
EPRI 2001	USA	2001	119–188	10,600	1.1–1.8	211	2.4–3.7
Targosz & Manson 2007	EU-25	2003–04	180	16,546	1.1	211	2.3
LaCommare et al. 2004	USA	2004	79	12,300	0.6	211	1.4
Reichl et al., 2013[3]	Austria	2013	2.3	417.6	0.6	211	1.3
ASCE 2013	USA	2020–40	97	15,500	0.6	211	1.3
Swaminathan and Sen, 1998	USA	1998	39	9,100	0.4	211	0.9
Nexant 2003	Nepal	2001	0.025	6.3	0.4	211	0.8
ASCE 2013	USA	2012–20	55	15,500	0.4	211	0.7
Campbell, 2012	USA	2012	25–55	16,200	0.15–0.4	211	0.3–0.7
Council of Economic Advisors et al. 2013	USA	2003–12	18–33	15,500	0.12–0.21	211	0.24–0.45

Note: [1] GDP is reported in current prices. [2] Based on the same proportion of GDP as in country of occurrence [3] Assessment of the impact of a 48-hour outage.

Source: Oxera analysis, based on various academic studies: ASCE (2011), 'Failure to Act: The economic impact of current investment trends in electricity infrastructure'; Campbell, R.J. (2012), 'Weather-Related Power Outages and Electric System Resiliency', Congressional Research Service, 28 August; LaCommare, K. and Eto, J. (2004), 'Understanding the cost of power interruptions to U.S. electricity consumers'; EPRI (2001), 'The Cost of Power Disturbances to Industrial & Digital Economy Companies'; Wyman, M. (2008), 'Power Failure: Addressing the Causes of Underinvestment, Inefficiency and Governance Problems in Ontario's Electricity Sector', May; Reichl, J., Schmidthaler, M. and Friedrich, S. (2013), 'Power Outage Cost Evaluation: Reasoning, Methods and an Application', *Journal of Scientific Research & Reports*, **2**:1, pp. 249–76; Swaminathan, S. and Sen, R.K. (1998), 'Review of Power Quality Applications of Energy Storage Systems', Sandia National Laboratories, July. Data from World Bank and Statistics New Zealand (2013), 'Regional Gross Domestic Product', March, available at: http://www.stats.govt.nz/browse_for_stats/economic_indicators/NationalAccounts/RegionalGDP_HOTPYeMar13.aspx, last accessed 15 May 2014; Nexant (2003), 'Economic Impact of Poor Power Quality on Industry, Nepal'; Executive Office of the President (2013), 'Economic Benefits of Increaseing Electric Grid Resilience to Weather Outages'; Targosz, R. and Manson, J. (2007), 'Pan European LPQI Power Quality Survey'.

Generally, this updated review is consistent with our original assessment that the risk associated with a severe event could be as high as NZ$1bn–NZ$3bn. However, consistent with NZIER's submissions, it also illustrates that smaller outages would have a less severe effect, with the costs being significantly below NZ$1bn in the absence of a material effect, and the differential therefore

[9] One study not presented above which was referred to in our initial reportis the Ontario – U.S. power outage which took place in 2003. Although a cost figure was reported, it was unclear how this figure was calculated, and therefore this study has not been used to estimate the cost of outages in New Zealand.

representing the potential effect, in the context of an under-investment problem.[10]

The NZIER study is based on data on outages in New Zealand, by class of customer, such as the load-weighted value of outage and measures of disruption to the network in New Zealand (SAIDI and SAIFI). NZIER finds that the total value of outage is approximately $0.28bn, but that this is not in the context of an under-investment problem.

Should there be a clear trend towards under-investment over a period, this analysis indicates that it is credible that the medium-term effect could be an increase in effect towards the NZ$1 billion level, or beyond. However, the Commission would then have the potential to review either the wider regulatory obligations (for example, quality and asset stewardship), or whether there was evidence that the central estimate of the WACC was too low, at the end of the period if appropriate, as illustrated in Figures 4.1 and 4.2 above. The greater the potential for a material under-investment risk within a single period, the stronger the case for the Commission to give some weight to the higher numbers.

We note from the cross-submissions (in particular, that of Covec) that there is also a case that our measure was too high because it is based on total GDP effect. Overall, we do not consider that it is realistic to disaggregate these effects, but we do acknowledge that this implies a level of caution in our approach of taking numbers directly from the range.

While Oxera also recognises the concerns regarding suitability of examples of reliability failure from large economies, there are constraints to finding like-for-like examples from island economies. We consider that these represent a suitable focal point for the Commission in determining the percentile.

NZIER's alternative approaches

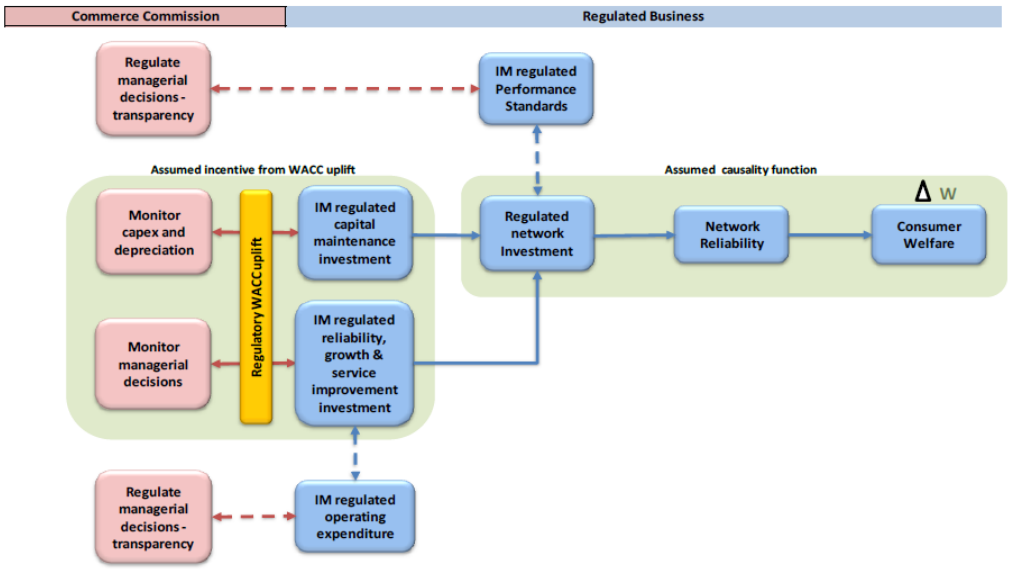
We note that NZIER presented evidence of the actual performance and spend of the network companies. However, the energy consumption and demand figures presented by NZIER represent historical figures of which the Commission would have been aware at the time of its previous determination when choosing the 75th percentile and in setting a price–quality path more generally. The percentile is around the need to incentivise an optimal level of investment on a forward-looking basis.

While historical CAPEX might have been below allowed levels, this does not suggest that energy firms should not be incentivised to invest in network reliability to cover against future risks to the performance of the network. If anything, it illustrates that the risks of under-investment are realistic, and supports the point raised in Figure 4.1 above that there is a credible under-investment problem. In its cross-submission, NZIER provided more evidence on its proposed approach. It provided an alternative 'thought-process' for CAPEX, which we consider to be consistent with our cycle of investment described in Figure 4.1 and Figure 4.2. NZIER's view on the approach to determining investment is illustrated in the figure below taken from its report.

[10] Eto, J., Koomey, J., Lehman, B., Martin, N., Mills, E., Webber, C. and Worrell, E. (2001), 'Scoping Study on Trends in the Economic Value of Electricity Reliability to the U.S. Economy', Lawrence Berkeley National Laboratory, LBNL-47911, June.

Figure 4.3 Extract from NZIER paper: role of WACC

Figure 1 Where WACC uplift fits in the causal chain (Scope of the issue)

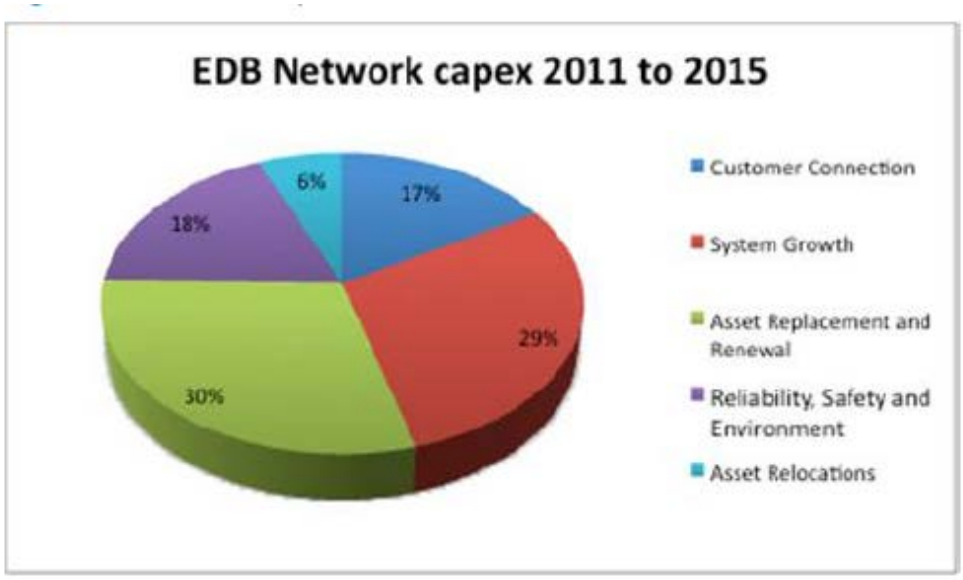


Source: NZIER

Source: NZIER cross-submission.

NZIER then considers the role of the WACC in determining different levels of CAPEX. It argues that reliability investment is only $400m of the $2bn of total CAPEX.

Figure 4.4 NZIER's view on the allocation of regional CAPEX investment



Source: NZIER cross-submission.

While we agree, in general, with the approach outlined by NZIER, we do not agree with all of the conclusions it draws from this approach. We do not see why capital investment in the categories of Asset Replacement and Renewal or System Growth, for example, would not be part of contributing to the long-term reliability of the network.

If, as indicated by NZIER, not all investments fall within the category of those needing to be incentivised through the choice of WACC, then it is also not

obvious that the response is a lower WACC, as this would both reduce the effect of the incentive where it is needed, and result in an uplift elsewhere. If applying a higher WACC to all CAPEX is over-generous, a more appropriate approach would seem to be to separate the types of investment within the RAB (as discussed separately on innovation below).

However, based on NZIER's analysis within its submission, we are not convinced that this would have a sufficiently material impact to justify the additional effort and complexity that would accompany such a 'split RAB' approach. We recognise that NZIER recommends that the response is to apply the 50th percentile, but for the reasons discussed below and in our original report, we consider that this is likely to understate the scale of the asymmetric risks of under-investment.[11]

4.4 Oxera's assessment

Our assessment is that the responses do not provide support for a different conclusion. Consistent with the Oxera report, they highlight that different assumptions could have resulted in different conclusions.

We are not convinced that the evidence for a higher percentile is sufficiently powerful to cause us to change our conclusions. However, we also feel that the evidence was clearly presented in our initial report. It is for the Commissioners to come to a decision on the appropriate percentile based on the evidence available. Our assessment is that this evidence would point to a percentile around the 60th to the 70th.

If anything, it could be that our approach is cautious, as the Commission potentially has other approaches to avert under-investment. However, we generally agree that the benefits of a relatively small uplift to the WACC will be sufficient to offset any costs. We are not persuaded that a more material uplift is proportionate to the size of risk of under-investment.

However, the Commissioners should be more minded to move towards a higher percentile (i.e. to give more weight to the more material risks of severe failure) if:

- the Commission considers that the ability of other measures to moderate under-investment in the medium term are very weak;
- the ability to observe and respond to under-investment over time is low; and
- a severe event could occur more quickly than assumed in Oxera's illustrations of the impact of under-investment—for example, if a severe event resulting from under-investment could occur within a single period.

Our review of the submissions is that they do not provide further evidence that these are credible risks in New Zealand, and therefore that a more material uplift to the WACC percentile is necessary.

[11] NZIER implies that the Oxera approach errs in assuming that an asymmetric risk profile exists and implies a choice above the 50th percentile. In practice, our framework does assume that there is 'asymmetric risk', in the sense of risk that is not symmetric as there is the potential for more material downside effects from under-investment. However, this does not automatically translate to a percentile above the 50th since it is possible that the probability of these events is sufficiently remote that a percentile above the 50th will not provide sufficient incentive to invest to justify the additional costs. This could be illustrated through sensitivity tests to our analysis above, with materially lower costs of failure.

5 Innovation

- In Oxera's original report, we noted that the potential for innovation could affect the choice of percentile, but concluded that there was not a sufficiently material effect to imply a different choice of percentile.
- A number of responses—in particular, Castalia for Transpower—provided additional evidence in response to this approach.
- Our analysis of the responses suggests that they do not clearly point to a need for a different WACC.
- For example, the investments highlighted in Castalia's analysis will either form part of the contribution to longer-term asset health or will improve efficiency, in which case there is already an incentive under the regulatory framework.

5.1 Oxera's approach

In evaluating the wider social and economic effects of the choice of the WACC percentile, Oxera focused on medium- to long-term network reliability. We noted that a lower WACC could result in a lower level of expenditure on innovative investment projects:

> Although technological innovation might be less relevant in the electricity distribution and transmission sectors than in other sectors, notably telecommunications, there are also risks around not making any allowance for investment in new technology (e.g. smart grids, renewable energy). Given that it is for the companies, rather than the Commission, to determine the level and nature of innovation, this is another area where the Commission should potentially be cautious in deferring investment.[12]

To the extent that such innovation contributes to medium- to long-term network reliability, it is captured in our analysis. However, we recognise that there may also be investments that reduce the long-term unit cost of providing electricity distribution and transmission services or that provide other benefits to consumers in terms of the level of service provided. In our report, we noted that such investments are likely to be less frequent in electricity distribution and transmission than in other sectors, and thus that the primary risk of under-investment would be to reduce network quality. A lack of investment in innovative projects was therefore considered to be a second-order effect and was largely excluded from our analysis.

> In telecommunications, under-investment may mean a continuation of lower-value services for customers, as opposed to the development of new and potentially more speculative technology to improve the customer experience. In electricity distribution and transmission, the primary output of the electricity network is continued operation (and the primary risk associated with under-investment is an increasing gap between actual network quality and the socially and economically optimal level of network quality).[13]

This section considers submissions made by respondents about the appropriate treatment of innovative investments.

[12] Oxera (2014), op. cit., p. 46.
[13] Oxera (2014), op. cit., p. 65.

5.2 Summary of submissions

Three respondents (CEG, Castalia and NZ Airports) argued that the focus of Oxera's report was exclusively on investments targeted at ensuring the resilience of the network, and that this ignores the benefits derived from innovative investments.

Broadly speaking, the argument runs that increasing the WACC percentile increases the incentive for companies to undertake investments that have benefits for customers and the wider economy, but that are otherwise NPV-negative for the company. The respondents noted that it was not obvious when innovative investments have not occurred and thus that, at a lower WACC percentile, the company may be able to withhold further investment. The example provided by CEG is that of a company that is able to make an investment that will reduce the cost of providing the service in the long run but involves sufficient upfront costs to mean that it will be unprofitable for it to invest. At a higher WACC percentile, such an investment may become NPV-positive, thereby creating benefits both for the customer (in the form of a lower long-run price) and for the provider (in the form of a higher return).

The respondents stated that accounting for these investments would provide support for a higher WACC percentile. Castalia considered that the economic investments that Transpower has undertaken in recent years have a sufficiently high benefit–cost ratio (BCR) to support a WACC determination at the 75th percentile.

Box 5.1 Summary of responses on incentives to innovate

CEG

'There are several other factors that will also have caused Oxera to have underestimated the upper limit of its WACC range. If these matters had been properly accounted for its upper limit would have been higher still. These factors include...its exclusive focus on reliability investments – factoring in the potential benefits from other types of investment would have increased the upper limit of Oxera's WACC range, as the Commission acknowledges.'

Castalia

'The "reliability" effects quantified in the Oxera analysis are quite different from the effects assessed in our evidence (and the evidence of other experts) on the impact of a low WACC on "economic" investments.

The impact that a low WACC would have on the benefits provided by "economic" investments is material. A sample of the economic investments recently commissioned and planned by Transpower has estimated net benefits of $2.5 billion. This is a material amount (including when compared with the impacts of reliability investments which, according to Oxera's analysis have a present value of between $8.6 and $26.0 billion). The impact of the decision on economic investment should be explicitly incorporated, including quantitatively, into the Commission's decision on the size of the WACC uplift. Assuming that Oxera's analysis on reliability impacts is correct, our analysis suggests that the economic benefits foregone by having a low WACC would justify the Commission using a WACC higher than the 67th percentile of the WACC range.

We find that economic investments with a benefit-cost ratio (BCR) of greater than 1.38 would justify consumers paying the 75th percentile of the WACC range (assuming that no economic investment happens at a 50th percentile WACC). The economic investments implemented and planned by Transpower are all above this threshold.

Although Transpower has an obligation to identify economic investments, these investments are not required to meet other regulatory obligations (such as reliability standards). Economic investments are therefore discretionary and rely heavily on Transpower's incentives to invest. The impacts of not making economic investments are also very subtle—with consumers paying slightly higher prices for electricity (due to a less optimal mix of generation and transmission).Because it is not obvious if economic investments have not occurred, if the WACC is too low, then Transpower is able to decrease its level of economic investment. This eliminates a source of benefit to consumers and means that customers will be paying higher prices than if the optimal investment had taken place.'

NZ Airports

'The Oxera report heavily relied upon by the Commission has analysed reliability investments in electricity lines services only. It provides no empirical evidence about other types of investments and/or investment effects.'

5.3 Oxera's analysis of submissions

The argument that the WACC may influence investment incentives has some merit. There may be investments that are NPV-negative for a company at the 50th percentile that would become NPV-positive with a higher WACC, and the benefits of these investments for customers may exceed the additional return associated with the WACC uplift. However, such an analysis would need to be considered on a case-by-case basis and would need to be weighed against the negative impact of over-investment in projects that become NPV-positive for the company but that have limited benefits for customers. That is to say, the benefits of innovative investments need to be considered in parallel with the costs of over-investment—i.e. a higher WACC may incentivise greater investments of all kinds and some additional investments may not have benefits for customers.

Castalia notes that the BCR of Transpower's economic investments exceeds 1.38 and thus justifies consumers paying the 75th percentile of the WACC. However, this is based on the assumption that all these investments would occur at the 75th percentile, and by comparison, none of this economic investment

happens at the 50th percentile. No evidence is provided to justify this assumption.

The argument relies on the assumption that if an innovative investment is NPV-negative, the company will disregard that investment. This is a realistic risk. However, it depends on the nature of the innovation and its interaction with the company's other obligations. For example, the company may alternatively seek out the regulator or government to determine whether there is a method of making the investment NPV-positive. This is particularly relevant in transmission, given that Transpower has (as acknowledged in the Castalia report) an obligation to identify innovative/economic investments.

Castalia's argument seems to be in part based on assuming that all investments can be split into two categories consistent with the regulatory approach—reliability investments and economic investments—and that the latter are all in the nature of 'innovation', and outside the scope of Oxera's analysis.

In practice, investments are likely to be allocated into a wider range of investment types. Table 5.1 illustrates the nature of different forms of investment, and how they are incentivised under the current regulatory approach:

Table 5.1 Types of investment

Aim of investment	Example in submission	Incentives
Short-term network reliability	Castalia terms these 'reliability investments'	Quality regulation and return on RAB
Longer-term network enhancement	HDVC Pole 1 replacement Wairakei ring Bunnythorpe-Haywards reconductoring Clutha Upper Waitaki Lines Project	Asset stewardship/quality regulation, return on RAB
Reduction in costs and improvement in efficiency over time	Kawerau	Lower costs and higher profitability in period, then return on RAB
Innovation that will lead to genuine benefits to consumers in terms of the level of service provided ('true innovation')	Vector's example of an innovative investment is its 'outage manager app'	Return on RAB only

Source: Oxera analysis of submissions.

Castalia's contention appears to be that all of Transpower's 'economic investments' are focused exclusively on innovation, have no benefit in reducing risk of network failure, and are therefore excluded from Oxera's analysis. It is not clear that this is the case, in practice, based on a review of the investments proposed by Transpower and included in Castalia's list. Many of these investments appear to be related to network enhancements designed to ensure that there is sufficient medium- to long-term network capacity to meet electricity demand (e.g. the Bunnythorpe-Haywards reconductoring and Clutha Upper Waitaki Lines Project), as opposed to innovative changes to the way in which electricity transmission services are provided. Investments in long-term network enhancements are in the nature of strengthening the longer-term resilience of the network, and are therefore effectively captured in Oxera's analysis.

The Kawerau project was estimated to reduce the total cost of producing electricity by between NZ$20m and NZ$27m. The exact nature of the regulatory regime and Transpower's expectations relating to the incentives will affect the NPV of such an investment. However, it appears to be an investment designed

to improve the effectiveness of the network and enhance Transpower's efficiency, rather than being 'true innovation'.

From the submissions made by or on behalf of the EDBs, the clearest example given of an innovative investment that would not meet the categories above was Vector's outage manager app. Oxera considers that the benefits of such an investment are likely to be small relative to reliability investments.

5.4 Oxera's assessment

Overall, given the low level of expenditure on such investments relative to the first two categories of investment in the electricity transmission and distribution sectors, and given that the additional costs of innovative investments (as well the additional return and any over-investment) would have to be netted off the benefits, Oxera determined that these were likely to be second-order effects and that the main under-investment problem for transmission and distribution companies would take the form of an 'increasing gap between actual network quality and the socially and economically optimal level of network quality'. We do not consider that the evidence provided by respondents has sufficiently disproved this judgement.

In sectors where there is greater scope for innovation, greater analysis of such investments may be warranted when setting the WACC percentile. However, we note that it is a WACC uplift applied to the entire asset base is unlikely to be the most efficient mechanism for incentivising such projects to be undertaken. The evidence indicates to us that the significant majority of capital investment (and therefore, RAB assets) are focused on delivering continuing service across New Zealand, now and into the future.

A project-specific WACC uplift targeted at innovation funding that sits outside the core price control or a government subsidy may, for example, be preferable options. We agree broadly with the framework developed by Castalia. However, it shows that if the level of 'true innovation' investment is small (if, in practice, it is below 10% for transmission, for example, and, if NZIER's analysis is correct, then arguably lower still for distribution), the level of return required on the other 90% of investment to provide incentives on that 10% would be disproportionate.

Oxera therefore recommends that if it is widely accepted that the current regulatory framework has resulted in companies failing to put forward innovative investments, the NZCC should consider alternative approaches to incentivising such innovation, unless the size of the innovative investment that sits outside the current regulatory approaches can be shown to be material. For example, in the GB energy sector, Ofgem has acknowledged that price cap regulation may not sufficiently incentivise innovation. This has led it to introduce an innovation stimulus package under its Revenue = Incentives + Innovation + Outputs (RIIO) framework. This involves companies competing for access to funding for innovative projects (see Box 5.2).

Box 5.2 Ofgem's approach to network innovation

As part of its RPI-X@20 review, Ofgem (the GB energy regulator) identified a need to encourage innovation in the electricity and gas networks. Ultimately, it chose to introduce an innovation stimulus package based on competition between providers for funding.

> We will introduce a time-limited innovation stimulus for electricity and gas networks. These will be open to projects at any point in the innovation cycle and to both network companies and third parties for innovation related to delivering the networks required for a low carbon energy sector. The innovation stimulus package will include substantial prize funds to reward network companies and third parties that successfully implement new commercial and charging arrangements to help deliver a sustainable energy sector.

As part of the Network Innovation Competitions (NICs), companies compete for funding for the research, development and demonstration of new technologies, operating and commercial arrangements. Funding is provided for innovation projects that meet Ofgem's evaluation criteria.

Source: Ofgem (2010), 'RIIO: A new way to regulate energy networks', October, p. 42.

6 Over-investment and reflecting the cost of investment

- Oxera's report noted that there was a potential risk of over-investment in the context of a WACC set above the 50th percentile. However, we concluded that the impact was not material in the context of the scale of the direct cost of a higher WACC.
- Professor Vogelsang suggested we had underestimated the costs of a WACC uplift. Other submitters supported this case and included it in their analysis.
- However, we note below that a strict interpretation of the example given by Professor Vogelsang relates to a notional case where there is 'gold-plating' of the network—i.e. additional investment that has zero value to users. In practice, the impact of additional investment needs to be estimated as the net effect of the costs of that additional investment, measured against the benefits.
- We agree that these effects were not explicitly addressed in our initial analysis. However, we propose that this is likely to become material only if the optimal WACC assumption and actual WACC assumption start to diverge sharply, which is unlikely given the Commission's range.

6.1 Oxera's approach

We noted in our report that a higher WACC could result in over-investment under the RAB/WACC framework, and that this could have costs for consumers. However, we predicted that over-investment would have a small impact as a result of the tools available to the NZCC—particularly for Transpower, for which the regulator has the power to exclude excess CAPEX from the RAB.

> There is, however, potential for the transmission and distribution companies to overinvest as the return they will earn on the investment could exceed their actual cost of capital. If this happens, customers pay for both the investment (through the depreciation charge) and the allowed return at the actual WACC percentile.
>
> The potential for over-investment is likely to be partly constrained by regulatory scrutiny of the companies' CAPEX plans. For Transpower, the level of CAPEX that is added to the RAB (and thus earns a return and depreciation allowance) is subject to ex ante approval by the Commission and any excess CAPEX incurred during the regulatory period is only included in the RAB (through annual wash-ups) only where the Commission determines that it has been efficiently incurred. As a result, a well-functioning regulatory regime should ensure that—while there will be incentives to overinvest—the impact of setting the WACC at the 75th percentile on actual investment levels will be moderated.[14]

Our report treated over-investment as a second-order effect, on the basis that a number of factors would constrain the incentives for, and ability of, companies to over-invest. It was noted that the potential for over-investment may be greater for EDBs than for Transpower.

6.2 Summary of submissions

A number of respondents picked up on Professor Vogelsang's criticism that the Oxera report had underestimated the costs of a higher WACC by ignoring the costs of over-investment.[15] He gave the example that if the higher WACC were to result in 10% more investment per year, this would be equivalent to an additional NZ$100m of costs, comparable to that within the direct effects.

[14] Oxera (2014), op. cit., p. 37.
[15] Vogelsang, I. (2014), 'Review of Oxera's Report, Input methodologies – Review of the "75th percentile" approach', 10 July.

Therefore, he argues, this should be considered by Oxera's analysis and would increase the costs of setting the WACC above the midpoint of the range. HoustonKemp takes this to imply that a multi-year NPV analysis would result in a different recommendation.

Box 6.1 Summary of responses on over-investment

Professor Vogelsang

'Assuming that the annual cost is NZ$100 million for the ΔI from moving from the midpoint to the 75th percentile the static consumer welfare loss increases from NZ$ 105 million to NZ$205 million. This would be a number, where Oxera's cost-benefit calculations looks already much less favourable than before.

My rudimentary additions to Oxera's empirical work indicate that, because of the effects of ΔI on static consumer welfare, the WACC uplift should be lower than indicated by Oxera.'

HoustonKemp

'Although we agree that the net cost associated with any investment increase above an 'optimal' level should be taken into account, the approach suggested by Professor Vogelsang is problematic and not appropriate in the context of Oxera's analysis. Such an approach would involve comparing the benefits arising in a single year with a cost estimate of a discounted stream of future cash flows. Because Oxera's analysis is based on an assessment of the impact on consumers (costs and benefits) in a given year, these figures are not comparable to the NPV of an on-going stream of annual cash-flows. Such an approach would significantly overstate the relative impact of the increase in the RAB.'

NZIER

'Absent from the Oxera analysis are dynamic costs from over-investment which will result in a potentially large welfare loss to the economy over time. Professor Vogelsang hints at this point in his July review paper but concedes that he does not have the data to adequately evidence this cost.'

6.3 Oxera's analysis of submissions

For the purposes of evaluating the impact of the WACC percentile on the level of investment, there are two main considerations:

- will a higher WACC percentile lead to an increased level of investment?
- if a higher WACC percentile leads to increased investment, should the cost of that investment be incorporated in the analysis of the loss function?

In terms of the first question, Professor Vogelsang assumes that setting the WACC at the 75th percentile would lead to additional investment of 10% per year. No evidence is provided to support this assumption, so it is relevant to question whether it is a realistic scenario. Choosing a higher WACC is intended to increase the companies' incentives to invest, but there are two factors that are likely to constrain the incentives for, and ability of, companies to over-invest.

- There may be regulatory tools that the Commission can use to ensure that RAB additions are limited to legitimate investment (i.e. to prevent over-investment).
- Once prices have been set under an ex ante regulatory framework, companies in any case have an incentive to invest less than their CAPEX allowance (at least until the final year of the control period). This ex post incentive to underspend should not be affected by the regulatory WACC and should act in the opposite direction to incentives to over-invest.

The impact on investment will depend on whether these factors outweigh the incentive to invest more when the WACC is higher. Professor Vogelsang's illustrative calculation does not reflect the fact that additional investment relative

to the counterfactual of 'optimal' investment brings with it additional benefits as well as additional costs.

In addition, this analysis does not take into consideration other factors that may limit companies' incentives, and ability, to deviate from optimal investment.

As such, it is not clear that an increase in the WACC percentile would lead to a significant increase in the level of investment. Even if this were the case, given that the base case is the optimal level of investment, there are likely to be some offsetting benefits from any additional investment, and hence NZ$100m of additional investment is unlikely in practice to represent a NZ$100m cost to customers.

6.3.1 Examples of incremental investment in electricity networks

Consider the following options for the potential nature of the additional investment.

- **Investment in swimming pools**. If the framework were sufficiently flexible to allow the companies to invest in any tangible assets, and for these to enter the RAB, the NZ$100m impact suggested by Professor Vogelsang could be correct—customers would commit to pay NZ$100m over the life of the assets and see no benefit. For Transpower, our understanding is that the Commission would have the power to offset such investments in calculating the future RAB and, consequently, there should be strong regulatory constraints on such investments. For EDBs, we understand that these constraints are weaker and there may thus be greater potential for such investments to enter the RAB.

- **Investment in network resilience/reliability**. If the framework effectively allows the companies to 'over-invest' in strengthening the network in the short term, this would represent an acceleration of future investment, and/or reduce the need for future maintenance/operating costs. As long as the costs were of the type generally accepted as required for the network to operate, positive externalities of the investment relevant to the Commission would be likely to ensue—probably in the form of an acceleration of future investment and better quality of service. These would offset the costs identified by Professor Vogelsang and, in our assessment, be likely to result in a much smaller net impact on consumers than the NZ$100m. It is this second-order effect that we considered in section 4 of the Oxera report and concluded would be unlikely to be material relative to the direct effects.[16]

- **Speculative/innovative investment**. There is a possibility that the businesses will identify innovative investments to improve or re-optimise the network and service quality—this investment forms part of the aim of the percentile. While there is a risk that such unproven investments could have lower benefits than their costs to consumers, we consider that there is a low probability of a material issue. Moreover, in practice it is this type of investment that is part of the 'gap' in investment, which may occur anyway under the current approach.

It is only under the first of these scenarios (i.e. investments that would result in neither innovations nor improved service quality) that the additional cost of NZ$100m of investment will be equal to the full NZ$100m. In reality, there are

[16] Oxera (2014), 'Input methodologies – Review of the "75th percentile" approach', prepared for New Zealand Commerce Commission, 23 June.

likely to be benefits to customers of any additional investments. In some cases—where there are significant positive externalities associated with the investment—the overall benefits could even outweigh the costs. This is the innovation argument discussed in section 5.

Overall, we consider that the impact of over-investment is a second-order effect, for a number of reasons.

- There are likely to be benefits, as well as costs, linked to additional investment. Only if the additional investment projects have BCRs that are significantly below 1.0 will there be a large associated cost.
- The NZCC has some direct controls that are intended to prevent over-investment (e.g. through examining Transpower's CAPEX proposals). Oxera's report is intended to capture only the incremental costs and benefits of a WACC uplift, while taking account of the impact of existing regulatory mechanisms on investment incentives.
- Over-investment may be picked up in regulatory efficiency assessments (although we understand that such assessments are not frequently carried out in the regulation of the electricity transmission and distribution sectors).
- Under ex ante price regulation, companies have ex post incentives to underspend relative to their CAPEX forecast. These incentives should not be affected by the setting of the WACC. Thus there should continue to be a countervailing incentive not to over-invest.

In combination, these factors should suggest that the impact of any over-investment will be small. Therefore, while a multi-year analysis may be more robust where there are large dynamic effects, there is little evidence to suggest that it would produce a better, or even different, answer in this case, while it would invariably increase the complexity of the analysis. The approach adopted—of assessing the costs and benefits on an annualised basis—is likely to be largely equivalent to the NPV basis.

6.3.2 What does the 'optimal' level of investment mean?

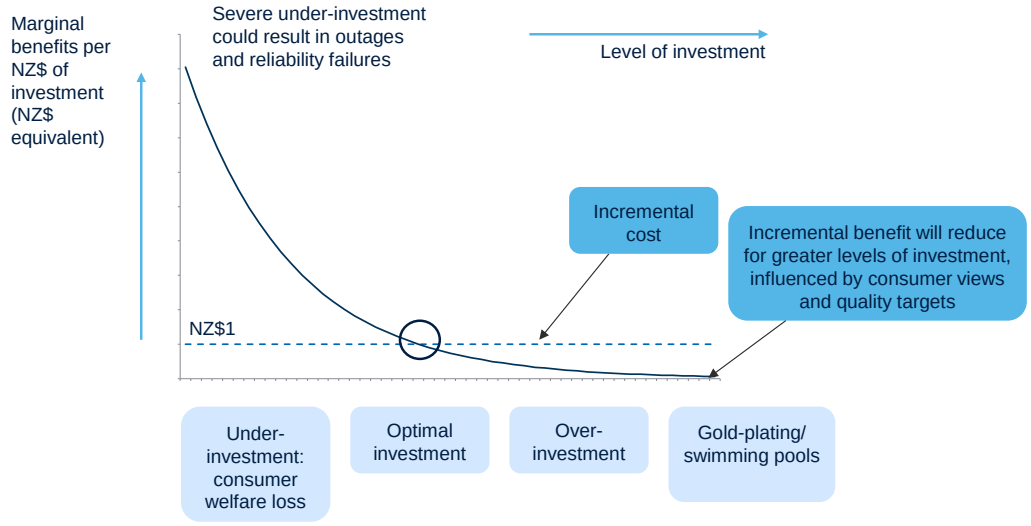
The question of 'over-investment' implies that there is an optimal level of investment, and should regulation result in incentives to invest which differ to that level then there is an adverse effect.

However, given that all investment (whether optimal or sub-optimal) has a cost in financial terms, a purely financial analysis would support under-investment, as it would reduce costs and prices paid by customers.

Therefore any definition of an economic framework for optimal investment must include a quantification of the benefits that arise to customers from that investment to be able to balance these costs and benefits of investment.

The costs and benefits of different levels of investment are compared in Figure 6.1. We assume a case where there is no ability for the regulator to respond to over- or under-investment:

Figure 6.1 Impact of deviating from the 'optimal' level of investment



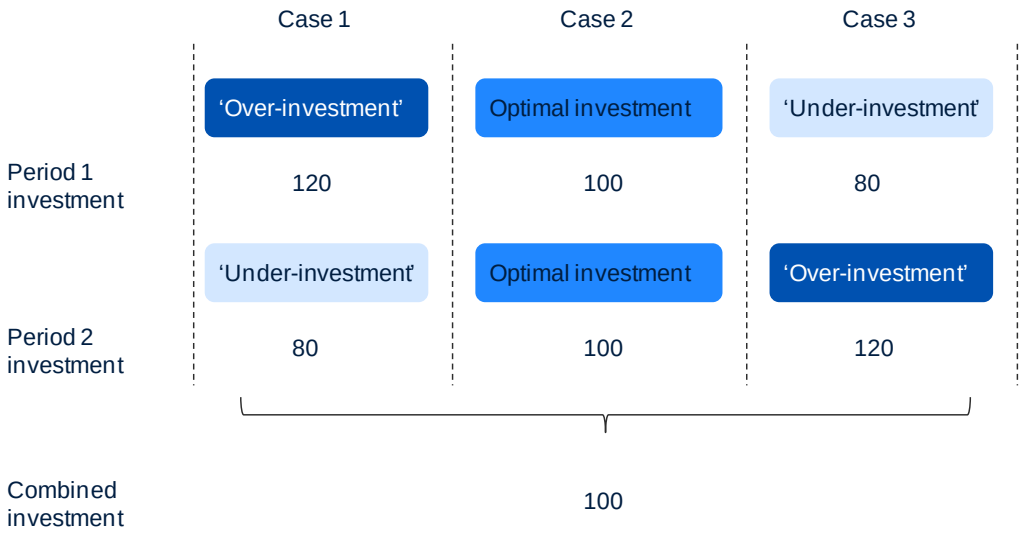
Source: Oxera.

Figure 6.1 illustrates that the costs of over- or under-investment would be as follows:

- **under-investment**—how much additional value would customers place on the additional investment that is forgone as a result of insufficient investment incentives, relative to its cost?
- **over-investment**—by how much does the cost of additional investment exceed its value to customers?

However, the impact described in Figure 6.1 (since it is a 'static' analysis) assumes that the costs of over- or under-investment are permanent. This may not always be the case. If the optimal level of network assets implies a need to invest around NZ$100m a year in the network, the 'optimal' level of investment over time can be achieved through different investment schedules.

Figure 6.2 Reverting to the 'optimal' level of investment over time?

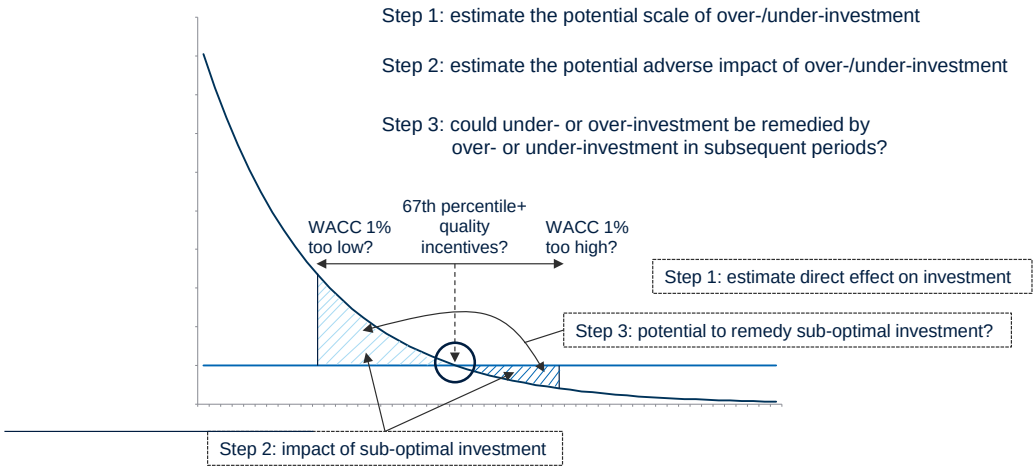


Source: Oxera.

There will be secondary effects in terms of the timing of costs and potentially sub-optimal performance levels in the interim period. However, in this case, these are likely to be relatively second-order (as indicated in Oxera's original report).

In summary, the process for assessing the impact of over- or under-investment will be as depicted in Figure 6.3.

Figure 6.3 Estimating the cost of deviating from the 'optimal' level of investment



Source: Oxera.

As a result, this is a relatively complex analysis since it requires assessment of both the 'optimal' percentile and the potential for persistent over- or under-investment at a 'sub-optimal' percentile.

In addition, it is apparent that the 'optimal' investment level is itself an unknown, and what return is required to promote this optimal investment will depend on the strength of the option for the companies to defer investment, and, potentially, to under-invest.

6.3.3 Assessing the impact of changes in the level of investment

Figure 6.3 demonstrates that the sensitivity analysis indicated by Professor Vogelsang's review appears to consider only the first part of the analysis (Step 1 above). Therefore, as described, it applies only to incremental investments that bring no additional benefits to customers.

By contrast, we note that the Oxera analytical framework as described in Figure 6.3 above implicitly assumes that all (or substantially all) the benefits of the additional investment that will occur as a result of moving from the 50th to a higher percentile are incremental to the longer-term benefits quantified separately in our assessment (i.e. the benefits from reducing the probability of severe outages). For example, there would be additional benefits from other forms of investment, such as to improve cost efficiency (reducing future regulated costs), to extend the reach of the network, or to replace faulty assets and maintain short-term network performance.

Our analysis implicitly assumes that such benefits broadly offset the incremental costs of investment resulting from a WACC above the 50th percentile, in addition to protecting customers against a low-probability asymmetric 'tail risk' of a severe disruption to service in the future. For example, as highlighted in Figure

4.4 above from NZIER, there are various types of investment in the network that are designed to achieve a range of objectives, although they will also contribute to the longer-term health of the network assets.

In practice, when setting an 'optimal' level of investment, benefits to more immediate measures of operational performance and/or to the cost efficiency of the network will need to be taken into consideration alongside benefits in terms of long-term asset health and stability. In the context of Figure 6.3 above, this would indicate that some of the benefits that we assume to broadly offset the costs of investment are reflected separately in our analytical framework as they relate to reductions in the cost of severe outages. Where this is the case, there could be a notional shortfall between the incremental sources of benefit from such categories of investment relative to the costs of that investment. This could result in a small reduction in the overall benefits relative to the costs within our analytical framework.

In summary, we note that Professor Vogelsang's assessment—that there may be additional costs to be reflected in the assessment of a higher percentile as it will result in a greater level of investment—is correct in principle where the costs of investment outweigh the incremental benefits of particular forms of investment (over and above their contribution to offsetting the longer-term risk of severe outages).

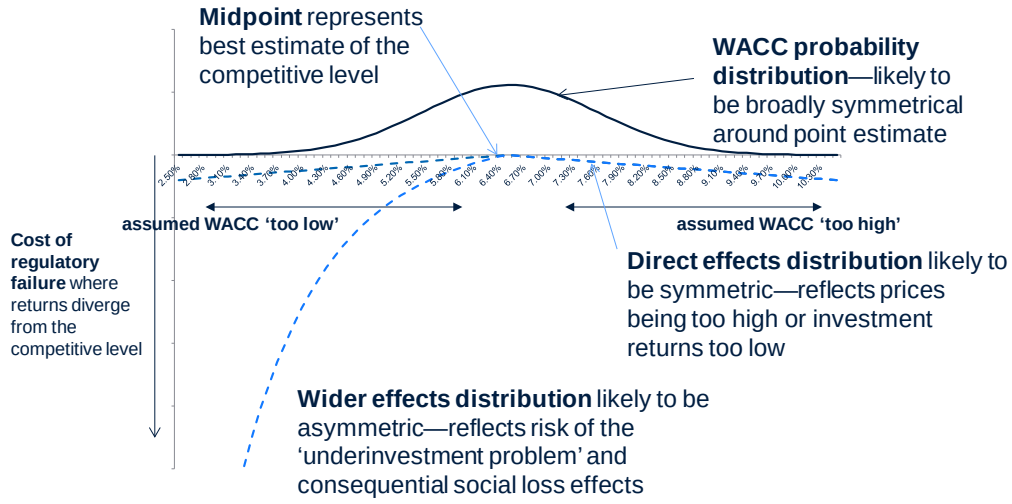
In practice, this effect will be reduced to the extent that there has been limited evidence provided of 'gold-plating' on the network. Much of the investment has additional benefits to users and/or to cost efficiency and we therefore consider that the net effect will be relatively small. However, this could provide an additional case for caution against erring towards the higher end of the range for the choice of WACC percentile.

6.4 Oxera's assessment

Our assessment is that the submissions have not fully reflected the consequences of different levels of investment within the framework considered by Oxera, although we recognise that our analysis makes some simplified assumptions—in particular, for very high percentiles, the risk of over-investment may be more material than illustrated in our initial review.

The approach proposed by Oxera is designed to minimise the costs of regulatory failure, as illustrated in the asymmetric loss function illustrated below.

Figure 6.4 Potential asymmetric risks of regulatory failure



Source: Oxera.

Within the symmetric effects, we explicitly did not include certain factors that we considered to be 'second order'—especially the costs associated with sub-optimal levels of innovation (considered in the previous section) and of investment.

In the context of investment, we consider the appropriate measure to be the level of capital spend relative to the 'optimal' level. The whole implication of the use of a higher percentile is that the optimal level may not occur at the 50th percentile. Therefore, there is no certainty that there is any real expectation of 'over-investment' at the 60th–70th percentile.

Our assessment was that, under an active regulatory framework such as that used for Transpower, the combination of:

- ongoing assessment of quality and asset stewardship indicators; and
- regular reviews of the level of investment in setting price paths

would, when taken together, imply that the net effect should be moderate (and certainly relatively small relative to the direct effect). If the Commission considers that these are insufficient, this would increase the potential for error from setting the WACC 'too high' or 'too low' and strengthen the need for caution.

For a simpler framework, such as that for the EDBs, there may be a greater risk of error, but none of the analysis provided, such as that from NZIER, indicates that there is a major concern around over-investment—if anything, there appears to be a trend towards under-investment.

We note that were a more detailed, multi-year analysis of the costs of potential over-investment to be undertaken, it would need to be considered in parallel with the potential benefits of innovation investments (see above). These are two sides of the same coin: some increased investment may lead to benefits; some may not and will be a cost to consumers. This would need to be considered on a case-by-case basis.

We also recognise that our assumption that this is a second-order effect is on the basis that the actual level of percentile is close to the 'optimal' level for promotion of investment. For example, for a WACC at (or below) the 50th percentile, or at or above the 80th percentile, the strength of incentives to under-

or over-invest will increase significantly. Therefore our analysis may underestimate the disadvantages of these options for the choice of percentile.

We also note the point that some of the costs of investment are not explicitly reflected within our analysis. Our view would be that the net impact of this effect would be relatively small, and unlikely to have a material impact on the choice of percentile, but it could represent a case against aiming towards the upper end of the range.

7 Detailed points from the expert submissions

This section considers a range of other submissions in response to the Commission's proposals and our report.

7.1 Further analysis of the Dobbs model suggests a higher WACC

Frontier Economics for Transpower produced a full update of the Dobbs (2011) analysis. Frontier's paper stated:

> The main difference between Dobbs'/Frontier's model and Oxera's analysis is that in the former, the (under)investment decisions as well as its welfare consequences are determined endogenously within the model, as opposed to be based on some rule of thumb assumptions. Oxera's analysis assumed that firms will withhold investment when the regulated WACC is less than the actual WACC by 0.5% to 1.0%. It is unclear us why this assumption is made and whether this takes into account of the firms' expectation of the future movement in WACC. For example, when investment can be deferred, the firm should be able to withhold its investment if the actual cost of finance is higher than the allowed rate of return. Assuming that the firm will under invest only if the shortfall is at least 0.5% could potentially underestimate the cost of delayed investment.

Frontier's submission recreates the Dobbs model, but with a set of assumptions that are tested where feasible. Adopting a consumer welfare standard, the Frontier model derives an optimal WACC at the 87th percentile. However, not all the assumptions within the Dobbs model can be tested. The Dobbs model, and therefore Frontier's conclusion, involved certain assumptions that are not shared by the Oxera analysis.

In general, the Dobbs model assumptions applied by Frontier are reasonable. For example, they include demand elasticity of -0.3. This is an average of elasticities calculated by the Australian Productivity Commission based on the work of Fan and Hyndman for the short term for the electricity generation business. However, in the long run this could be more elastic, which would lead to a lower optimal WACC and higher deadweight loss for a given price increase due to greater percentage change in consumption.

However, other assumptions require judgement. Frontier 'infers' the demand from new investment from Transpower's CAPEX information. It makes a conservative assumption that demand served by new investment is 1% of that served by existing investment. Sensitivity to this number could potentially have a material impact on the final WACC percentile obtained.

Frontier also assumes that the existing and new demand curves exhibit the same elasticity. Notionally, using the long-term elasticity and then assuming that this would be the same for existing and new demand would be a valid assumption.

Although Frontier gives a reasonable macroeconomic basis for the dampening of demand growth served by existing investment in New Zealand, a growth rate of 0% is conservative. A slightly higher growth rate would lead to a lower optimal WACC. Lastly, if Frontier assumed a higher proportion of transmission and distribution prices to be of the nature of fixed costs, the optimal WACC would be lower. This is shown in its extreme input scenarios, which assume a higher fixed-cost component, leading to a lower optimal WACC.

More generally, our analysis is significantly more transparent in supporting the Commission in exercising its judgement. We stated:

> The approach is consistent with the 'social loss' approach outlined by Dobbs, van Zijl and others, but gives weight to the practical issues involved in estimating the parameters within the social loss analysis. We focus on the impacts of the choice of WACC which can be directly related to the regulator's duties. Since there is no single answer to some of the parameters within the analysis, our approach provides a range of measures. This will then provide evidence to support the Commission in reaching a view on the appropriate percentile.

By contrast, it is not clear from Frontier's submission why the benefits of investment are sufficient to justify the 87th percentile, under a consumer welfare standard.

Our analysis suggests that, in practice, relative to our analysis, these benefits are likely to be overstated or to reflect benefits that would be delivered in any case by quality regulation that requires ongoing investment in the network, without the need for a material premium to the WACC.

We note that Professor Dobbs himself reviews the Frontier analysis.[17] While there are differences between his approach and ours, notably to the base case assumption on the relevant welfare standard, it is notable that Professor Dobbs states:

> My other concern lies with the extent to which the model can be used as a quantitative guide to the best choice of percentile to set for the allowed rate of return. This kind of model articulates why a significant uplift is warranted, but in my opinion, it is unclear how much quantitative significance should be placed on the model predictions. For example, there are reasons for considering the uplift should be greater (because there are sources of uncertainty, notably over future demand and technology, that are explicitly ignored in the model), and reasons for why it should be smaller (because there are other ways in which reliability and investment can be influenced by the regulator, because decision makers do not necessarily behave as Neoclassical economic theory predicts etc.)

We agree with Professor Dobbs' conclusions. The Dobbs (2011) analysis provides a framework that shows that there is a clear economic rationale for a WACC premium, and a need to develop evidence to inform the choice of that percentile. However, it is not possible, as implied by the Frontier analysis, to calibrate exactly the relationship between the costs and the benefits of these investments for customers.

7.2 Benefits of a multi-period analysis

The submissions suggested that Oxera should have been more explicit in considering the benefits of a multi-period analysis. Our analysis was not 'static'—Figures 4.1 and 4.2 above considered how the choice of WACC in the IMs would drive investment over time. However, the analysis did not explicitly consider the inter-period effects.

HoustonKemp considered this in responding to Professor Vogelsang's arguments on the costs of over-investment:

[17] Dobbs, I. (2014), 'Comments on the Application of the Dobbs [2011] model', September.

> Although we agree that the net cost associated with any investment increase above an 'optimal' level should be taken into account, the approach suggested by Professor Vogelsang is problematic and not appropriate in the context of Oxera's analysis. Such an approach would involve comparing the benefits arising in a single year with a cost estimate of a discounted stream of future cash flows. Because Oxera's analysis is based on an assessment of the impact on consumers (costs and benefits) in a given year, these figures are not comparable to the NPV of an on-going stream of annual cash-flows. Such an approach would significantly overstate the relative impact of the increase in the RAB.

Similarly, NZIER suggested a dynamic analysis, again with reference to Professor Vogelsang's review.

> Absent from the Oxera analysis are dynamic costs from over-investment which will result in a potentially large welfare loss to the economy over time. Professor Vogelsang hints at this point in his July review paper but concedes that he does not have the data to adequately evidence this cost.

HoustonKemp takes this to imply that a multi-year NPV analysis would result in a different recommendation. Although such an analysis may be more robust where there are large dynamic effects, there is little evidence to suggest that it would produce a better, or even different, answer, while it would invariably increase the complexity of the analysis. The approach adopted—assessing the costs and benefits on an annualised basis—is likely to be largely equivalent to the NPV basis.

Our view was therefore that the separate consideration of individual years would not change the assessment of the appropriate percentile. What would be more relevant is the impact of the dynamic effects over different periods. However, as discussed in section 4 above, this largely depends on the Commission's view of its ability to use dynamic regulatory intervention to address under-investment, rather than relying on a persistent and material premium to the WACC.

Therefore, in principle, we accept that a dynamic, multi-period assessment could influence the Commission's decision, but our assessment is that this is best done through the appropriate interpretation of the range, and that the Commission has effectively reflected this within its final choice of percentile.

7.3 Oxera used the wrong standard error

The original Oxera report used the Commission's approach to measuring standard errors, and stated the following:

> The Commission's approach assumes that certain WACC parameters, which cannot be observed directly from the financial markets, have a measurable uncertainty over their actual values. The range is estimated as a normal distribution, or 'bell curve'. This recognises that there is no strict limitation on the extent to which the WACC could differ to expectations, but the probability of a small error is greater than the probability of a larger error.[18]

The main response on the estimation of the standard error was presented by Sapere:

[18] Oxera (2014), 'Input methodologies – Review of the "75th percentile" approach', prepared for New Zealand Commerce Commission, 23 June, section 6.1.

> 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.
>
> 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 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.[19]

Our analysis states clearly that we adopt the Commission's approach to estimating uncertainty for the WACC for our analysis, the underlying theory of which can be debated. Sapere proposes an alternative approach to estimating the standard error of the WACC, under the assumption that both the actual WACC and its standard error are unknown.

Sapere's case may have some merit. However, it is not clear that, under a more extensive statistical analysis, the only effect that should be considered would be that of the 'right' WACC to be used in estimating loss probabilities. This was noted in Covec's cross-submission:

> The Sapere submission argues that Oxera has erred by assuming that the mark-up component is a fixed amount rather than a random variable. While technically true, it is questionable whether there is merit in considering this argument given the somewhat loose statistical grounding of the WACC distribution analysis generally.
>
> More importantly however, the adjustment proposed by Sapere is itself based on an assumption that the estimates of WACC and the percentile mark-up are statistically independent. We outline reasons why these variables may covary negatively, which would undermine and potentially reverse Sapere's conclusions on the direction of bias.

However, the revised probabilities presented in Table 1 of Sapere's report are marginally above those estimated by Oxera. Oxera's recommendation for a point estimate between the 60th and 70th percentile indicated a range of 7.3–23.6% for a loss of 0.5–1.0%. Sapere's revised numbers indicate a range of 10.9–26%. This relatively small effect would be partly offset by the higher 'cost' and therefore lower net benefit of a higher percentile that would result from the standard error being higher.

As such, even if Sapere's analysis were considered valid, it would be unlikely to result in Oxera revising its recommendation. We agree with Covec that it is disproportionate to re-open the assessment of the form and size of the standard error at this stage.

[19] Sapere (2014), 'Proposed amendment to the WACC percentile–Commerce Commission's draft decision', 29 August, p. 19.

7.4 Assessment of the expected loss factor

The Oxera report highlighted an additional relevant cross-check of 'expected loss' analysis:

> The 'expected loss' approach would therefore consider the value to customers of reducing the downside risk for the investor, assuming that investors will seek to underinvest to offset the risk of value reduction, and that the under-investment problem will increase with a higher differential. The 'expected loss' represents the size of downside risk for investors. As long as the WACC is at or above the 50th percentile, this will be offset by 'expected profits' in cases where the actual WACC is below the assumed WACC. The relevance of the expected loss is that it represents a notional 'insurance premium' to offset the under-investment problem.[20]

Sapere considered Oxera's analysis to be erroneous.

> While expected loss to investors is a useful alternative to loss probabilities, Oxera's calculations are all in error. 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.'
>
> 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. 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 $24 million from lower charges and imposes additional costs of $34 million in reduced reliability.[21]

In practice, Sapere's proposals constitute an alternative way of calculating expected loss, not evidence that Oxera's analysis is erroneous.

In the simplest possible case, where there is a 50% chance of a gain of NZ$100, and a 50% chance of a loss of NZ$100, Sapere argues that the expected loss is NZ$100, as it is certain that the loss will be NZ$100 (if a loss occurs). Under Oxera's approach, the expected loss is NZ$50, as there is a 50% chance of no loss, and a 50% chance of a loss of NZ$100.

These are different definitions of an expected loss, and Sapere's assumption is different, rather than Oxera's approach being in error.

[20] Oxera (2014), 'Input methodologies – Review of the "75th percentile" approach', prepared for New Zealand Commerce Commission, 23 June, Box 6.2.
[21] Sapere (2014), 'Proposed amendment to the WACC percentile–Commerce Commission's draft decision', 29 August, section 5.4.

In practice, we cannot see why Sapere's approach would be more relevant. Its approach would imply that customers should pay for the expected loss under all cases. We would consider that the better approach would be for customers to pay the expected value of losses—i.e. to consider the value of the expected loss, as described in Oxera's report.

Tel: +44 (0) 1865 253 000
Email: enquiries@oxera.com

www.oxera.com

Oxford
Park Central
40/41 Park End Street
Oxford
OX1 1JD
United Kingdom

Berlin
Pariser Platz 4a
10117 Berlin
Germany

Brussels
Stephanie Square Centre
Avenue Louise 65
Box 11
1050 Brussels
Belgium

London
200 Aldersgate
14th Floor
London
EC1A 4HD
United Kingdom

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