Initial WACC Review

Report Prepared for Vector

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Executive Summary

Synergies Economic Consulting has been engaged by Vector Limited to undertake a review of the Weighted Average Cost of Capital (WACC) to apply to its gas pipeline and electricity lines businesses in the context of Part 4 of the Commerce Act and the Commerce Commission's (the Commission's) associated development of an input methodology relating to the regulatory cost of capital. In undertaking this review we have referred to the Commission's Revised Draft Guidelines in relation to the estimation of the cost of capital, dated 19 June 2009 (the Guidelines), as well as other relevant precedent.

Given time constraints, this report presents our initial assessment of the key issues underpinning each parameter and whether there is considered to be reasonable grounds to depart from either the principles set out in the Guidelines and/or specific parameter values that have been previously proposed by the Commission for the relevant assets. A more detailed report will follow, which is to be submitted by the end of August.

A summary of our initial assessment is as follows.

1. We are not seeking to propose substitution of an alternative model for the Brennan-Lally CAPM, however still consider the assumption of a closed economy to be extremely limiting, given foreign investors will have a practical influence on the values of a number of the key parameters.

2. We do not accept the adoption of a maturity for the risk-free rate that matches the term of the regulatory period because this ignores refinancing risk. In practice, a large commercial business such as Vector would fund its long-term assets with at least some long-term debt. The Commission has already acknowledged that the interest rate risk associated with this could be managed by hedging. Hence, if the term of the risk-free rate continues to be set with reference to the length of the regulatory period, at minimum, compensation should be provided for these hedging costs.

3. In relation to capital structure, we have initially examined:

    - the sample of comparator firms that we have also used for the beta analysis (which are mainly US firms);

- the sample of Australian energy utilities considered by the Australian Energy Regulator (AER) as part of the development of its recent Statement of Regulatory Intent (SoRI) on WACC; and
- observed book values for some of the major New Zealand energy utilities over the past five years.

Based on our initial assessment we consider that the 40% assumption that has previously been applied by the Commission is more likely to be at or towards the lower bound of a reasonable range. The upper bound of that range would be at least 60%.

4. While the Commission has previously adopted a value of zero for the debt beta, in the Guidelines it has indicated that it may now adopt a positive number, although the methodology and the possible order of magnitude of the estimate remain unclear. The difficulties in estimating debt beta have been recognised by others (including Lally). While alternative methods have been proposed, there is currently no robust, accepted methodology of deriving a reliable estimate for the debt beta.

   Given any CAPM-derived estimate will always overstate the value of the debt beta given the extent to which the debt margin is driven by non-systematic risks, this methodology must be discarded. While we acknowledge that the debt beta may have some positive value, in the absence of any reliable methodology to measure it we are of the view that it should be set at zero.

5. In reviewing the beta assumption, we examined a sample of listed gas and electric utilities, most of which are domiciled in the US. A first principles analysis will be conducted as part of our more detailed review. We limited our sample to firms with 60 months of data, and eliminated any estimates that failed our statistical filters.

   Our main concern is that the starting point for Lally's previous assessment for US firms – being an asset beta of 0.3 – may be too low. In our view, the range is more likely to be in the order of 0.3 to 0.4. Adjustments then need to be applied to reflect differences between the regulatory regimes in the US and New Zealand (Lally has applied 0.1) and the differences in the systematic risk of gas versus electricity (Lally added 0.1 for gas). Overall, we concur with these adjustments. There are a number of aspects of our analysis that we propose to investigate further as part of our more detailed review.

6. It remains difficult to estimate the MRP with any certainty, particularly when applying it as a proxy for the forward-looking MRP. The fundamental problem

in this context is the difficulties in determining a robust estimate from New Zealand market data. We have therefore referenced long-term historical estimates from other jurisdictions produced by Dimson et al (2006), in particular:

- 6.5% for the US, with a standard deviation of 20.16; and
- 7.81 for Australia, with a standard deviation of 18.8.

Without making any adjustments for jurisdictional differences, the AER's recently determined MRP of 6.5% is equivalent to a TAMRP of 8.15%.

Adjusting the US estimate for New Zealand market characteristics is important but is difficult to do in a robust way. This is because there are a number of differences here, not all of which can be quantified. Further, we have not made any adjustments to ensure consistency with the Commission's preference to use a five year risk-free rate. We intend to examine some of these issues in more detail as part of the detailed report.

Overall, however, when we consider all of the evidence presented here, we consider that the MRP of 7% is too low. Putting the effects of the global financial crisis aside, the long-term historical MRP is more likely to be in the order of 8%, rather than 7%. We are also of the view that forward-looking estimates remain too unreliable to draw any robust conclusions regarding the MRP. We are therefore of the view that unless evidence of a structural break emerges with time, reliance should continue to be placed on historical estimates.

It should also be noted that this report has not addressed the debt margin, or debt and equity raising costs. It is understood that these are to be considered for the end of August.

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1 Introduction

Synergies Economic Consulting (Synergies) has been engaged by Vector Limited (Vector) to recommend an appropriate Weighted Average Cost of Capital (WACC) to apply to its gas pipeline and electricity lines businesses in the context of Part 4 of the Commerce Act and the Commerce Commission's (the Commission's) associated development of an input methodology relating to the regulatory cost of capital. In doing this, we will identify, if relevant, any key differences between the WACCs that would apply to electricity lines and gas pipeline businesses that are subject to regulatory control.

In undertaking this review we have referred to the Commission's Revised Draft Guidelines in relation to the estimation of the cost of capital, dated 19 June 2009 (the Guidelines). We have also considered previous determinations by the Commission, including its 2008 *Authorisation for the Control of Supply of Natural Gas Distribution Services by Powerco Ltd and Vector Ltd* (the 2008 Authorisation). We have also had regard to other relevant regulatory precedent, as well as generally accepted commercial practices. Overall, we recognise that any departures from the principles and parameter values set out in the Guidelines needs to be supported by evidence to show that the alternative is a materially better approach or outcome.

Given time constraints, we have prepared an initial report which summarises our key considerations on each parameter. Further analysis will be undertaken as part of a detailed report, which is to be submitted by the end of August. We will review and refine our recommendations in light of this more detailed analysis.

The first section of our report examines some general methodological issues. The specific parameters are then considered.

2 Methodology

2.1 Uncertainty in WACC estimation

One of the reasons that WACC estimation in regulatory determinations can prove so controversial is because it often involves the pursuit of precision in areas that remain inherently uncertain. For example, notwithstanding the efforts that have been made to improve beta estimation, it remains highly susceptible to estimation error (this is considered in more detail later). Further, it remains well recognised that the 'optimal' level of gearing for a firm in a given industry is more likely to sit within a range, rather than represent a precise estimate.

We therefore endorse the Commission's intention to apply 'reasonableness' checks, such as financeability tests. We also endorse its recognition of the asymmetric consequences of error by selecting a WACC from above the mid-point of the range.

At the same time, the 'checks and balances' that the Commission proposes in themselves introduce some additional uncertainty for regulated businesses. For example, it is proposed that alternative models to the Capital Asset Pricing Model (CAPM) may be applied. However, it is not clear under what circumstances that might occur or what weight would be given to those models.

The CAPM has a number of recognised deficiencies however there currently remains no widely accepted alternative that could serve as a more superior asset pricing model. While alternatives can be used to test the reasonableness of the outcomes produced by the CAPM, it is not clear what would happen if there were significant differences between the outcomes produced by alternative models. What this may necessitate is an adjustment to the WACC range, or further consideration of where the point estimate is selected from within that range.

It is certainly clear that a degree of judgment needs to be applied and that is reflected in our assessment. In our view, the key test that should be applied is whether the proposed estimate put forward by the regulated business lies within a reasonable range of outcomes, not whether one estimate is better than another. The Guidelines retain considerable discretion for the Commission, which creates uncertainty for the regulated business.

2.2 Form of the CAPM

The standard form of the CAPM is extensively used globally for estimating the cost of equity capital. Motivated by the introduction of dividend imputation, the post-tax CAPM developed by Michael Brennan was adapted to New Zealand by Martin Lally and others. The result has been widely referred to as the Brennan-Lally CAPM. A simplified version of this model has been adopted by the Commission. Although some reservations were expressed by the Commission's independent experts, the Commission has decided to continue using the model.

Our primary concern with the Brennan-Lally CAPM is the assumption of a closed economy. For example in Australia, in its Statement of Regulatory Intent (SoRI) the Australian Energy Regulator (AER) recently determined that it would recognise the presence of foreign investors in the domestic capital market, notwithstanding that the Officer WACC framework has often been applied based on an assumption of full segmentation from the global economy[1]. In our view, this approach is realistic as it recognises the practical influence that foreign investors can have on some of the key WACC inputs, without necessitating the application of a model that assumes full integration with the world economy.

We concur with the Commission that only a single version of the model can be used. It is also recognised that each version has its own advantages and disadvantages. Given that the Commission has made it clear that it will continue to apply the Brennan-Lally CAPM (after noting the potential issues with assuming a closed economy), we have applied that version here. However, we are of the view that caution needs to be exercised when interpreting outcomes while ignoring the practical influences that overseas investors will exert in the New Zealand market.

[1] Australian Energy Regulatory (2009), Electricity Transmission and Distribution Network Service Providers - Statement of the Revised WACC Parameters (Transmission), Statement of Regulatory Intent on the Revised WACC Parameters (Distribution), May.

3 Parameters

3.1 Risk free rate

We note that after considering the views of the various stakeholders (and the Expert Panel), the Commission remains committed to setting the risk-free rate based on the maturity that matches the length of the regulatory period. This is different to the practice adopted by all Australian regulators, for example, who use a ten year bond maturity. This includes the AER, who proposed the use of a maturity that matched the length of the regulatory period in its Draft SoRI, before subsequently reverting to the use of a ten year maturity based on evidence submitted by the regulated businesses, which showed that they do seek to obtain funding for longer terms. In making that determination the AER acknowledged that the assumption of a shorter term would increase refinancing risk.[2]

3.1.1 The NPV=0 requirement

The Commission's preference to use a rate that matches the term of the regulatory period is based on the proposition that it is necessary to maintain NPV neutrality. This in turn has been based on the recommendation of Professor Lally. Lally's conclusion is based on what Lally himself acknowledges as highly simplified assumptions. Under his model:

> ...the only source of uncertainty is in future real interest rates. [3]

In particular, this assumes that there is no refinancing risk when debt matures. If interest rate risk is the only risk that is considered, then it will be optimal to match the term of the funding with the term of the regulatory period. This of course assumes that the interest rate achieved on the debt matches the cost of debt set by the regulator, which in turn requires that the entire debt portfolio is refinanced over the same period that the risk-free rate is set.

Notwithstanding that this model is acknowledged as being highly simplified, its conclusions have been relied upon with no consideration given to the actual commercial and regulatory environment.

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[2] ibid., p.173.

[3] M. Lally (2002), Determining the Risk Free Rate for Regulated Companies, Paper Prepared for the Australian Competition and Consumer Commission, August.

Refinancing risk is of fundamental importance when a business determines its funding strategy. Ignoring this risk is too far an abstraction from reality. If refinancing risk is considered, limiting the term of any funding to the term of the regulatory period will fail the NPV=0 test.

Under the circumstances assumed by Lally, the optimal funding strategy for a business would be to match the term of the funding with the length of the regulatory period. In order to minimise refinancing risks and ensure that the actual cost of debt was as close as possible to the regulated cost of debt, this would involve refinancing the entire portfolio around the reset dates. Clearly, this is neither realistic nor prudent for most businesses, including Vector.

The Commission does acknowledge that:

> Regulated firms may borrow for periods longer or shorter than the regulatory cycle if they wish. Any interest rate risk associated with doing so could be offset in the interest rate swap market.[4]

There are two difficulties with this. First, it imposes a cost of hedging on the business that is not currently compensated (noting that these costs would not otherwise be incurred if the business was not regulated because it would not be required to hedge its risk in this way). Second, it only manages the interest rate risk associated with the fixing and periodic reset of the regulated cost of debt. However, the underlying refinancing risk on its physical debt portfolio remains unchanged.

A further risk that has not been considered here is the exposure that the businesses have to interest rates on new borrowings undertaken to fund capital expenditure during the course of the regulatory period. This is a separate issue that could be considered as part of debt raising costs (to the extent that it is prudent to hedge at least part of this exposure).

3.1.2 Recommendation

Economic regulation should complement efficient commercial decisions by regulated businesses. In our view, the rational benchmark firm will set the term of its debt funding in the most efficient manner, and it should not be rewarded for inefficient financing practices. The evidence clearly shows that businesses with long term assets

[4] Commerce Commission (2009), Revised Draft Guidelines: The Commerce Commission's Approach to Estimating the Cost of Capital, 19 June, para.148.

will seek to fund themselves for longer terms. They also seek to maintain some portfolio diversification to manage interest rate, liquidity and refinancing risks. This is efficient commercial practice.

Our recommendation is that the risk-free rate is therefore based on a ten year bond maturity. If a maturity that matches the term of the regulatory period continues to be applied, we would recommend that at minimum, a business be provided separate compensation for the reasonable costs of hedging the interest rate risk on its debt (this may best be done via a separate allowance in the cash flows).

3.2 Capital structure

3.2.1 Overview

It is not possible to readily identify a single 'optimal' capital structure for any firm, in any industry. Instead, we consider it more appropriate to focus on determining the optimal 'range' for the industry. The lower bound of that range recognises the benefits of gearing that accrue to the firm (including its relatively lower cost and possible tax advantages). The upper bound reflects that there is a point beyond which taking on additional borrowings will expose the firm to financial distress. This will be largely driven by the firm's risk profile, which will depend on the nature of its industry as well as firm-specific characteristics.

3.2.2 Determining the optimal capital structure range for regulated gas and electricity utilities

We concur with the Commission's approach of basing the capital structure assumption on an appropriate notional capital structure for the relevant industry. This involves examining gearing levels for similar firms, averaged over an appropriate period to recognise that actual gearing levels observed at any one point in time may not reflect the target level of gearing for that business (for example, this may be due to where it currently is in its capital expenditure cycle).

It is also important to consider this within the context of the implied credit rating. This includes testing the impact of different gearing levels on key financial ratios, which will in turn influence the credit rating. We would propose to look at this in our more detailed report.

For the purpose of this initial assessment we have examined:

- the sample of electricity and gas businesses that have been used for the purpose of the beta assessment (the comparator sample); and

- observed gearing levels for some Australasian energy businesses.

Comparator sample

Our comparator sample comprises listed firms contained in the industry categories 'gas utilities' and 'electric utilities'. Using data from Bloomberg, we have obtained the average gearing levels for each firm over the last five years. Where rated, we have also obtained their current credit rating from Standard and Poor's. Most of the firms are from the US. Differences in the average gearing levels for the different jurisdictions therefore also need to be considered.

As will be highlighted in the beta assessment, there are few comparators that are only engaged in transmission and/or distribution. We have therefore included firms that are engaged in transmission and/or distribution but also undertake other activities in the energy sector, such as generation. The implications of this will need to be considered when interpreting the results. Some firms are involved in both gas and electricity markets (the GIC classification reflects where most of the company's revenues are sourced). It should be noted that the sample is slightly larger than our beta sample as some of the firms failed our statistical filters for the purpose of the beta assessment. Descriptions of the companies are provided in Attachment A.

The average gearing levels of our sample of comparator gas utilities over the last five years is provided in the following table.

Table 1 Average gearing levels: gas utilities

Company	Average debt to total value	Credit rating[a]
Mostly transmission/distribution		
Australia		
APA Group	58.7%	-
Envestra Limited	78.9%	BBB-
Canada		
Gaz Metro Limited Partnership	53.4%	A-
Pacific Northern Gas Ltd	39.3%	-
US		
AGL Resources Inc	35.5%	A-
Atmos Energy Corporation	38.7%	BBB+
Southwest Gas Corporation	41.2%	BBB
Chesapeake Utilities Corporation	32.0%	-
Piedmont Natural Gas Company	35.2%	A
WGL Holdings Inc	28.2%	AA-
Northwest Natural Gas Company	32.9%	AA-
The Laclede Group	35.7%	A

Company	Average debt to total value	Credit rating[a]
Corning Natural Gas	55.9%	-
RGC Resources Inc	30.7%	-
Integrated gas utilities (all US)		
EQT Corporation	30.2%	BBB
National Fuel Gas Company	29.5%	-
Energen Corporation	26.6%	BBB
UGI Corporation	40.6%	-
Ferrellgas Partners	70.2%	-
Delta Natural Gas Company	40.9%	-
Nicor Inc	55.9%	AA
South Jersey Industries Inc	33.0%	-

a As at 5 August 2009

Source: Gearing data: Bloomberg; credit ratings: Standard & Poor's

Some of the observations we can make from this data are as follows:

- the range for US firms engaged primarily in distribution or transmission is between 28.2% and 55.9%. The simple average is 36.6%;
- the Australian firms and one of the two Canadian firms are more highly geared. APA Group and Envestra's average gearing levels are 58.7% and 78.9% respectively.

In interpreting these numbers, consideration should be given to any differences between the various jurisdictions that might impact gearing levels. These issues are discussed further below.

The average gearing levels for electric utilities over the past five years are shown in Table 2.

Table 2 Average gearing levels: electric utilities (all US firms)

Company (Jurisdiction)	Average debt to total value	Credit rating[a]
Mostly transmission/distribution		
Exelon Corporation	30.4%	BBB
Pepco Holdings Inc	38.8%	BBB
Integrated electric utilities		
FPL Group	34.6%	A-
Duke Energy Corporation	28.7%	A-
Entergy Corporation	30.9%	BBB
American Electric Power Company	36.9%	-
FirstEnergy Corp	37.1%	BBB
Allegheny Energy	45.1%	BBB-
Northeast Utilities	38.1%	BBB

Company (Jurisdiction)	Average debt to total value	Credit rating[a]
DPL Inc	46.6%	-
NV Energy Inc	48.1%	BB
Westar Energy	33.5%	BBB-
Great Plains Energy Incorporated	33.5%	BBB
Cleco Corporation	31.7%	BB
Idacorp Inc	34.5%	BBB
Allete Inc	26.9%	-
Unisource Energy Corporation	58.7%	-
UIL Holdings Corporation	31.3%	-
El Paso Electric Company	37.9%	-
The Empire District Electric Company	40.4%	-
Central Vermont Public Service Corporation	28.5%	BB+

a As at 5 August 2009

Source: Gearing data: Bloomberg; credit ratings: Standard & Poor's

All of our firms are domiciled the US. The average gearing level for the two firms primarily involved in transmission and/or distribution are 30% and 39%.

Overall, it is not clear that there are any discernible differences between the gearing levels of firms in the gas and electricity industries, although this is not considered surprising given the particularly imprecise nature of capital structure estimation and the reasonably wide range of outcomes observed. It is also not possible to discern any differences between transmission and distribution to justify treating these differently for the purpose of estimating the optimal range of gearing levels. What we do observe, however, is that the credit ratings of the electricity utilities are lower than the gas utilities.

Australasian firms

In developing the SoRI, the AER examined a sample of Australian gas and electricity businesses as part of its review of the optimal gearing level of the efficient benchmark network service provider. The sources they reviewed included:

- market values from Bloomberg, for APA Group, DUET, Envestra, GasNet, SP AusNet, and Spark Infrastructure;
- book value analysis from Standard & Poor's, for CitiPower, Country Energy, the Dampier Bunbury Natural Gas Pipeline Trust, ElectraNet, Energy Australia, Energy Partnership (Gas) Pty Ltd, Envestra Victoria, Ergon Energy, ETSA Utilities, Integral Energy, Powercor and United Energy.

They also published an adjusted Bloomberg dataset that adjusted total debt to remove the effects of stapled securities, loan notes and double leveraging.

The average gearing levels are reported in the following table.

Table 3 AER: reported average gearing levels of gas and electricity utilities

Year	Bloomberg (market)	Bloomberg (adjusted)	Standard & Poor's	Average
2002	66.3	67.4	61.6	**65.1**
2003	63.9	63.7	66.7	**64.8**
2004	62.2	58.2	64.7	**61.7**
2005	62.8	63.3	67.8	**64.6**
2006	60.3	62.1	66.4	**63.0**
2007	58.7	57.8	65.1	**60.5**
Average	**62.4**	**62.1**	**65.4**	**63.3**

Source: Australian Energy Regulatory (2009), Electricity Transmission and Distribution Network Service Providers - Statement of the Revised WACC Parameters (Transmission), Statement of Regulatory Intent on the Revised WACC Parameters (Distribution), May, p.113.

The data on actual observed gearing levels reported by the AER provides clear support for the benchmark gearing level of 60% that was determined by the AER, and has been consistently applied to distribution and transmission network businesses by all jurisdictional regulators in Australia.[5]

We have also examined gearing levels maintained by the major New Zealand gas and electricity utilities over the past five years (based on book values). This is shown in Table 4.

Table 4 New Zealand utilities – gearing levels

Financial year ending	Vector	Powerco	Orion Group	Unison
2004	65.1%	64.8%	27.5%	47.4%
2005	53.8%	48.8%	19.6%	43.3%
2006	53.3%	61.9%	19.7%	33.7%
2007	56.5%	61.6%	26.3%	32.0%
2008	50.7%	74.8%	24.5%	46.0%
Average	**57.2%**	**59.3%**	**23.3%**	**39.1%**

Note: Based on non-current liabilities to total assets.

Given their relative size, we consider Vector and Powerco to be the most appropriate comparators for this purpose. The average gearing level of both firms over the last five years has been close to 60%. It is important to note that as these gearing levels are for

[5] This was also prescribed in the National Electricity Rules for all transmission network service providers, as well as distribution network service providers in New South Wales and the Australian Capital Territory.

the entire business, they do not necessarily reflect the gearing maintained by the gas and electricity transmission and distribution networks. However, all other things being equal, we would expect that the sustainable gearing for a regulated business activity is likely to be higher than the gearing level that could be maintained for other contestable activities.

3.2.3 Interpreting the data

It is difficult to draw any definitive conclusions from our comparator sample for a number of reasons. First, none of these firms are close comparators to a 'stand-alone' regulated gas or electricity network business. Unless each company publishes separate balance sheets for each business activity in the group (which is often not the case), it will not be possible to make any robust adjustments to the firm-wide gearing level in order to estimate the gearing level of the transmission or distribution business.

Second, we have relied primarily on US data. As outlined above, consideration needs to be given to the average gearing levels between the US and New Zealand markets. Some of the key factors that could influence these differences include the relative tax advantage of debt, the depth and sophistication of the capital markets and the availability of risk management tools. Third – and this will also be an issue that will need to be considered for the beta analysis – most of these firms are likely to be in a more competitive market environment than a regulated New Zealand utility, particularly those firms that are integrated. In theory, as noted above, we would expect the gearing levels of the contestable activities, such as generation, to be lower than the gearing level that could be maintained for a transmission or distribution network business.

Overall, it is not clear what the net impact of these differences will be. For example, the relative depth and sophistication of capital markets in the US and the availability of risk management tools might facilitate higher gearing levels by firms in this market. On the other hand, those firms who are in more contestable markets and hence face higher risk, will only be able to maintain lower gearing levels.

In making comparisons between the different datasets, it is also important to note that there are some differences in the measurement basis for each. The Bloomberg data is based on interest-bearing debt to enterprise value. Our New Zealand sample is based on book values (which we understand is the Commission's preference).

In our view, the evidence from Australasian businesses is likely to be of most relevance to Vector. This is for a number of reasons. First, the businesses are largely involved in transmission and/or distribution, and a significant number are regulated. Second, the

Australian and New Zealand tax regimes are similar, as are the size and sophistication of the domestic capital markets (particularly relative to the US).

Based on our initial assessment we consider that 40% is more likely to be at or towards the lower bound of a reasonable range. The upper bound of that range would be at least 60%.

Given there is no clear difference between the gearing levels observed for gas and electricity businesses, it is considered appropriate to apply this same assumption to electricity and gas networks. There is also no evidence to suggest that different gearing levels should be applied to distribution and transmission.

In our more detailed analysis we will undertake a further review of our comparators, including considering the potential impacts of jurisdictional differences. We will also consider the impact of different gearing levels on key financial ratios and hence the credit rating.

3.3 Debt beta

3.3.1 Commission's position

Historically, the Commission has applied a zero debt beta. From our review of the Guidelines, the Commission's position on this is very unclear. What it does conclude is that:

> When setting allowed rates of return, the Commission intends to estimate debt betas wherever feasible using the CAPM. If, for the reasons outlined above, reliable estimation proves infeasible, the Commission intends to draw on recent published evidence (which usually relate to overseas markets such as the US) to inform its view on the magnitude of (New Zealand) debt betas.[6]

This is of significant concern for two reasons. First, this position is very unclear and presents considerable uncertainty for regulated businesses. Second, as we will outline below, there is no generally accepted method to reliably estimate debt betas. Hence, we expect that reliable estimation will "prove infeasible". Further, we are not aware of any empirical evidence – from the US or elsewhere – that presents a method of estimating debt beta that has gained, or is likely to gain, widespread acceptance.

[6] ibid., para. 195.

3.3.2 Problems with estimating the debt beta

An approach that has been used to estimate the debt beta uses the structure of the CAPM:

$$\beta_d = (R_d - R_f)/(E(R_m) - R_f)$$

Where:

β_d = beta of debt

$(R_d - R_f)$ = debt premium

$(E(R_m) - R_f)$ = market risk premium.

This has the appeal of using a familiar relationship between beta and the market risk premium $(E(R_m) - R_f)$. However, there are a number of problems. In application, the market return is measured as the return on an equity market. In principle, to be applied to debt, the market return should be measured with a market index that includes debt. Also, the approach attributes the total of the promised debt risk premium $(R_d - R_f)$ to systematic risk. However, given it is recognised that a substantial determinant of the cost of debt is non-systematic default risk, this approach will significantly over-estimate the value of the debt beta.

An alternative approach is to assume the debt beta is zero. Lally has previously recommended the application of a debt beta of zero in a regulatory context:[7]

> …on account of the difficulties in estimating the debt beta, the slightness of the error in treating it as zero, the likelihood that the resulting errors are less than those arising from the Authority's current approach, and the likelihood that the errors will be of the less serious type than those arising from the Authority's current approach.

The Australian Competition and Consumer Commission (ACCC) considered this issue in the development of its *Statement of Principles for the Regulation of Electricity Transmission Revenues*.[8] It noted the uncertainty surrounding the estimate of the debt beta, particularly given that it was not generally used by investors, and that different approaches yield different outcomes. It determined that it would apply a value of between 0 and 0.2. Importantly:

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[7] M. Lally (2004), The Cost of Capital for Regulated Entities, Report prepared for the Queensland Competition Authority, p.75.

[8] Australian Competition and Consumer Commission (2004), Decision: Statement of Principles for the Regulation of Electricity Transmission Revenues – Background Paper, December.

> …the ACCC considers that the debt beta is immaterial as long as the same value is used in the de-levering and re-levering process.[9]

Most (but not all) of the State-based regulators now adopt zero. The preferred approach of both the ACCC and the AER is to adopt a value of 0.[10]

The fundamental deficiency of using the CAPM-based approach to derive the debt beta is that it will always overstate the debt beta given the debt margin is largely driven by non-systematic risk factors. This situation is exacerbated at the current time given the blow-out in credit spreads that have occurred due to conditions in global financial markets, with an increase in the debt margin resulting in a significant increase in the debt beta.

As noted above, the debt beta estimate is not considered a significant issue provided the same estimate is used in the equity beta de-levering and re-levering process. However, that in turn implies that the regulated entity's equity beta is being set with direct reference to the comparator data. When a higher value of debt beta is applied, for example, it will result in a relatively higher value for the de-levered asset betas (the comparators), and a lower equity beta when the regulated entity's asset beta is re-levered. In other words, this will prove 'immaterial' if the regulated entity's asset beta is set with *direct* reference to the comparator estimates.

This will not always be the case, particularly if the risk profile of the business is different to its comparators. More importantly, the fundamental issue here is whether there is a sound economic basis to support the estimated value for the debt beta. The potential anomaly is highlighted in the current environment with the increase in credit spreads.

As noted above, the cost of debt is largely driven by non-systematic default risk. There is no evidence to suggest that the expansion in credit spreads is due to an increase in the systematic risk of debt (that is, an increase in the covariance between the return on debt securities and the return on the market).

More specifically, this implies that there has been a global transfer of risk from equity holders to debt holders. There is no evidence that this has occurred nor is there any plausible reason why this would be the case. The more realistic scenario is that the systematic risk of debt has not changed and the movements in credit spreads are based

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[9] ibid.

[10] Australian Energy Regulator (2008), Explanatory Statement – Electricity Transmission and Distribution Network Service Providers, Review of the Weighted Average Cost of Capital (WACC) Parameters, December, p.201.

on changes in perceived default risk (worsened by signalling problems associated with trading in the market for debt)[11].

In any case, as outlined above, given that the debt beta itself cannot be readily estimated the actual influence of systematic risk on corporate bond yields remains unknown.

What this highlights is the significant issues associated with deriving the debt beta using the CAPM. The sensitivity of the debt beta estimate to changes in the debt margin assumes that these changes are solely driven by systematic risk. If this relationship does not hold, which we are firmly of the view is not the case, it can actually produce an outcome which has no theoretical support and in fact may contradict what is more likely to be the case in practice.

3.3.3 Recommendation

The difficulties in estimating debt beta have been recognised by others (for example by Lally, as outlined above). While alternative methods have been proposed, there is currently no robust, accepted methodology of deriving a reliable estimate for the debt beta. Given any CAPM-derived estimate will always overstate the value of the debt beta given the extent to which the debt margin is driven by non-systematic risks, this methodology must be discarded. While we acknowledge that the debt beta may have some positive value, in the absence of any reliable methodology to measure it we are of the view that it should be set at zero.

In our view, a debt beta of zero should be applied because there is currently no robust way of estimating a value that measures the systematic risk of debt only. This is particularly important given the asymmetric consequences of error. An assumption of zero has therefore been recommended for Vector.

3.4 Equity beta

3.4.1 Methodological issues

Approaches to estimating beta

There are three basic approaches to estimating systematic risk of equity, being:

[11] That is, given the heightened uncertainty associated with corporate debt investors perceive the desire of a debt holder to sell that debt as a 'signal' that the debt holder has inside information about the negative quality of the debt.

1. *Direct Estimation.* If the firm is listed, regression analysis can be used to estimate the relationship between the firm's returns and the returns on the domestic share market index. At least several years of trading data is required to provide a statistically meaningful estimate. Also, the applicability of the estimated equity beta will depend upon whether the company is involved in business areas outside of the regulated activity being studied.

2. *Comparable Companies.* This approach begins by identifying a set of comparable listed companies with a similar business and risk profile. Using share price information for the companies, their equity betas are estimated using regression analysis. As the companies will have different gearing levels (and hence different financial risk), these equity betas must be 'de-levered' to produce an asset beta.

3. *First Principles.* This approach analyses the factors that impact the sensitivity of a firm's returns to movements in the economy or market. It can be used for two main purposes. First, it can be used to assist in the selection of comparable companies. Second, as the comparable companies analysis will tend to produce a range of plausible estimates for beta, the first principles analysis can assist in determining where the particular firm may be within that range based on its relative risk profile.

Vector is a listed entity so it is possible to estimate a beta for the firm as a whole. However, the regulated network businesses are part of a larger portfolio of energy-related businesses held by Vector. As the risk profile of the regulated networks will be different from the risk profile of the entire (diversified) group, the beta estimate for Vector cannot be solely relied upon for this review.

A first principles analysis is considered of fundamental importance. Apart from informing an interpretation of where the beta for Vector's regulated networks might sit relative to the comparators, it will also assist in understanding the extent to which there are differences between electricity and gas businesses, and transmission and distribution networks. In particular, we need to understand if those differences are likely to be sufficiently material to warrant a different beta estimate.

We have not had the opportunity to complete a first principles analysis for this initial assessment. However, it will be included subsequently in our more detailed report.

Problems in estimating beta

Before progressing to the more detailed analysis, it is important to be aware of the susceptibility of beta to estimation error. It is not possible to directly observe a firm's true beta. Instead, estimates are obtained by regressing the historical returns of a firm's shares against the historical returns for a market index, over the same time period. As

with any statistical estimate, it is measured with uncertainty. This uncertainty is likely to be more pronounced for individual firms. As a consequence, the resulting data estimates can be of limited reliability and caution should be exercised in applying these estimates in a forward-looking analysis.

There are a number of ways to address measurement error. As a starting point, any beta estimates with poor statistical properties[12] should be discarded (this is discussed further below). There are a number of other ways to deal with the uncertainty surrounding the estimation of beta, including:

- adjusting for thin trading, which is a common cause of measurement error, using techniques such as the Scholes-Williams technique;
- adjusting for mean reversion (i.e. the tendency for equity betas to move towards the equity beta of the market over time) using techniques such as the Blume and Vasicek adjustments[13]; and
- the formation of portfolios. Portfolio betas have substantially lower standard errors and yield more precise estimates of beta. While there are benefits in using this approach via reductions in the standard error, as more firms are used caution should still be exercised to ensure that they are relevant comparators.

A report by Gray et al provides a useful summary of the various methods of estimating beta, as well as their performance.[14] The study uses historical data to compare the predicted beta estimate in accordance with the CAPM, with the actual equity return for the relevant forecast period. The closer the predicted estimate to the actual equity return, the better the estimation technique. A summary of the findings of the report are:

- it is preferable to use data periods of longer than four years;

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[12] The **R^2**, or coefficient of determination, measures the explanatory power of the regression equation (that is, how much of the variability in Y can be explained by X). It takes a value of between 0 and one. For example, an R-squared of 0.7 would suggest that 70% of the variability in the individual share's returns is explained by variability in the returns on the market. The **standard error** measures the sampling variability or precision of an estimate. That is, as the estimate is derived from a sample distribution, it measures the precision of the model parameter. A lower standard error is preferred as it indicates a more precise measure. A third commonly used measure is the **t statistic**. The t statistic is calculated for each coefficient in a regression model (in this case, the beta coefficient) for the purposes of hypothesis testing. The tendency is to test the hypothesis that the regression coefficient is significantly different from zero. This is done within a specified confidence interval (for example, 95%). Generally, the t statistic should exceed two to be considered reliable. These measures have been used in this analysis to screen comparator beta estimates.

[13] The impact of this adjustment is to 'draw' the value of the estimated beta closer to one. The typical adjustment is simply: Adjusted beta = (1/3 * the market beta of one) + (2/3 * estimated beta). This can be reduced to: Adjusted beta = 0.33 + (0.67 * estimated beta).

[14] S. Gray, J. Hall, R. Bowman, T. Brailsford, R. Faff, and R. Officer (2005), The Performance of Alternative Techniques for Estimating Equity Betas of Australian Firms, Report Prepared for the Energy Networks Association.

- monthly observations are preferred to weekly observations;
- Blume-adjusted estimates that account for mean reversion provide better estimates;
- statistical techniques that eliminate outliers are preferred, provided the outlier is not expected to re-occur; and
- a beta estimate derived from a sample of firms in an industry is preferred to an estimate for an individual firm.

Approach applied in this review

There are a number of measures we have implemented here in an attempt to address estimation error.

First, we have constructed estimates for a sample of firms that are considered to be of the most relevance to Vector's electricity and gas networks.

Second, we eliminated any firms that did not have five years of monthly share price data. Unfortunately, Vector had to be excluded on this basis. A summary of the rationale for using monthly data, and not say, weekly, is provided in the following Box.

Box 1 Rationale for the use of monthly observations

Because shares are traded relatively infrequently it is not always possible to obtain a precise measurement of return. If returns could be measured continuously then the return on an individual security (R_{it}) and the return on the market (R_{mt}) would be a perfectly matched pair so that regressions of R_{it} and R_{mt} would give precise beta estimates. Because prices for shares occur and are reported at distinct random intervals an accurate calculation of returns is almost impossible. If correct returns cannot be measured it becomes very difficult to calculate correct betas.

One of the issues that needs to be considered is the interval over which the return on the asset is measured. In many cases trades in a specific share do not occur every day. It follows that the time period or lag over which observations are taken may result in some information being ignored.

This problem does not depend on infrequent trading. Much of the research has focused upon daily information. This research argues that beta estimates, particularly in the short term, vary according to the lag period used to measure the returns.

Research has shown that the 'interval effect' on beta estimation is that as the interval is shortened:

- beta falls for relatively thinly traded securities; and
- beta rises for relatively thickly traded issues of securities.

Cohen, Hawawini, Maier, Schwartz and Whitcomb (1983) and Fung, Schwartz and Whitcomb (1982) have conducted studies in the United States, France and Australia and they see the true beta is a function of the lag period taken to measure returns and the size of the firm. Both variables (lag and firm size) are seen as indicators of the frequency of trading in a particular security.

There is no reason why non-trading should be confined to one day or week. When daily prices are used it is easy to understand why beta estimates fluctuate. A small fluctuation in price would be quite substantial in terms of day to day changes and day to day estimations. However as the time periods for measuring returns are extended, the expectation is that more stability would enter the measurement and smaller fluctuations occur in beta estimates. With smaller fluctuations R_{it} and R_{mt} should have a stronger relationship. Hence the longer the interval, the stronger is the relationship.

Third, we eliminated any estimates from the sample that had a t-statistic of less than two (see footnote 12 for an explanation of the t-statistic).

The reason we have applied these filters is because regression analysis is a statistical procedure that is commonly used to estimate beta in the absence of being able to observe the 'true' value of that beta. The explanatory power of the resulting estimate is of fundamental importance. If the resulting estimate has relatively low explanatory power, we cannot be confident that the estimate provides any valuable information regarding the true value of that beta.

Blume adjustment

The Blume adjustment is a statistical technique that is used in recognition of the tendency for betas to mean revert towards unity over time. The adjustment is applied by a number of data providers, such as Bloomberg. Gray et al identify two main reasons why betas may exhibit mean reversion:

- it reflects a conscious decision by management to move the firm towards the average risk of the market (via its investment strategies); **or**
- beta *estimates* might revert towards unity even if the 'true' beta is stable:

> That is, Blume-type adjustments can be interpreted in the context of measurement error rather than any conscious decision undertaken to move the firm's true beta toward unity.[15]

Regulators have tended to reject the application of the Blume adjustment based on the first reason. However, this ignores the fact that mean reversion may have nothing to do with actual management practice and could actually be due to the second reason, and hence may be a source of measurement error that in turn could result in regulatory error. There is no evidence confirming why the second reason should be rejected in favour of the first. In the absence of such evidence we are of the view that a conservative approach would be to consider a number of possible adjustments for measurement error that could improve the quality of the comparator estimates.

[15] S. Gray, J. Hall, R. Bowman, T. Brailsford, R. Faff, and R. Officer (2005), op.cit., p.10.

We note that the Expert Panel did not reach a consensus view on this issue. Dr Lally was opposed to using the Blume (or Vasicek) adjustments. Professors Myers and Franks, on the other hand, gave more recognition to the issue of mean reversion.

We have therefore provided our comparator beta estimates with and without the Blume adjustment.

3.4.2 Selecting the comparator sample

We have examined two sectors in our analysis, being:

- gas utilities; and
- electric utilities.

In compiling the sample, we applied a number of filters with two key aims, being to ensure that:

- the business activities of the firm are sufficiently relevant to our purpose, placing emphasis on firms involved in gas and/or electricity transmission and distribution; and
- the sample was statistically robust, given the issues with estimation error that were outlined above. Despite the filters being applied here, estimation error will remain an issue and needs to be kept in mind when drawing any conclusions from the analysis.

The filters applied were as follows:

- at least five years of monthly data is necessary for each firm. We applied a minimum threshold of 60 observations; and
- beta estimates with a t-statistic of less than 2 were excluded (refer footnote 12).

The most relevant comparators will be New Zealand firms although as has already been widely recognised, there are insufficient firms to limit our analysis to this market. This has similarly proven in issue in Australia, where there is also a relatively small number of firms that meet these requirements. In particular, given mergers and divestments that have occurred in the industry, there are difficulties finding firms for whom 60 months of data can be collected.

Significant caution should also be exercised in relying upon foreign comparators, and preference should be given to those jurisdictions that have (at least broadly) similar economic, commercial and regulatory structures. For this reason, we have limited our

overseas jurisdictions to Australia and the United States. However, further adjustments may need to be made, particularly for the US firms, which dominate our sample.

Full details of our sample are provided in Appendix A. All data was sourced from Bloomberg.

We delevered the observed equity betas using the average gearing for each firm over the same five year period. We applied the formula recommended by the Commission, which is:

$$\beta_a = \beta_d\left[\frac{D}{D+E}\right] + \beta_e\left[\frac{E}{E+D}\right]$$

Because we have assumed a debt beta of zero, the first term of this equation drops out.

3.4.3 Results

There are fourteen businesses in our sample of gas utilities. The results are summarised in the following table. Again, we have separated those firms that are predominantly involved in transmission and/or distribution, from the more integrated firms.

Table 5 Betas for gas utilities

Company	Equity beta	Standard error	t-stat	R^2	Average debt to value	Asset beta (no Blume)	Asset beta (with Blume)
Mainly transmission and distribution							
Australia							
APA Group	0.751	0.189	3.968	0.214	58.7%	0.310	0.344
Envestra Limited	0.865	0.259	3.333	0.161	78.9%	0.182	0.192
Canada							
Gaz Metro Limited Partnership	0.396	0.132	2.987	0.133	53.4%	0.184	0.278
Pacific Northern Gas	0.412	0.133	3.094	0.142	39.3%	0.250	0.368
US							
AGL Resources Inc	0.395	0.118	3.355	0.163	35.5%	0.255	0.383
Atmos Energy Corporation	0.505	0.105	4.795	0.284	38.7%	0.310	0.410
Southwest Gas Corporation	0.727	0.143	5.097	0.309	41.2%	0.427	0.480
Chesapeake Utilities Corporation	0.462	0.145	3.184	0.149	32.0%	0.314	0.435
Other integrated gas utilities							
National Fuel Gas Company (US)	0.727	0.151	4.819	0.286	29.5%	0.513	0.576
EQT Corporation	0.826	0.192	4.306	0.242	30.2%	0.577	0.617

Company	Equity beta	Standard error	t-stat	R^2	Average debt to value	Asset beta (no Blume)	Asset beta (with Blume)
Energen Corporation (US)	1.198	0.193	6.201	0.399	26.6%	0.879	0.832
UGI Corporation (US)	0.352	0.137	2.566	0.102	40.6%	0.209	0.336
Ferrellgas Partners (US)	0.648	0.142	4.555	0.263	70.2%	0.193	0.227
Delta Natural Gas Company	0.471	0.110	4.261	0.238	40.9%	0.278	0.381

Source: Bloomberg

Of the firms involved primarily in distribution or transmission, we can observe:

- for the US firms, the range is between 0.255 to 0.427 (0.383 to 0.48 Blume-adjusted). The average (simple) is 0.326 (0.418 Blume-adjusted) and the standard deviation is 0.041;
- there is considerable variability amongst our small sample of Australian and Canadian firms.

Considerable variability is also exhibited within our sample of integrated utilities, with asset betas ranging between 0.193 (0.227 Blume-adjusted) to 0.879 (0.832 Blume-adjusted). This could also reflect the diverse activities of the firms. The simple average is 0.442 (0.495 Blume-adjusted) with a standard deviation of 0.22. We need to be particularly cautious in interpreting these results as it reflects the risks of other activities, such as generation.

The results from our sample of electric utilities are provided in Table 6.

Table 6 Betas for electric utilities

Company	Equity beta	Standard error	t-stat	R^2	Average debt to value	Asset beta (no Blume)	Asset beta (with Blume)
Mainly transmission and distribution (all US)							
Exelon Corporation	0.629	0.147	4.283	0.24	30.4%	0.438	0.523
Pepco Holdings Inc	0.577	0.154	3.758	0.195	38.8%	0.353	0.439
Other integrated electric utilities							
US							
FPL Group	0.636	0.129	4.933	0.296	34.6%	0.416	0.494
Duke Energy Corporation	0.437	0.107	4.101	0.225	28.7%	0.312	0.444
Entergy Corporation	0.673	0.141	4.760	0.281	30.9%	0.465	0.540
American Electric Power Company	0.571	0.123	4.635	0.270	36.9%	0.361	0.450
FirstEnergy Corp	0.550	0.173	3.178	0.148	37.1%	0.346	0.439
Allegheny Energy	0.995	0.209	4.752	0.280	45.1%	0.546	0.547
Northeast Utilities	0.501	0.133	3.761	0.196	38.1%	0.310	0.412
DPL Inc	0.579	0.120	4.837	0.287	46.6%	0.309	0.383

Company	Equity beta	Standard error	t-stat	R^2	Average debt to value	Asset beta (no Blume)	Asset beta (with Blume)
NV Energy Inc	0.787	0.167	4.719	0.277	48.1%	0.409	0.445
Westar Energy	0.663	0.121	5.481	0.341	33.5%	0.441	0.515
Great Plains Energy Incorporated	0.810	0.123	6.603	0.429	33.5%	0.539	0.581
Cleco Corporation	0.537	0.126	4.277	0.240	31.7%	0.367	0.471
Idacorp Inc	0.432	0.141	3.065	0.139	34.5%	0.283	0.406
Allete Inc	0.742	0.141	5.260	0.323	26.9%	0.542	0.604
Unisource Energy Corporation	0.601	0.201	2.987	0.133	58.7%	0.248	0.302
UIL Holdings Corporation	0.731	0.160	4.582	0.266	31.3%	0.502	0.563
El Paso Electric Company	0.694	0.135	5.152	0.314	37.9%	0.431	0.494
The Empire District Electric Company	0.790	0.128	6.158	0.395	40.4%	0.471	0.513
Central Vermont Public Service Corporation	0.674	0.255	2.640	0.107	28.5%	0.482	0.559
New Zealand							
TrustPower Limited	0.760	0.133	5.727	0.361	26.5%	0.559	0.617

Source: Bloomberg

There is only one non-US firm in the sample; TrustPower Limited, whose activities are of less relevance for this purpose. Of the two most useful firms, the asset betas are 0.353 (0.439 Blume-adjusted) and 0.438 (0.523 Blume-adjusted). Of our remaining integrated US utilities, the asset betas range from 0.283 (0.406 Blume-adjusted) to 0.546 (0.547 Blume-adjusted). The simple average of the asset betas is 0.41 (0.482 Blume-adjusted), with a standard deviation of 0.09.

3.4.4 Conclusions

It is difficult to draw firm conclusions from the preceding samples. First, there are only a relatively small number of firms that might be considered appropriate comparators for this purpose. Second, we need to take account of jurisdictional differences. Lally considers the differences between US and New Zealand firms in his 2008 report.[16] One of the differences he considered was leverage and tax. Overall, he found that the tax and leverage differences (coincidentally) net out. We will consider this issue further as part of our more detailed report.

Lally considered a number of other data sources in his review, including estimates produced by Damodoran, Alexander et al (1996), Ibbotson Associates and Standard and Poor's. Overall, he assessed an asset beta of 0.3 for US electricity utilities and gas

[16] M.Lally (2008), The Weighted Average Cost of Capital for Gas Pipeline Businesses, 28 October.

distribution firms. Lally concluded that 0.3 was a lower bound given the rate of return regulation that is applied in the US. He added an increment of 0.1 to reflect the differences in the regulatory environments between US and New Zealand.

Lally's base estimate of 0.3 is slightly lower than what our findings suggest, particularly if the Blume adjustment is taken into account. Further, notwithstanding the statistical filters we applied, the standard errors of the individual estimates remind us that it remains probable that a beta could be observed above or below these estimates. Our findings suggest that an asset beta between 0.3 and 0.4 may be a more reasonable starting point before the adjustments are made for jurisdictional differences, even without the Blume-adjustment.

The results of our beta analysis showed that on average, the betas of electric utilities where higher than gas. While we are yet to undertake our detailed first principles analysis, in terms of distribution and transmission, we would expect the beta of gas to be higher (this is the regulatory treatment that has largely been reflected in Australian regulatory decisions, for example). One of the key reasons for this is because gas tends to be considered a 'fuel of choice' relative to electricity.

Lally reached similar conclusions in his analysis. The key reasons that he saw gas utilities as having higher risks are:[17]

- the presence of more growth options;
- the high income elasticity of demand (with a large proportion of gas – around 30% - used as an intermediate product in the petrochemical industry);
- a reasonable proportion of its usage is for variable rather than base supply; and
- a relatively higher proportion of its demand is accounted for by commercial and industrial users.

Lally adds a further increment of 0.1 to account for these differences. He does not consider that there are sufficient differences to warrant a different beta for transmission versus distribution.

Lally therefore proposes an asset beta of 0.4 for electricity and 0.5 for gas.

Our main concern is that the starting point for Lally's assessment – being an asset beta of 0.3 – may be too low. At the same time, we acknowledge the potential deficiencies of our sample. There are a number of aspects of our analysis that we propose to investigate further as part of our more detailed review.

[17] ibid.

3.5 Market Risk Premium

3.5.1 Commerce Commission's Position in Draft Guidelines

The estimation of the market risk premium (MRP) has proven reasonably contentious in regulatory determinations. The MRP is the amount an investor expects to earn from a diversified portfolio of investments over and above the return earned on a risk-free investment. The key difficulty in estimating the MRP arises from it being an expectation and therefore not directly observable.

> The equity premium is not only the single most important number of finance, but estimating it is also our most perplexing problem.[18]

Given the number of issues surrounding the estimation of the MRP and the debate that has occurred in previous regulatory decisions, we found it particularly surprising that relatively little attention was given to this issue by both the Expert Panel and the Commission.

There are a number of methods that have been used to estimate the MRP. The most common approach is to apply a long-term historical average of the excess returns from holding shares (based on the return on the relevant sharemarket index) compared to the risk-free rate. Overall, we concur with the Commission that historical techniques are the most useful starting point for the analysis. We note that the Commission recommends the use of Dimson et al (2008) estimates, adjusted for long-term trends in price-dividend ratios. It then recommends using forward-looking estimates as a cross-check. Judgement is unavoidably applied to arrive at a recommended estimate.

We note that there was consensus amongst the Expert Panel on some, but not all, of the issues that they examined (which, as we outlined above, were extremely limited). The panel members agreed that the Commission should:[19]

- continue to draw on international estimates; and
- retain its approach of considering forward-looking and historical estimates.

However, there was some difference of opinion in the relative weight that should be applied to forward-looking and historical estimates, with Franks and Myers

[18] I. Welch (2000), Research Roundtable Discussion: The Market Risk Premium, p.3, available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=234713.

[19] J. Franks, M. Lally & S. Myers (2009), Recommendations to the New Zealand Commerce Commission on an Appropriate Cost of Capital Methodology, p.22.

recommending that primary weight is placed on historical estimates and Lally favouring equal weights over a wide range of estimation methods.

In this section we will first consider an appropriate historical estimate for the MRP. We will then examine this estimate within the context of forward-looking estimates, with particular focus on the implications of the global financial crisis for the MRP.

3.5.2 Estimation method

There are a number of issues that need to be considered here, including:

- jurisdiction;
- data source;
- length of the estimation period;
- geometric versus arithmetic averages; and
- term of the risk-free rate.

Each of these issues is considered below.

Jurisdiction

We note the Commission's continued concerns with relying on New Zealand data, given issues such as the interest rate controls and financial regulation applying prior to 1985, and the limited size, maturity and liquidity of the New Zealand equity market. This is contrasted with the US market, which is "significantly more established, well-diversified, and deeply traded."[20]

In our view, there are a number of alternatives here. One is to use some sort of global average MRP, and then make an adjustment to the estimate to reflect the characteristics of the New Zealand market. Our concern with using a global average is that it masks considerable underlying variability across jurisdictions. Further, some of the jurisdictions in that sample may be particularly inappropriate comparators to New Zealand.

A second approach is to attempt to identify a jurisdiction – or subset of jurisdictions – that is most similar to New Zealand. However, given the range of influences that need to be considered here, including (but not limited to) market structure and regulation,

[20] Commerce Commission (2009), Revised Draft Guidelines: The Commerce Commission's Approach to Estimating the Cost of Capital", 19 June, p.35.

liquidity, size, taxation, sophistication and transaction costs, it is extremely difficult to identify such a comparator/s. The Australian market is likely to be the closest relevant comparator, noting that there are still significant differences in the size and underlying structure of the New Zealand and Australian economies. Also, the Australian economy went through a similar transition in the 1980s as did New Zealand, which presents the same issues that the Commission has identified in using New Zealand data.

A third approach is to take an estimate from the largest, most liquid capital market in the world, being the US market, and then seek to apply that estimate to New Zealand, adjusting for key differences between the markets. The key difficulty with this approach is that there are a number of distinguishing characteristics that could influence the relative MRP in each jurisdiction. Further, estimating the impact of each influence on the MRP is problematic.

Each approach therefore has its difficulties. On balance, we consider the third approach to be the most suitable starting point for our purposes.

Data source

The Commission has recommended the use of estimates produced by Dimson, Marsh and Staunton. We have referred to a comprehensive study they undertook in 2006, which developed estimates of the equity risk premium for 17 countries and then considered the results within the context of the 'equity premium puzzle', which has underpinned concerns by the Commission (and others) that observed historical equity risk premia may be overstated.[21]

The study uses the DMS global database, which:[22]

> …comprises annual returns, and is based on the best quality capital appreciation and income series available for each country, drawing on previous studies and other sources. Where possible, data were taken from peer-reviewed academic papers, or highly rated professional studies.

In particular, one of the 'guiding principles' for their study was to:[23]

[21] E. Dimson, P. Marsh & M. Staunton (2006), "The Worldwide Equity Premium: A Smaller Puzzle", London Business School, 7 April.

[22] ibid., p.8.

[23] ibid., p.10.

> …avoid survivorship, success, look-ahead, or any other form of *ex post* selection bias…

although they do acknowledge that the database still suffers from survivorship bias because all 17 countries have a full 106 year data history.

Length of the estimation period

There are a number of questions that need to be considered before we consider their results. The first is the length of the estimation period. One school of thought proposes that as long a horizon as possible should be used. This is because from year to year, the MRP is extremely volatile and a longer term average is required to produce a meaningful estimate. This assumes that investors' risk aversion has not changed over time and the average market risk premium has remained stable.

An alternative view is that only more recent data is relevant, particularly if the market has undergone significant structural change over time (for example, the introduction of dividend imputation). This approach results in an estimation problem in that estimates based on shorter datasets have standard errors that are too high to produce a statistically meaningful estimate.[24] Further, conditions prevailing over a short period of time may not necessarily be an appropriate basis for a forecast (for example, unusually high returns or high volatility).

Dimson et al have produced estimates over a 106 year period between 1900 and 2005. In using such a long time period, they examined year on year estimates, as well as estimates for key sub-periods through time, including the impact of significant world events. This confirmed the inherent volatility of shorter term estimates. They conclude that:[25]

> When estimating the historical equity premium, therefore, the case for using long-run data is clear. Stock returns are so volatile that it is hard to measure the mean historical premium with precision. Without long-run data, the task is impossible, and even with over a century of data, the standard error remains high – even if we assume that the underlying series is stationary.

We concur with the use of a long-term estimate as a proxy of the forward-looking MRP. The only circumstance under which this might be questioned is where there has

[24] A. Marsden and M. Lally (2004), ("Historical Tax-adjusted market risk premiums in New Zealand: 1931-2002",*Pacific Basin Finance Journal, p.*423 – 449) report standard deviation of annual returns of over 23% for historical market risk premiums.

[25] ibid., p.16.

been a structural change, which has altered the way in which investors assess risk and return. This is considered at the end of this section.

Geometric versus arithmetic averages

Dimson et al report both geometric and arithmetic averages. As there is a material difference between the estimates under each approach, a decision must be made as to which is the most appropriate to use for this purpose.

Arithmetic averages are more popular but arguments are made in the literature for geometric averages on the basis that are more efficient (that is, they will produce less biased estimates of the "true average"). A study by Hathaway noted significant differences between averages under each method, with the arithmetic mean producing an estimate of 7.2%, whereas the geometric mean estimate was 6%.[26] Hathaway opined that the geometric return is more appropriate for historical averaging, but the arithmetic average is appropriate for future estimates as it provides an unbiased estimator of expected future outcomes.

Gray and Officer also support the use of an arithmetic mean.[27] They state that the arithmetic mean is the preferred method on the basis that we are looking to estimate the expected value of the MRP. They note that a geometric mean is appropriate:[28]

> …when estimating the aggregated return from a buy and hold strategy over a long period, but that is not the purpose here. The MRP is to be used in the CAPM to compute the cost of equity expressed in annual terms. Therefore, we require an estimate of the expected return, over the next year, on the market portfolio over and above the risk-free rate. What return do we expect on the market portfolio over the next year, relative to the risk-free rate? The historical data provides us with many observations on what the market returned relative to the risk-free rate over a one-year period. To the extent that each of these observations should be given equal weight, a simple arithmetic average is appropriate.

We are of the view that an arithmetic average is the most appropriate method for estimating the MRP based on historical data. The CAPM is a single time horizon model and as such the use of a geometric average would be inconsistent with its assumptions.

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[26] N. Hathaway (2005), Australian Market Risk Premium, Capital Research Pty Ltd.

[27] S. Gray & R. Officer (2005), A Review of the Market Risk Premium and Commentary on Two Recent Papers, A Report Prepared for the Energy Networks Association, p.21.

[28] ibid.

Estimates

The estimates produced by Dimson et al are summarised in the following table.

Table 7 Annualised equity premiums 1900 - 2005

Country	Arithmetic Average	Standard Error	Standard Deviation
Australia	7.81	1.83	18.80
Belgium	4.37	1.95	20.10
Canada	5.67	1.74	17.95
Denmark	3.27	1.57	16.18
France	6.03	2.16	22.29
Germany[a]	8.35	2.69	27.41
Ireland	5.18	1.78	18.37
Italy	7.68	2.89	29.73
Japan	9.98	3.21	33.06
Netherlands	5.95	2.10	21.63
Norway	5.26	2.66	27.43
South Africa	7.03	1.88	19.32
Spain	4.21	1.96	20.20
Sweden	7.51	2.17	22.34
Switzerland	3.28	1.70	17.52
UK	5.29	1.61	16.60
US	6.49	1.96	20.16
Average	6.08	2.11	21.71
World – ex US	5.18	1.48	15.19
World	5.15	1.45	14.96

a Germany omits 1922-23

Source: E. Dimson, P. Marsh & M. Staunton (2006), "The Worldwide Equity Premium: A Smaller Puzzle", London Business School, 7 April, p.18.

The long-term historical average US MRP is 6.5%. While the authors express some caution in interpreting the US estimate because of 'ex post success bias' (which is some 1.31% higher than the 'world' estimate, excluding the US), they also observe that the US still ranked only seventh out of the 17 countries based on the arithmetic mean. After considering the issue of survivorship bias in some detail, they conclude that:

> …provided a very long run approach is taken, inferences from the United States do not appear to have given rise to very large overestimates of the historical world equity premium. It is still possible, however, that our world index overstates worldwide historical equity returns by omitting countries that failed to survive.[29]

[29] ibid., p.21.

A further issue that needs to be considered is the maturity of the risk-free rate that underpins the MRP estimate, recognising that estimates that reference bond rates are typically based on long maturities. Dimson et al note that their US estimates are based on the ten to fifteen year bond index. The Australian estimates use a five year bond rate to 1949, and then a ten year rate to 1986. From 1986 onwards they use the JP Morgan Australian government bond index based on a maturity of over seven years.

We note that the Commission has considered the issue of consistency between the risk-free rate maturity used to estimate the cost of debt and equity and the maturity that underpins the estimation of the MRP. However, they do not consider that it is necessary to adjust for this.

In our view, this has the potential to give rise to a fundamental inconsistency. The impact of this inconsistency depends on the term structure of interest rates, with the yield curve – on average – tending to be upward sloping. Given the shape and slope of the yield curve varies considerably through time, this needs to be considered over the longer term.

Application to New Zealand

US data

The fundamental differences between the US and New Zealand markets mean that we cannot simply apply the US estimate as a proxy for the New Zealand MRP. As noted above, there are a number of factors that can influence this. Some of these factors will reduce the New Zealand MRP relative to the US, whereas others will increase it. The analysis is further complicated by the clear correlation between the factors.

Some of the key factors that could influence the relative differences are listed in Table 8.

Table 8 Key differences between US and New Zealand markets

Factor	Differences	Direction of influence on New Zealand MRP (relative to US MRP)
Market size	New Zealand market significantly smaller than US	Increase
Market composition and diversification	New Zealand market considerably less diversified. Average size of the US companies that comprise the index will be much larger than New Zealand.	Increase
Liquidity	New Zealand market considerably less liquid	Increase
Sophistication	New Zealand market less sophisticated. For example, fewer instruments are available to manage risks.	Increase
Taxation	Different capital gains regimes (as to who they apply to and the rates applied eg New Zealand has higher rates)	Net impact not considered material.

Factor	Differences	Direction of influence on New Zealand MRP (relative to US MRP)
	New Zealand has dividend imputation. However, as in reality, the marginal investor that sets prices is likely to be foreign, the value of imputation credits will not be reflected in observed estimates of the New Zealand MRP.	

While an adjustment should be made for these differences, the difficulty is that it is not possible to make a robust adjustment for each factor (even if we can adjust for some of them). What we can clearly conclude, however, is that the New Zealand MRP would be materially higher than the US MRP.

Comparisons with Australian estimates

From the data in Table 7, the MRP estimate for Australia is 7.81%, which is considerably higher than the regulatory precedent of 6%. In order to enable a comparison with the New Zealand estimate, we need to convert this standard MRP to a tax-adjusted MRP (TAMRP).

As has been noted in previous submissions, a MRP of 6% equates to a tax-adjusted MRP (TAMRP) in the Brennan Lally model of around 8% (assuming a long-term risk free rate of 5.5% and a tax rate of 33%, noting that this result was rounded up). Based on a 30% tax rate, this estimate is 7.6%. If the 7.81% estimate produced by Dimson et al is applied to these same assumptions, the equivalent TAMRP is 9.45%. This is significantly higher than the Commission's recommended estimate.

Recently, in its recent Final Decision in relation to the WACC to apply to electricity distribution and transmission businesses, the Australian Energy Regulator (AER) increased the MRP from 6% to 6.5%. This is equivalent to a TAMRP of 8.15%. The primary rationale for this was the impact of the global financial crisis. This is considered further below.

3.5.3 Forward-looking estimates of the MRP

In general, there is an inverse relationship between changes in actual returns and the expected (or forward-looking MRP). In other words, when the historical MRP is changing (based on very short-term estimates), the forward-looking MRP will move in the opposite direction. Further, a small movement in the historical MRP can result in quite significant changes in the forward-looking MRP.

This has certainly been observed during the global financial crisis. Following the significant compression in equity returns, which will also compress historical estimates of the MRP (particularly over shorter horizons), significant increases in the expected

MRP were observed. However, these estimates are extremely volatile. For this reason, we do not consider that it is appropriate to rely on these forward-looking estimates to set the MRP, particularly given the asymmetric consequences of error. However, what such differences can do is flag the need for more detailed examination. This is particularly the case where there is a significant difference between forward-looking and historical estimates. At the same time, we need to remain cognisant that short-term forward-looking MRPs are extremely volatile. We must therefore be extremely cautious in drawing any conclusions from these differences, including discarding historical estimates, which may still remain the most appropriate proxy for the longer term forward-looking MRP.

As noted above, in arriving at its recommended estimate of 6.5%, the AER took into consideration the potential impact of the global financial crisis on raising equity capital. In particular, the AER interpreted two possible explanations for the current market conditions, being:

- that the prevailing medium term MRP is above the long-term MRP, but will return to the long term MRP over time; or
- that there has been a structural break in the MRP and the forward looking long term MRP (and consequently also the prevailing) MRP is above the long term MRP that previously prevailed.[30]

This contrasts to previous regulatory debates, which have focussed on whether the value of the MRP has fallen.

It is therefore possible that such a structural break has occurred following the crisis, but this will be difficult to reliably estimate, particularly in the short-term until substantial data has accumulated post-break. In the meantime, however, while caution should be exercised in interpreting and applying forward-looking estimates, we are of the view that the realities facing businesses such as Vector cannot be ignored. These realities are that it is more difficult to raise debt and equity capital. While the market has shown signs of recovery, the likely reality is that uncertainty will continue to prevail for some time.

3.5.4 Recommended MRP estimate

In conclusion, it remains difficult to estimate the MRP with any certainty, particularly when applying it as a proxy for the forward-looking MRP. The fundamental problem

[30] Australian Energy Regulatory (2009), Electricity Transmission and Distribution Network Service Providers – Review of the Weighted Average Cost of Capital (WACC) Parameters, May, p.238.

in this context is the difficulties in determining a robust estimate from New Zealand market data. We have therefore referenced long-term historical estimates from other jurisdictions produced by Dimson et al (2006), in particular:

- 6.5% for the US, with a standard deviation of 20.16; and
- 7.81 for Australia, with a standard deviation of 18.8.

Without making any adjustments for jurisdictional differences, the AER's assumed MRP of 6.5% is equivalent to a TAMRP of 8.15%.

Adjusting the US estimate for New Zealand market characteristics is important but is difficult to do in a robust way. This is because there are a number of differences here, not all of which can be quantified. Further, we have not made any adjustments to ensure consistency with the Commission's preference to use a five year risk-free rate. Overall, however, when we consider all of the evidence presented here, it is clear that a MRP of 7% is too low. Putting the effects of the global financial crisis aside, the long-term historical MRP is more likely to be in the order of 8%, rather than 7%. We are also of the view that forward-looking estimates remain too unreliable to draw any robust conclusions regarding the MRP. We are therefore of the view that unless evidence of a structural break emerges with time, reliance should continue to be placed on historical estimates.

3.6 Other issues

Other key issues that we have not considered in this report are:

- the debt margin; and
- debt and equity raising costs.

We understand that these matters will be addressed in detailed reports that will be submitted by the end of August.

3.7 WACC range

We note the Commission's preference to continue to specify a WACC range based on standard deviations. Our preferred approach would be to specify ranges for those parameters that cannot be precisely estimated, such as beta, capital structure and the market risk premium, based on the evidence examined (standard deviations should still be considered for individual estimates, where relevant). In our view, this is a better approach than specifying a point estimate with a standard deviation, as it reinforces that for these key parameters, there are likely to be a range of reasonable outcomes.

These ranges can then be used to construct the WACC range, with a point estimate selected from within that range. We note that Professors Myers and Franks also endorsed such an approach.

Finally, as noted upfront we fully endorse the Commission's position to continue to select a point estimate from the upper bound of the range, in recognition of the asymmetric consequences of error. This is also a potential way of dealing with other asymmetric risks such as asset stranding, to the extent that they are not otherwise compensated. For example, this may involve moving to the upper bound of the range (given the 75th percentile recognises the asymmetric consequences of error only, but not issues such as stranding risk).

A Comparator companies

Company	Description
GAS UTILITIES	
Mainly transmission/distribution	
APA Group (Australia)	APA Group has interests in a portfolio of high-pressure gas transmission pipelines in Australia covering four states and two territories which transport natural gas.
Envestra Limited (Australia)	Envestra Limited operates natural gas distribution networks and transmission pipelines in South Australia, Queensland and the Northern Territory. The Company's networks distribute gas to households and businesses in Adelaide, Brisbane (north of Brisbane River), Alice Springs and various regional centers in South Australia and Queensland.
Gaz Metro Limited Partnership (Canada)	Gaz Metro Limited Partnership is a Quebec energy company and a Canadian natural gas distributor serving customers in Quebec and the northeastern United States. The Company also has interests in natural gas transportation enterprises, sells goods and services through various companies in the energy and fiber optic fields, and provides rehabilitation services for waste water infrastructures.
Pacific Northern Gas Ltd (Canada)	Pacific Northern Gas Ltd. owns and operates natural gas transmission and distribution systems. The Company's western transmission line provides service to communities and industrial facilities. Pacific's subsidiaries provide gas distribution service.
AGL Resources Inc (US)	AGL Resources Inc. primarily sells and distributes natural gas to customers in Georgia and southeastern Tennessee. The Company also holds interests in other energy-related businesses, including natural gas and electricity marketing, wholesale and retail propane sales, gas supply services, and consumer products.
Atmos Energy Corporation (US)	Atmos Energy Corporation distributes natural gas to utility customers in several states. The Company's non-utility operations span various states and provide natural gas marketing and procurement services to large customers. Atmos Energy also manages company-owned natural gas storage and pipeline assets, including an intrastate natural gas pipeline in Texas.
Southwest Gas Corporation (US)	Southwest Gas Corporation purchases, transports, and distributes natural gas to residential, commercial, and industrial customers in portions of Arizona, Nevada, and California. The Company also provides construction services to utility companies, including trenching and installation, replacement, and maintenance services for energy distribution systems.
Chesapeake Utilities Corporation (US)	Chesapeake Utilities Corporation is a utility company that provides natural gas transmission and distribution, propane distribution, and information technology services. The Company distributes natural gas to residential, commercial, and industrial customers in Delaware, Maryland, and Florida. Chesapeake Utilities' propane is distributed to customers in Delaware, Maryland, and Virginia.
Piedmont Natural Gas Company (US)	Piedmont Natural Gas Company, Inc. is an energy and services company that primarily transports, distributes, and sells natural gas. The Company serves residential, commercial, and industrial customers in North Carolina, South Carolina, and Tennessee. Piedmont also, through subsidiaries, markets natural gas to customers in Georgia, and distributes propane in various states.
WGL Holdings Inc (US)	WGL Holdings Inc., through its Washington Gas Light Company subsidiary, sells and delivers natural gas and other energy-related products and services. The Company serves residential, commercial, and industrial customers throughout metropolitan Washington, D.C. and the surrounding

Company	Description
	region.
Northwest Natural Gas Company (US)	Northwest Natural Gas Company distributes natural gas to customers in western Oregon, as well as portions of Washington. The Company services residential, commercial, and industrial customers. Northwest Natural supplies many of its non-core customers through gas transportation service, delivering gas purchased by these customers directly from suppliers.
The Laclede Group (US)	The Laclede Group, Inc. is the parent company for Laclede Gas Company, a public utility involved in the retail distribution of natural gas. The Company serves an area in eastern Missouri, including the city of St. Louis, St. Louis County, and parts of several other counties. Laclede also operates underground natural gas storage fields and transports and stores liquid propane.
Corning Natural Gas (US)	Corning Natural Gas Corporation purchases and distributes gas through its own pipeline distribution and transmission systems. The Company serves residential, commercial, industrial, and municipal customers in the Corning, New York area. Corning also sells gas burning appliances, provides tax preparation services, operates a real estate agency, and owns a retail complex.
RGC Resources Inc (US)	RGC Resources, Inc. and its subsidiaries distribute and sell natural gas and propane. The Company serves residential, commercial, and industrial customers in the Roanoke Valley and Bluefield areas of southwestern Virginia, as well as southern West Virginia.
Other integrated gas	
National Fuel Gas Company (US)	National Fuel Gas Company is an integrated natural gas company with operations in all segments of the natural gas industry, including utility, pipeline and storage, exploration and production, and marketing operations. The Company operates across the United States.
EQT Corporation (US)	EQT Corporation is an integrated energy company with emphasis on Appalachian area natural-gas supply, transmission and distribution. The Company, through its subsidiaries, offer natural gas products to wholesale and retail customers.
Energen Corporation (US)	Energen Corporation is a diversified energy holding company. The Company acquires, develops, explores, and produces oil, natural gas and natural gas liquids in the continental United States. The Company also purchases, distributes and sells natural gas, principally in central and north Alabama.
UGI Corporation (US)	UGI Corporation distributes and markets energy products and services. The Company is a domestic and international distributor of propane. UGI also distributes and markets natural gas and electricity, and sells related products and services in the Middle Atlantic region of the United States.
Ferrellgas Partners (US)	Ferrellgas Partners, L.P. sells, distributes, markets, and trades propane and other natural gas liquids. The Partnership serves residential, industrial/commercial, portable tank exchange, agricultural, wholesale and other customers throughout the United States, the District of Columbia, and Puerto Rico.
Delta Natural Gas Company (US)	Delta Natural Gas Company, Inc. distributes, stores, transports, gathers, and produces natural gas. The Company, through its subsidiaries, buys and sells gas, as well as operates underground storage and production properties.
Nicor Inc (US)	Nicor Inc. is holding company. The Company, through its subsidiaries, provides gas distribution services in Illinois as well as containerized freight transportation services the Bahamas and the Caribbean region. Nicor als provides energy-related products and services to retail markets and markets natural gas on a wholesale basis.
South Jersey Industries Inc (US)	South Jersey Industries, Inc. is an energy services holding company. The Company provides regulated, natural gas service to residential, commercial, and industrial customers in southern New Jersey. South Jersey also markets total energy management services, including natural gas, electricity, demand-side management, and consulting services

Company	Description
	throughout the eastern United States.
ELECTRIC UTILITIES	
Mainly transmission/distribution	
Exelon Corporation (US)	Exelon Corporation is a utility services holding company. The Company, through its subsidiaries distributes electricity to customers in Illinois and Pennsylvania. Exelon also distributes gas to customers in the Philadelphia area as well as operates nuclear power plants in states that include Pennsylvania and New Jersey.
Pepco Holdings Inc (US)	Pepco Holdings, Inc. is a diversified energy company. The Company primarily distributes, transmits, and supplies electricity and supplies natural gas to customers in New Jersey, Delaware, Maryland, and the District of Columbia.
Other integrated electric	
FPL Group (US)	FPL Group, Inc. is a holding company. The Company, through its subsidiaries, generates, transmits, distributes, and sells electric energy utilizing natural gas, wind and nuclear resources.
Duke Energy Corporation (US)	Duke Energy Corporation is an energy company located primarily in the Americas that owns an integrated network of energy assets. The Company manages a portfolio of natural gas and electric supply, delivery, and trading businesses in the United States and Latin America.
Entergy Corporation (US)	Entergy Corporation is an integrated energy company that is primarily focused on electric power production and retail electric distribution operations. The Company delivers electricity to utility customers in Arkansas, Louisiana, Mississippi, and Texas. Entergy also owns and operates nuclear plants in the northern United States
American Electric Power Company (US)	American Electric Power Company, Inc.(AEP)is a public utility holding company. The Company provides electric service, consisting of generation, transmission and distribution, on an integrated basis to their retail customers. AEP serves portions of the states of Arkansas, Indiana, Kentucky, Louisiana, Michigan, Ohio, Oklahoma, Tennessee, Texas, Virginia and West Virginia.
FirstEnergy Corp (US)	FirstEnergy Corp. is a public utility holding company. The Company's subsidiaries and affiliates are involved in the generation, transmission and distribution of electricity, exploration and production of oil and natural gas, transmission and marketing of natural gas, and energy management and other energy-related services.
Allegheny Energy (US)	Allegheny Energy, Inc. is an electric utility holding company. The Company, through various subsidiaries, serves customers in parts of Pennsylvania, West Virginia, Maryland and Virginia.
Northeast Utilities (US)	Northeast Utilities is a public utility holding company. The Company, through its subsidiaries, provides retail electric service to customers in Connecticut, New Hampshire, and western Massachusetts. Northeast also distributes natural gas throughout Connecticut.
DPL Inc (US)	DPL Inc. is a holding company whose principal subsidiary is The Dayton Power and Light Company. Dayton Power & Light sells electricity to residential, commercial, and government customers in west central Ohio.
NV Energy Inc (US)	NV Energy, Inc., through its subsidiaries, generates, transmits, and distributes electric energy throughout Nevada and the Lake Tahoe area of California. Additionally, the company provides natural gas services in the Reno Sparks area of Nevada.
Westar Energy (US)	Westar Energy, Inc. is an electric utility company servicing customers in Kansas. The company provides electric generation, transmission and distribution services.
Great Plains Energy Incorporated (US)	Great Plains Energy Incorporated provides electricity in the Midwest United States. The Company develops competitive generation for the wholesale market. Great Plains is also an electric delivery company with regulated generation. In addition, the Company is an investment company focusing

Company	Description
	on energy-related ventures nationwide that are unregulated with high growth potential.
Cleco Corporation (US)	Cleco Corporation generates, transmits, distributes, and sells electric energy to customers in Louisiana. The Company, through a subsidiary, also markets energy and energy management services. In addition, the Company is involved in energy asset development opportunities in the Southeastern region of the United States.
Idacorp Inc (US)	IDACORP, Inc is the holding company for Idaho Power Company, an electric utility and IDACORP Energy, an energy marketing company. Idaho Power generates, purchases, transmits, distributes, and sells electric energy in southern Idaho, eastern Oregon, and northern Nevada. IDACORP Energy maintains electricity and natural gas marketing operations.
Allete Inc (US)	ALLETE, Inc. provides energy services in the upper Midwest United States. The Company generates, transmits, distributes, markets, and trades electrical power for retail and wholesale customers.
Unisource Energy Corporation (US)	Unisource Energy Corporation is the holding company of Tucson Electric Power Company. The Company generates, purchases, transmits, distributes, and sells electric energy to retail and wholesale customers. Unisource also owns all of the outstanding common stock of Millennium Energy Holdings, Inc.
UIL Holdings Corporation (US)	UIL Holdings Corporation, through The United Illuminating Company, provides electricity and energy-related services to customers and municipalities in Connecticut. The Company's other subsidiary, United Resources Inc., is the umbrella for UIL's non-regulated business units, including Precision Power, American Payment Systems, United Capital, and United Bridgeport Energy.
El Paso Electric Company (US)	El Paso Electric Company generates, distributes, and transmits electricity in west Texas and southern New Mexico. The Company also serves wholesale customers in Texas, New Mexico, California, and Mexico. El Paso Electric owns or has partial ownership interests in electrical generating facilities.
The Empire District Electric Company (US)	The Empire District Electric Company generates, purchases, transmits, distributes, and sells electricity. The Company supplies electricity to parts of Missouri, Kansas, Oklahoma, and Arkansas. Empire also provides water service to several towns in Missouri.
Central Vermont Public Service Corporation (US)	Central Vermont Public Service Corporation purchases, produces, transmits, distributes, and sells electricity. The Company serves customers in Vermont. Central Vermont's subsidiary distributes and sells electricity in parts of New Hampshire bordering the Connecticut River.
TrustPower Limited (New Zealand)	TrustPower Limited is a regional New Zealand power company which operates electricity generation networks and also supplies and distributes electricity and other related services to customers. TrustPower also has operations in retailing electricity throughout New Zealand.