Response to the Commerce Commission's Gas Control Inquiry Draft Framework Paper : Estimation of the Weighted Average Cost of Capital

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1. INTRODUCTION

We have been engaged by NGC Holdings Limited (NGC) to assist in developing a response to the Commerce Commission's Gas Control Inquiry, as outlined in the Draft Framework Paper of 16 July 2003. In particular, we were asked to evaluate the methodology developed by the Commerce Commission (and the Commission's expert, Associate Professor Martin Lally) to determine the weighted average cost of capital (*WACC*) that may be used as part of the proposed regulatory process.

We broadly agree with the WACC methodology proposed by the Commission. However, we disagree with the Commission's approach to determining some of the factors underlying the WACC calculation. These factors are addressed and appropriate values are suggested.

It is particularly difficult to accurately assess the required cost of equity for the gas industry. The base of gas distribution and transmission companies in New Zealand is inadequate to allow accurate determination of the systematic risk based on comparisons with similar companies. It is therefore necessary to expand the comparison base. In view of the similarities between the electricity and gas distribution and transmission industries, and also given the large volume of work already done by the Commission and others to determine the appropriate WACC for electricity distribution companies, comparison between these sectors appears appropriate.

In doing so, however, it is important to clearly understand the significant differences that exist between the electricity and gas markets. These relate in particular to the higher income and price elasticity of demand in the gas industry and the relative ease with which gas can be substituted by other energy sources. Based on the suggested WACC methodology and using appropriate parameters, we derive a range estimate for NGC's *WACC* that has a mid-point of 9.6%.

In our view, an additional margin should be added to this estimate of *WACC* to allow for market imperfections and dynamics[1]. This is to compensate investors for the non-systematic risks inherent in these market imperfections, such as market friction, timing flexibility, irreversibility of investment, optimisation risk and reconciling project-specific risk premia.

We also discuss the asymmetrical impact that the setting of *WACC* has on infrastructure development and question the ability of a regulator to actually distinguish between excess profits and random departures of realised rates of return from any target rate of return.

We have set out in Appendix 2 our qualifications and experience relevant to this topic.

[1] See Appendix 1, authored by Professor Glenn Boyle.

2. BACKGROUND

The Commission indicated that it is considering the use of a *WACC* figure for price-setting purposes under the proposed regulatory environment for the gas industry. The *WACC* will form an integral component of a building block type approach to determine an "efficient level of revenue". This approach is similar to the procedure used for other determinations. The most recent such estimate was for the TSO cost calculation, but other recent cases include the airfields inquiry and the regulation of electricity lines businesses.

The Commission's estimates of *WACC* for the airfields and electricity lines businesses were at the low end of the range of estimates made in the submissions by industry participants. For the TSO cost calculation the Commission has followed that tendency even further by adopting the extremely low estimate of 6% for *WACC*. We are concerned that similarly low figures may be proposed for the gas industry without giving sufficient regard to all factors that impact on the systematic risk-profile of the industry or taking into account the negative outcomes that would result from setting the *WACC* at levels that would discourage further investment in the sector.

3. ESTIMATION OF WACC

In this section, we describe the methodology used by the Commission to estimate *WACC* and highlight where we differ from the views of the Commission.

3.1 Choice of model

As in the earlier cases, the Commission has adopted the following definition of *WACC*:

$$WACC = k_e(1-L) + k_d(1-t_c)L \qquad (1)$$

where k_e is the cost of equity, k_d is the cost of debt, t_c is the corporate tax rate (assumed to be 0.33), and L is the leverage ratio. Thus *WACC* is defined as a weighted average of the cost of equity and the (after tax) cost of debt. There is no unique definition of *WACC* but the definition adopted by the Commission is that commonly applied in valuation and investment decision-making in New Zealand and is therefore uncontroversial.

Equation (1) specifies the method for calculating *WACC* but the component costs are not observable. Thus, determination of *WACC* requires estimation of each of the component costs. The weights assigned to the component costs should be based on current or target market values.

3.2 Cost of Equity: The Model

Estimation of the cost of equity, k_e, is the most difficult element in the estimation of *WACC*. It may be estimated either by ad hoc methods or from a theoretical model. The Commission uses the CAPM and we agree that this is an appropriate starting point. The Commission uses the following form of the CAPM:

$$k_e = R_f(1-0.33) + \beta_e TAMRP \quad (2)$$

where R_f is the risk free rate, β_e is the equity beta coefficient and $TAMRP$ is the tax-adjusted market risk premium. Equation (2) is commonly referred to in New Zealand as the 'post tax' form of the CAPM, in which the $TAMRP$ is given by:

$$TAMRP = R_m - R_f(1-0.33) \quad (3)$$

with R_m being the expected rate of return on the market portfolio of risky assets.

Other versions of the CAPM could be used to estimate the cost of equity. However, given the dividend imputation tax system and the uncertainty on tax rates, we agree with the Commission's choice of the post tax form of the CAPM.

3.3 Tax Adjusted Market Risk Premium

In recent cases, the Commission's estimate of the $TAMRP$ has been based on a simple average of the estimates obtained from a variety of different approaches to estimation of the $TAMRP$. This implies equal weighting for the different approaches. For the reasons discussed in van Zijl and Irwin (2001) our view is that the best approach to estimation of the $TAMRP$ is extrapolation from a long time series of market data on the premium, which is one of the methods relied upon in the Commission's average.

Given that the New Zealand market was highly controlled before the mid eighties, a long series of data for the New Zealand market is, in our view, not an appropriate basis for forming an estimate of the $TAMRP$.[2] For these reasons, our view is that the Dimson (2002) data provides the best basis for estimation of the $TAMRP$ for New Zealand. Data from the Dimson study, covering the period 1900-2000 is given in Table 1 below and shows the premium of R_m over R_f.

[2] A similar view is expressed by Bowman (2001) in respect of estimation of the market risk premium for Australia.

Country	$R_m - R_f$ (Arithmetic mean (%))
Australia	8.0
Belgium	4.8
Canada	6.0
Denmark (from 1915)	3.3
France	7.0
Germany (excludes 1922/23)	9.9
Ireland	4.6
Italy	8.4
Japan (from 1914)	10.3
Netherlands	6.7
South Africa	7.1
Spain	4.2
Sweden	7.4
Switzerland (from 1911)	4.2
US	7.0
UK	5.6
Median	**6.9**

Table 1: Arithmetic mean values of $R_m - R_f$

Adopting the value for the US (which is much the same as the median for the set) and applying this in (3) to correct for the tax factor, $(1-0.33)$, results in a point estimate of about 9% for the *TAMRP* for the post tax form of the CAPM. Given this point estimate a range estimate of 8-10% for the *TAMRP* might then appear appropriate. However, the estimation is subject to considerable uncertainty and recognising that some of the alternative approaches to estimation produce significantly lower estimates, we adopt a range estimate of 8-9%.[3]

3.4 Asset Beta

Ideally beta should be estimated from market data on the company (investment) in focus. In the case of NGC, its equity beta is estimated at 1.14 [4], which corresponded to an asset beta of 0.67 based on the financial leverage at the time. However, this figure is based on the historical profile of the company. NGC has recently undergone significant changes with its divestment from the electricity retailing business and financial restructuring. Given the paucity of relevant performance data of the company in its new form, reliable market-based estimation of the beta of its gas transmission and distribution business is not currently possible. Thus, as is usually the case, data limitations make beta the most

[3] It is interesting to note that the recent survey of the views of New Zealand practitioners and academics on the market risk premium indicates a consensus estimate for the *TAMRP* by practitioners of 9% and by academics of 7.5% (Lally, M., Roush, M. and T. van Zijl, "The MRP Consensus Estimate – New Zealand", INFINZ Newsletter, July 2003)

[4] Obtained from the PricewaterhouseCoopers report "The Cost of Capital Report" as at 31 March 2003.

difficult of the CAPM parameters to estimate and its estimation involves a high degree of uncertainty.

We agree with the Commission that in the absence of sufficient market information, a proxy beta has to be estimated by comparison with the beta for comparable companies with similar risks and activities. We also broadly agree with the factors listed by the Commission as having an impact on beta figures, with the exception of the following :

- The Commission assumes that firms subject to rate-of-return regulation should have lower sensitivity to unexpected changes in the economy, because the regulatory process is geared towards achieving a fair rate of return and that price control will have a similar effect, provided that prices are regularly reset.[5] This argues for a lower beta figure. However in practice, the presence of regulatory control, or even the threat of such control, acts as an additional risk factor which would lead investors in the regulated, or potentially regulated business to seek additional returns on their investment. This was recognised by Lally (2003) in his determination on the cost of capital for electricity lines businesses where he argued that in the event of control, with respect to the asset beta, his range estimate of 0.3 to 0.5 would move to 0.4 to 0.5.

- The increased risk associated with regulation arises from factors such as the uncertainty brought about by the continual threat of future changes in the regulatory rules, asymmetric impact of a revenue or price ceiling (relative inability to recover lost revenue during years with low consumption and requirement to cap revenue in years with higher consumption), reduced financial management independence and a reduced ability to effectively structure financially for short-term fluctuations such as rapid growth in consumer numbers.[6]

In assessing the beta for NGC and other gas distribution or transmission companies, we recommend that the Commission should be guided by the beta values of comparable international gas distribution companies, or industry sectors.

In addition, electricity and water distribution utilities could also be used as comparators, especially when subject to similar control regimes. For such a comparison to be reasonable however, factors such as the relative income elasticity of demand and price elasticity of demand for the different service offerings become critical to consider, as well as the level of competition or substitutability that exist for the services.

In Table 2 below international beta figures for the gas and electricity sectors, in the US and European markets are listed.[7] These figures are the un-weighted average figures for the individual companies making up the various sectors.

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[5] Section 5.217 of the Draft Framework Paper

[6] Some of these aspects are discussed in more depth by Overcast (2003)

[7] These figures were obtained from Professor Aswath Damodaran's website : http://pages.stern.nyu.edu/~adamodar/

Table 2 : Asset Beta figures for comparable industry sectors

INDUSTRY NAME	*NUMBER OF FIRMS*	*UNLEVERED BETA*
USA Market data		
Electricity Utilities	73	0.38
Natural Gas (Distribution & diversified)	74	0.45
European market data		
Electric distribution	6	0.51
Natural Gas distribution	7	0.74

The companies contained in table 2 include a mix of regulated and unregulated firms and as such, the use of the beta values in an absolute sense should be approached with some care. We however wish to focus on the average differential between the betas for gas and electricity companies, for which the mix of companies is less important.

From these figures it is clear that gas distribution utilities both in the US and in Europe have a higher systematic risk profile than electricity distribution companies, with a differential of 0.07 for the US and 0.23 for Europe, or a weighted average of 0.09.[8] This situation would be similar or even amplified in New Zealand, as discussed below.

- Gas marketing in New Zealand is still in a relatively immature phase and market penetration rates are thus low. In comparison, the gas markets in Europe and the US are mature and penetration rates are very high. Growing markets are generally more volatile than mature markets.

- Information comparing national electricity and gas consumption figures for the period 1986 to 2001 is presented in figure 1. To facilitate easy comparison, we normalised the consumption figures, setting 1986 consumption figures to a base index of 100. The variance in gas and electricity consumption confirms anecdotal evidence that the gas market is significantly more volatile than the electricity market.

- Electricity generation is a major use of gas in New Zealand[9]. A significant correlation therefore exists between gas and electricity usage. However, as gas-fired generation plants are generally used to provide the variable components of overall power generation (as opposed to base load supply from hydro-electric, geo-thermal and coal energised generation), the actual consumption of gas for power generation would be subject to higher variance than electricity consumption patterns would suggest.

[8] Given the relatively small number of companies, distribution and transmission companies (for gas and also for electricity) have been grouped together. However, the transmission and distribution energy consumption patterns are closely related and the systematic market risks faced are thus likely to be similar.

[9] For example, in 2001, 17% of gas consumed in New Zealand was for electricity generation purposes. Gas was used for 30% of all electricity generated in the country.

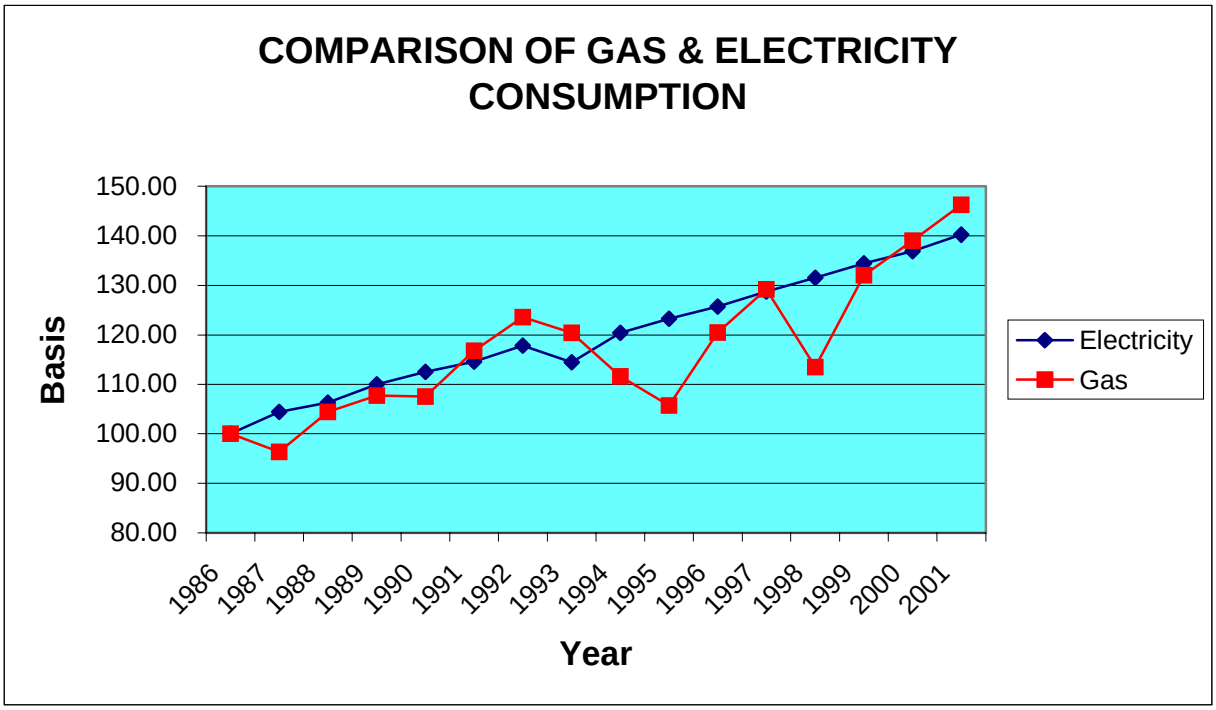

Figure 1: Comparison of national gas and electricity consumption (1986 base = 100)[10]

- New Zealand gas pipeline businesses are subject to likely greater levels of risk because of the thin nature of the upstream gas production market, unlike other established markets where long-term reserves are present.[11]

- Outside its use for electricity generation, the gas market is for energy supply to industry, commerce and domestic consumers. In this market it competes with other energy sources (including electricity) and is therefore sensitive to pricing movements in these markets. In table 3 below, an indication is provided of the relative international ratios of electricity to gas energy prices, normalised to the New Zealand ratio. This clearly illustrates that the gap between electricity and gas energy prices in New Zealand is much smaller than in other developed countries, especially in Europe. This in turn would indicate that the use of gas in New Zealand would be more sensitive to movements in electricity prices than that experienced elsewhere in the developed world.

  This comparison looks at the energy component of gas and electricity consumption only.

[10] Figures obtained from the July 2002 Energy Data File, published by the Ministry of Economic Development

[11] For example, Australia have proven gas reserves projected to last in excess of 100 years.

Table 3: Comparison of international Electricity/Gas energy price ratios[12]

Country	1994	1995	1996	1997	1998	1999	2000	2001	2002
Barbados							3.5	4.4	
Cuba							3.8	3.8	
Denmark	3.2	3.3	3.2	2.9	4.1	3.8	4.1	4.4	4.2
Belgium	3.4	3.5	3.1	2.7	3.3	3.0	3.0		
Germany	3.6	3.6	3.0	2.6	3.2	3.0	2.8		
Austria	3.3	3.4	3.3	2.8	3.5	2.6	2.7	2.9	
Japan	3.5	3.3	2.5	2.0	2.5	2.8	3.2		
Spain	3.3	3.2	2.9	2.4	2.8	2.5	2.3	2.1	
Netherlands	2.1	2.2	2.4	2.0	2.5	2.5	3.1	3.6	3.3
Luxembourg	2.5	2.7	2.4	2.1	2.6	2.5	2.3	2.4	2.6
Italy	2.7	2.5	2.4	2.1	2.6	2.3			
France	2.8	2.8	2.6	2.1	2.4	2.2	2.2		
Switzerland	2.3	2.7	2.4	2.1	2.5	2.4	2.3	2.2	2.1
OECD Europe[2]	2.5	2.5	2.3	2.0	2.4	2.3	2.4		
United Kingdom	2.4	2.2	2.1	2.0	2.4	2.3	2.5	2.5	2.2
Argentina							2.1	2.1	
Ireland	2.2	2.0	2.0	2.0	2.3	2.0	2.2	2.1	1.8
OECD[1]	2.2	2.1	1.9	1.7	2.0	2.0	2.3		
Portugal									2.0
Finland	1.9	2.1	2.0	1.8	2.2	2.0	2.0	1.9	2.0
Turkey	1.5	1.3	1.5	1.3	1.6	1.6	1.9	2.1	
United States[3]	1.6	1.4	1.3	1.3	1.6	1.5	1.7	1.7	1.6
Greece					1.7	1.5	1.4	1.4	
Colombia							1.3	1.5	
Chile							1.4	1.3	
Hungary	0.8	1.0	1.0	1.1	1.4	1.4	1.6	1.7	1.8
Chinese Taipei (Taiwan)	1.5	1.3	1.2	1.1	1.2	1.2	1.5	1.4	
Bolivia							1.2	1.4	
Australia[3]	1.3	1.2	1.2	1.1					
Poland	0.9	1.0	0.9	0.9	1.2	1.1	1.4	1.7	
New Zealand	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Czech Republic	0.6	0.6	0.6	0.5	0.9	0.9	1.1	1.3	1.5
Slovak Republic (Slovakia)	0.6	0.5	0.5	0.5	0.6	0.7	1.3	1.7	
Kazakhstan			0.5	0.7	1.1	0.7	0.7	0.7	
Venezuela	0.5	0.6	0.3	0.6	0.9	1.0			
Romania	0.5	0.4	0.4	0.4	0.8				

(normalised to a New Zealand ratio = 1)

- Growth in non-electricity generating gas consumption requires the use of gas-fired equipment and appliances. While life-cycle studies, especially for residential installations, mostly suggest that gas is the most cost efficient of the available energy

[12] Source: Energy Prices & Taxes - Quarterly Statistics, First Quarter 2003, Part II, Section D, Table 20, and Part III, Section B, Table 19, Paris: International Energy Agency, 2003.

alternatives, the initial acquisition and set-up costs for gas appliances is usually substantially higher than for alternative products[13]. The implication is that more discretionary funds are usually required to install gas-fired equipment where (initially) cheaper alternatives are readily available. This means that the incidence of installation of new gas-fired appliances is more highly correlated to general economic conditions than for example electrical equipment, in spite of the fact that gas may be the most cost-effective long-term choice.

The evidence above would suggest that gas consumption in New Zealand is significantly more volatile than electricity consumption and is more sensitive to general market movements. In addition, this variation in consumption and market-sensitivity would be greater than that indicated for the US and Europe. Based on the average margin of 0.09 by which beta for gas distribution companies in the US and Europe exceed the beta for electricity utilities or distributors and taking into account the relatively higher systematic market risk of the local gas distribution industry compared to these established markets, we conclude that for the New Zealand market an increment in the gas distribution beta figure over the electricity distribution beta figure of 0.1 to 0.15 is appropriate.

Lally (2003) concluded that the asset beta, for electricity lines businesses in New Zealand was in the range of 0.3 to 0.5 with a point estimate of 0.4. In our February 2003 submission to the Commission[14] we expressed broad agreement with that conclusion but pointed out that the data set on which the estimates was partly based had been updated to give an average asset beta for US electricity utilities of 0.37, thus leading to a range estimate of around 0.35 to 0.55.

Taking this amended range and applying the beta increment discussed above, our view is that the asset beta for NGC is in the range 0.45 to 0.65 with a point estimate of 0.55.

As noted by the Commission, the asset beta and equity beta are related as follows:

$$\beta_e = \beta_a(1+\frac{L}{1-L}) \qquad (4)$$

Taking into account NGC's proposed leverage ratio, as discussed in section 3.6 below, the equity beta would therefore be in the range between 1.00 and 1.44.

3.5 Risk Free Rate

The Commission's view is that the term for the risk free rate should match the period for which prices are set. In the case of the TSO draft WACC determination this term was set at one year and for the Electricity Lines Business WACC estimate it was set at 5 years. In our view however, the traditional approach of estimating the risk free rate from the 10-year yield is more appropriate. Gas utilities invest for the long term and therefore the shareholders would look to the companies earning a rate commensurate with the risk and term of the investments made. Setting the estimate on the basis of a shorter term would

[13] Compare for example the cost of electric water heaters with gas-fired water heaters

[14] LECG submission : "Review of the Commerce Commission's estimate of WACC for Electricity Lines Businesses and the relationship to profit thresholds", February 2003.

seem to be undue interference in the financial management decisions of the companies and be likely to add to the deadweight loss of regulation.

Shorter term rates are generally more volatile than longer term rates. By setting the rates for shorter periods, the Commission therefore introduces a further uncertainty which would have to be hedged against, and which investors would require to be compensated for.

Furthermore, use of a short-term estimate of the risk free rate is inconsistent with the estimate of the market risk premium that is based on a long-term risk free rate. The CAPM is developed on the basis of a single risk free rate and from equations (2) and (3) it is obvious that it would be incorrect to use a short term risk free rate in (2) but a long term risk free rate in (3).

In principle the estimate of the risk free rate should be based on a rate at a point in time. However, to avoid any unusual features in the market at the time of the estimation, the average over a month or similar period seems reasonable. However, in estimating the risk free rate, semi annual compounding should be used.[15] Thus, based on the average of the ten-year government bond yield over the month prior to the date of this report (14 August 2003) of 5.78%[16], the risk free rate is estimated as 5.86%.

3.6 Cost of Debt and Leverage

The cost of debt, k_d, is estimated as the sum of the estimated risk free rate, R_f, and a debt margin dm:

$$k_d = R_f + dm \qquad (5)$$

The debt margin is the additional compensation investors require for lending at risk and is thus likely to vary with the level of leverage.

There is no analytical basis for determining the optimal capital structure and what is in fact optimal is probably best inferred from practice. Firms in choosing one capital structure over another presumably balance up factors such as the reduction in agency costs from increased debt against higher expected bankruptcy costs.

The amount of the debt margin is ultimately a simple empirical matter. NGC currently has no long-term debt. This was as a result of its recent restructuring and divestment of its electricity retailing business. However, the company intends to structure itself at a

[15] The conversion to an annually compounded rate uses the following relationship:

$$R_f^{annual} = \left(1 + \frac{R_f^{semi-annual}}{2}\right)^2 - 1$$

[16] Reserve bank data obtained from http://www.rbnz.govt.nz/statistics/exandint/b2/data-01.html#TopOfPage

leverage ratio of around 55 %[17] and preliminary costings indicate that the debt margin at this ratio will be approximately 2 %. It would seem undesirable that the Commission should arbitrarily set a leverage ratio and debt margin, as doing so may add further to the deadweight loss. We therefore recommend that a business' actual or proposed leverage ratio and cost of debt should be taken into account when determining the *WACC* for that business.

The effect of variation in leverage on *WACC* is relatively small. It is easily shown that for the post tax form of the CAPM, the change in *WACC* , $\Delta WACC$, resulting from a shift in leverage L_0 (with debt margin dm_0) to leverage L_1 (with debt margin dm_1) is given by:

$$\Delta WACC = (1-.33)(L_1 dm_1 - L_0 dm_0) \qquad (6)$$

Thus, for example, an increase in leverage from 0.3 (with debt margin 1.5%) to 0.5 (with debt margin 2%) results in an increase in *WACC* of 0.37%.

4. ESTIMATED WACC FOR NGC

In table 3 below, we indicate our estimates of the value ranges for the various components underlying the *WACC* for NGC, as well as the *WACC* figures that result from these.

Table 3 : Estimate of WACC for NGC

Parameter		**Proposed estimates**	
	low	**midpoint**	**high**
TAMRP	8%	9%[18]	9%
β_a	0.45	0.55	0.65
R_f	5.86%	5.86%	5.86%
dm	2%	2%	2%
L	55%	55%	55%
β_e	1.00	1.22	1.44
k_e	11.9%	14.9%	16.9%
k_d	7.86%	7.86%	7.86%
WACC	**8.3%**	**9.6%**	**10.5%**

Accepting the mid-range value would indicate a *WACC* for NGC of 9.6%.

[17] The actual leverage will depend on realising the NGC growth strategy and may in fact rise as high as 60% is this is successful.

[18] My range estimate for the MRP is not symmetric, that is, I assign very low probability to the MRP being less than 9% and thus the midpoint is about the same as the high end of the range.

5. IMPLICATIONS OF ERRORS IN THE ESTIMATE OF WACC

From the perspective of a potentially regulated sector, the Commissions' decisions on *WACC* have an obvious direct bearing on investment and operating decisions. This is discussed below.

5.1 Impact of insufficient compensation on investors

Basic finance theory states that investors require a rate of return on their investments in a business commensurate with the systematic risk faced by the business. If it is perceived that the rate of return on investments is likely to be below that warranted by the risk profile, investment would be withheld, or placed elsewhere.

As stated earlier, we believe that the estimates of *WACC* determined by the Commission in its recent decisions, and in particular in its draft determination for the TSO, are low. The use of these low *WACC* estimates presupposes that regulated businesses face a systematic risk below that of similar businesses operating under non-regulated conditions. Indeed, the Commission states that

> *"Firms subject to rate of return regulation should have lower sensitivity to unexpected changes in the economy, because the regulatory process is geared towards achieving a "fair" rate of return. Price regulation will have a similar effect,…"* [19]

However, depending on the precise design of the regulatory system, this is not borne out in practice and the systematic risk can often be higher under regulation. Furthermore, its introduction, or even potential introduction, raises the possibility of future increased regulatory measures with effects unfavourable to the firm and therefore causing investors to require a higher return on long-term investments. Under imperfect market conditions, the reduced cash-flow generally implied by regulation, is unlikely to be perfectly offset by a lower systematic risk. This affects enterprise value and adds to the overall risk of regulation.

We therefore believe that by setting the *WACC* for regulated industries at the bottom end of market expectations, investment in and by these industries may be reduced. As most of the entities affected by the Commission's decisions are basic infrastructure providers, the end result will be reduced investment in New Zealand's infrastructure.

5.2 Impact of under-investment in infrastructure

Under-investment in infrastructure will typically lead to degraded services and could eventually cause major disruptions and an inability to cope with a growing demand for the service in question. As much of the New Zealand infrastructure is already under stress [20], decisions that will further inhibit infrastructure renewal or expansion could have

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[19] Commerce Commission report "TSO Weighted Average Cost of Capital", dated 19 May 2003, paragraph 40.

[20] Electricity provision (generation, transmission and distribution) is a good example of an infrastructure industry that requires significant investment to meet the current and future needs of the country.

severe implications for the economy, the potential for growth and the lifestyle of New Zealand citizens.

This potential for degraded services appears to be contrary to the Government's recognition of the need to strengthen the New Zealand infrastructure to support the economy and to provide a sound foundation for promoting growth and innovation.[21]

We believe that it is critical that regulation does not impede infrastructure businesses from investing to maintain and enhance services consistent with consumer demand, as these services are critical to support a growing economy. We also note that such impediments to investment appear to be emerging in some of the regulatory approaches in, for example, Australia, as the following quote from Gary Banks, Chair of the Productivity Commission, suggests, in a recent conference speech titled "*Competition regulation of Infrastructure : getting the balance right*":[22]

> "*The [Productivity] Commission's recent inquiries have revealed a need to re-balance the emphasis in infrastructure regulation away from achieving immediate gains for users and consumers from existing assets – much of them government owned or previously government owned – to a regulatory framework that will also facilitate efficient investment in new facilities. In this way, pro-competition regulation is more likely to ensure that Australia has modern infrastructure which is developed and used efficiently, with long-term benefits to the Australian community.*"

5.3 Asymmetrical impact of under and over investment

It is important to note the asymmetrical impacts on consumers of under and over investment in infrastructure.

In general, under-investment is likely to have a significantly higher economic cost than over-investment. The primary reason for this is that modest over-investment will typically lead to slightly higher prices than otherwise, but the consumer is able to access the desired service. In spite of the higher elasticity of demand for gas than for other commodities such as electricity, , this slight increase in price is unlikely to have a significant impact on consumer decisions. Given increasing demand for services over time, the few negative effects of over-investment are also continually diluted.

Under-investment on the other hand will typically lead to the degrading of services, as discussed in section 5.2, and could in some cases cause major disruption to the consumer's processes and businesses.

In economic terms, under-investment leads to the loss of the entire consumer and producer surplus associated with the output shortfall. In contrast, slight over-investment is equivalent to providing higher quality service than consumers demand, and hence the

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[21] We note for example a telling comment made by the Minister of Finance (Dr Michael Cullen) during his address on infrastructure spending in New Zealand to an ABN AMRO client function on 3/7/03 : "*The ground we are searching for is not one of heavy handed central management or regulation of infrastructure providers*" (http://www.beehive.govt.nz/ViewDocument.cfm?DocumentID=17236)

[22] Banks, G., "Competition regulation of infrastructure : getting the balance right", presentation to the IIR conference, National Competition Policy Seven Years On, 14 March 2002.

only economic loss is that associated with the difference between the consumer valuation of the higher service level and its opportunity cost.

Availability of a reliable and efficient gas supply at a reasonable cost is one of the cornerstones of the New Zealand economy. Decisions of a regulatory nature that have the potential to do long-term damage to the industry, as sketched above will therefore impact not only on the gas industry, but also on the wider economy. If the Commission is therefore determined to embark on a regulatory course for the industry, we therefore suggest that the Commission should adopt a conservative approach towards the setting of *WACC* estimates. The calculation of *WACC* will always be subject to significant uncertainty. As the Commission will therefore be forced to make assumptions, we conclude that errors in these assumptions should always lean to the higher end of *WACC* estimates.

5.4 Market imperfections

Even if it were possible to make near perfect estimates of the parameters of *WACC* , leading to point estimates, or at least very narrow range estimates, application of the *WACC* approach is also subject to capital market imperfections. *WACC* is an appropriate criterion for investment decision making only if there are no market imperfections and the investment opportunity set is static.

Finance theory would dictate that investors require compensation for systematic risk only, as non-systematic risk can be diversified away. In an imperfect market this is however not the case. The implication of this is that investors do in fact require some compensation for what would normally be considered non-systematic risks. To achieve this, two approaches are normally possible – a more accurate identification of the capital base on which returns are required, or a margin over WACC . In practise both these approaches should be considered, but as accurate identification and valuation of the whole capital base on which returns could be reasonably expected is often difficult, we therefore favour an increment to the WACC to allow for market imperfections.

The factors contributing to this margin are discussed in more detail in appendix 1.

The Commission has to date not allowed for an additional margin to compensate for market imperfections. It has been suggested that non-systematic risk could be accounted for by simply moving to the top end of the proposed cost of equity range as obtained through the CAPM model. This would however be incorrect, as the range is intended to make allowance for uncertainties in the factors underlying systematic risk, not to compensate for non-systematic risk factors.

We therefore recommend that a margin over WACC be determined to account for the factors discussed in appendix 1 and that this margin be added to the WACC determined by the Commission.

6. COMPARISON OF REALISED RATES OF RETURN WITH WACC

The Commission indicated that it is considering the use of a *WACC* figure for price-setting purposes, under the proposed regulatory environment. The *WACC* would form an integral component of a building block type approach to determine an "efficient level of revenue".

The Commission proposes to express its pricing principles over the medium term[23], so that short-term fluctuations do not distort judgements. It is important that any comparison of a theoretical rate of return with the actual return reflect recognition of the uncertain nature of the comparison. Rate of return is a stochastic variable. That is, if a firm was to set itself the objective of earning a target rate of return (equal to *WACC* plus an appropriate margin), it could expect to achieve the target rate only on average. In any particular year, random factors can combine to result in a realised rate of return that differs markedly from the target. The Commission's task is to differentiate between a realised rate that differs from an acceptable target rate due to random factors and a realised rate that differs because the firm is operating with the objective of exceeding that target rate.[24]

The Commission's task closely parallels that of a manufacturing entity applying quality control to a production process. The standard approach in quality control is to take a sample of output from the process, measure the average value of the dimension being controlled, and then compare that sample average value with the expected benchmark value for the dimension. If the sample average value exceeds the benchmark value by less than a certain critical amount it is assumed that the excess is due to random factors. However, if the excess is greater than the critical amount, it is assumed that the process is no longer geared to producing to the benchmark value and an investigation is carried out. The investigation may indicate that the excess was in fact due to random factors or it may indicate that some adjustments are required to the production process. The size of the critical amount depends on the variability of the process, the sample size, and the level of significance adopted (the probability of concluding that the process is out of control when in fact it is in control).

The problem with applying this approach to rates of return is that they are extremely variable and therefore the critical amount is likely to be very large. For example, if it is assumed that the standard deviation of the rate of return is 8%, then the critical amount that would apply in the context of identifying excess profit is around 9% at the 5% level of significance and rises to 15% at 1% level of significance. Clearly these are very large

[23] Actual term not stated

[24] This issue is also discussed in Boyle and Guthrie (2002).

amounts relative to any reasonable estimates of a target rate of return comprising *WACC* plus the margin. That is, it would be very difficult on the basis of 5 or less years of evidence on realised rates to reject the assumption that a firm is aiming to earn an acceptable target rate of return.

Appendix I : Margin over WACC

Glenn Boyle

A view that has become increasingly prevalent among finance researchers in recent years (see for example, Stulz, 1999; Dixit and Pindyck, 1994) is that the WACC specification of risk is incomplete and that most projects require a margin above WACC in order to adequately cover the costs of all capital that they employ. This view is partly the result of several decades of corporate finance research that emphasizes the additional costs of real world frictions and dynamics, and partly the result of empirical evidence suggesting that competitive firms care about risks not captured by WACC. This section of the report reviews these areas of research and their implications for the cost of capital.

I.1 Market Frictions

The WACC calculation is based on modern portfolio theory, which stresses the difference between systematic and unsystematic risk: the latter can be eliminated via portfolio diversification while the former cannot. Maximum diversification is achieved when investors hold the market portfolio, an observation that leads directly to the CAPM, in which all assets are priced with reference to the market portfolio. As a result, the cost of capital for any project incorporates a premium only for variation in the project's returns that is positively correlated with returns on the market portfolio; other project-specific risks are uncompensated.

There is an obvious problem with this approach. Intuitively, it is difficult to accept the proposition that a project that could wipe the firm out if it goes badly can be of the same (or even less) risk than another project that has no significant implications for the firm's financial health. But this is a direct implication of the view that only market risk matters.

One reason why project-specific risks may be important is that real-world market frictions impose additional costs and constraints on the raising of capital. To see how these are relevant, recall the underlying logic of the WACC approach. One implication of that approach is that the value of any project is the same regardless of the firm that undertakes it. In other words, the project can be assessed and valued independently of any other firm projects and opportunities, synergistic effects aside. The reason for this is that if the new project goes badly, there are no implications for the value of these other assets; the funds needed to finance these assets are available in the same quantity and at the same cost as applied before the introduction of the new project.

However, this is unlikely to be the case in practice. When a firm's financial position is weakened due to losses on a particular project, several things happen that adversely affect the firm's other assets. First, its debt rating may fall, thereby increasing the cost of additional debt financing. Second, firm management has a greater incentive to engage in morally hazardous behaviour, further increasing the cost of additional debt financing. Third, firm stakeholders are more reluctant to continue or extend their relationship with the firm, thereby raising the costs of these relationships and depleting internal funds. Fourth, if the losses are severe, the firm incurs additional costs of employee redundancy, debt renegotiation and the like, all of which reduce internal funds.

The end result of all this is that, contrary to the WACC approach, project-specific risk can affect the cost of investment in a new project by changing the values of the firm's other

investments. This occurs because losses on the project can have a significant impact on the firm's balance sheet, making it costly or even impossible to raise further funds from capital markets. Yet without such funds, the firm may have to forego future valuable projects or shut down existing ones. This potential loss of value on other investments represents an additional cost to the firm's providers of capital for which they require compensation. This adds to the cost of the new project.

As a concrete illustration of this point, consider the acquisition of an electricity retailer that sells more than it generates. This exposes the acquiring firm to the risk that spot prices for electricity will rise. But since this risk can be diversified away (by, for example, purchasing the shares of net generators of electricity), it does not affect its WACC and, therefore, the cost of acquisition. While this might be plausible if the spot price risk has no effect on the value of the firm's other investments, this will not generally be the case, as NGC discovered with its acquisition of TransAlta. When wholesale electricity prices rose to unprecedented levels in 2001, NGC experienced significant financing problems, ultimately requiring support from its major shareholder. By contrast, an acquisition of Trustpower, for example, would not have exposed NGC to the same quantum of spot price risk and the additional financing costs would not have been incurred. Similarly, a net generator of electricity could have purchased TransAlta and not experienced the same impact of the high spot prices. Acquisitions of electricity retailers clearly require a margin above WACC that depends on the individual characteristics of both the acquisition and the acquirer. And exactly the same consideration applies to all large projects.

This additional cost is zero in the WACC calculation because there are no impediments or costs to refinancing, so the value of the firm's existing and future investments are unaffected. In the real world, such costless recapitalisation is a fantasy.

To summarise, when a firm takes on a new project, it becomes exposed to the risk of future losses on this project, regardless of whether its market risk is large, small, or even negative. Because such losses potentially weaken the firm's financial position, this increases the likelihood that it will be subject to a financing constraint in the future. This, in turn, makes it less likely that it will be able to fund future valuable investment opportunities. This reduces the current value of those investment opportunities, thereby adding to the cost of the new project.

I.2 Timing Flexibility

There is another, more subtle, reason why project-specific risk can affect the cost of investment. Even if a new project has no implications for the firm's overall financial health, its specific risks expose the firm to potential losses. And the greater the specific risks, the greater the potential losses. Since firms obviously prefer to avoid losses, the existence of project-specific risks provides an incentive to delay investment in order to obtain further information. To the extent firms have the flexibility to do this, they hold a so-called *real option* - the option of deciding 'when' to invest. Because options are both valuable and can usually only be exercised once, commencing a project incurs not only the direct cost of the project, but also the indirect cost of using up the option. The sacrifice of the option is an additional cost for which the firm's providers of capital require compensation, effectively raising the project's cost of capital.

In effect, timing flexibility gives the firm the ability to 'maximise' the project's net present value by investing at a date that 'minimises' its potential losses. Because such flexibility is,

obviously, valuable, providers of capital are willing to pay a premium for it (e.g., they bid up the firm's share price), and this additional provision of capital represents an additional cost of investment in the new project. And this additional cost stems directly from project-specific risks - the greater these are, the greater is the value of timing flexibility and hence the greater the premium investors are willing to pay.

Again, this additional cost is zero in the WACC calculation because it implicitly assumes that investment projects either cannot be delayed (i.e., the firm has no flexibility in the timing of its investment) or, if they can be delayed, that they're fully reversible (i.e., the decision to invest or not invest can be reversed if subsequent events reveal that decision to be a bad one). In the first case, the firm has no timing flexibility and so investors do not pay any flexibility premium. In the second case, flexibility has no value because any decision can be costlessly undone. For example, if it turns out that it would have been better to commence investment today rather than last year, then the firm can effectively undo last year's decision and start the project again today. Similarly, if it turns out that the project is a bad one, the firm can abandon it and get its money back.

In practice, most projects are likely to have at least some degree of both timing flexibility and irreversibility. Consequently, most projects incur an indirect investment cost proportional to their project-specific risk.

I.3 Optimisation risk

For regulated firms, a particularly relevant manifestation of irreversibility is so-called optimisation risk. In a regulatory environment where assessment of an efficient level of revenue or acceptable profits is based on the asset value of a company, and where an ODV or ODRC methodology is used to determine that asset value, companies face the additional risk that a regulator may remove assets from its base. This would result in it having to lower its prices not to exceed profit thresholds or acceptable returns on its assets.

In a reversible world, such as that assumed in the WACC calculation, networks would always be able to operate in an optimal configuration. Any investment that subsequently turned out to involve redundant assets could be reversed and the new optimal technology installed in its place. In practice however, the degree of irreversibility in network investments is high and optimising existing networks as envisaged in an ODRC assessment, is simply not practical or cost-effective. This implies that an ODRC valuation may remove assets from the investment base when any reasonable competitive benchmark would leave them in place.

Because of optimisation risk, efficient regulation requires that firms receive compensation in the form of a margin additional to WACC. The Commission recognised this point in earlier draft determinations related to electricity lines businesses.[25]

[25] Refer for example to the Commerce Commission report titled "Regulation of Electricity Lines Businesses – Targeted Control Regime" dated 23 December 2002 (par 53) and Lally (2003), p24.

I.4 Reconciling project-specific risk premia with conventional WACC wisdom

Embedded in the standard WACC calculation is the notion that only market risk matters for determining a project's cost of capital; project-specific risks can be diversified away. By contrast, the arguments presented above maintain that project-specific risks matter as well. But if these risks can in fact be diversified away - and there is no compelling reason to suspect they cannot - then how can investors require a premium for them?

The crucial point here is that project-specific risks do *not* affect the cost per unit of capital used in a project - this depends only on systematic risk for the usual reasons - but instead affect the *number* of units of capital used in that project. In other words, project-specific risks determine the quantity of capital used in a project, not its price. When market frictions are present, a new project's specific risks have no effect on the rate of return required by the market on investment in this project, but they do affect the value of the firm's other projects and growth opportunities. This adds to the quantity of capital employed by the new project, over and above its direct cost of plant, equipment etc. Similarly, when the firm has timing flexibility, a new project's specific risks have no effect on its required return, but they do add to the flexibility premium and thus increase the quantity of capital employed by the new project.

The link between project-specific risks and the project's discount rate (cost of capital) follows directly. If a new project is to earn WACC on its *total* investment cost (direct plus indirect costs), then clearly it must earn more than WACC on its direct investment cost. Two examples may assist in illustrating this idea.

Example 1

Suppose a proposed new project costs $1 million in plant, equipment and other direct costs of investment, and its WACC is estimated to be 10% per annum. Conventional wisdom then dictates that the investment must have annual expected profits of at least $1.1 million if it lasts for one year, or at least $100,000 if it is a perpetuity.[26] But suppose the project has specific risks that, if realised, will make it impossible for the firm to take advantage of a growth opportunity currently valued at $5 million by the firm's investors. With a 20% probability of this occurring, beginning the new project incurs not only direct costs of $1 million, but also indirect costs of $1 million. Then the total cost of investment in the project is not $1 million, but $2 million. Consequently, the investment must have annual expected profits of at least $2.2 million if it lasts for one year, or at least $200,000 if it is a perpetuity. In the latter case, the expected return on the direct investment cost *only* (i.e., $1 million) is not 10%, but 20%; in the former case it is 120%!

[26] For a one year project, the relationship between expected profits, WACC, and the cost of investment (I), is given by: expected profits = (1 + WACC) * I. For a perpetuity, it is given by: expected profits = (WACC) * I.

Example 2

Consider again the project of Example 1, but now suppose that the firm has flexibility in deciding the date on which to begin this project. Although at the WACC of 10%, the project's NPV is currently zero, it is estimated that this could rise to $1 million if the firm invests at the best possible date. Recognising this potential, investors pay an extra $1 million for the firm's securities. As a result, the total cost of investment in the project is not $1 million, but $2 million. Consequently, the investment cannot begin until the present value of its cashflows is at least $2 million, i.e., it must have annual expected profits of at least $2.2 million if it lasts for one year, or at least $200,000 if it is a perpetuity. The corresponding expected returns on the direct investment cost are the same as in Example 1.

As these examples demonstrate, requiring an investment to have an expected return equal to its WACC may not come even close to returning the cost of the capital employed in that investment. In both examples, the minimum-acceptable expected rate of return on the project is 20% if the investment is a perpetuity, or 120% if it lasts one year, considerably greater than the 10% WACC.

The point that project-specific risks affect a project's cost of capital indirectly via their impact on the quantity of capital used by the project, rather than directly on the cost of capital itself, is a crucial one for understanding the absence of any allowance for such risks in the WACC calculation. It is sometimes argued that the WACC calculation incorporates any necessary adjustment for project-specific risks via the market risk premium, so no further margin is required. This is based on the logic that, first, the market risk premium is a weighted average of the required risk premia of individual firms and that, second, these individual risk premia will reflect firm-specific risks to the extent that these matter. Ergo, the market risk premium input to the WACC contains the appropriate allowance for project-specific risks and, hence, no further adjustment is needed.

This argument is wrong. First, it is obviously incomplete, even according to its own logic. The market risk premium is an average across all firms, so it can apply only to firms that have exactly the same specific risks as those of the 'average' firm. Firms that deviate form this average will require a greater or smaller adjustment. Second, and far more importantly, the logic is flawed. As pointed out above, project-specific risks affect the quantity of capital used in a project, not the cost per unit of capital. But the market risk premium estimates the cost per unit of capital invested in the market portfolio and thus has nothing at all to do with the investment costs associated with project-specific risks.

I.5 Empirical Evidence

Although the NZ data are limited, there is ample evidence from overseas that competitive firms require a significant premium for project-specific risks. Summers (1987) finds that the average discount rate used by Fortune 500 firms in the mid-1980s was approximately double the maximum WACC possible for the average firm. More recently, Poterba and Summers (1995) report similar findings for Fortune 1000 firms: an average real discount rate of 12.2% versus a maximum-possible WACC of 7%.

One possible counter to this evidence is that high discount rates simply reflect an internal control premium for overly-optimistic cashflow forecasts by project managers. However, this seems unlikely to be important, for several reasons.

First, and most importantly, the available research evidence suggests otherwise. For example, Mukherjee and Hingorani (1999) report that the most common reasons for top-line managers to employ high discount rates are high non-market risk, project irreversibility, and valuable future investment opportunities. The first and third of these are consistent with concern about market frictions and future financing costs; the second is consistent with the recognition of timing options. In addition, they find that internal control reasons seem to be considerably less important than the above three factors. Similarly, Graham and Harvey (2001) find that more than a third of firms adjust their discount rate upwards in response to project-specific risks, and also to non-market macro risks such as interest rates, GDP, and unexpected inflation. And Keck, Levengood and Longfield (1998) report that such behaviour is even more prevalent in the firms of smaller countries that are less integrated into global capital markets.

Second, if top-line managers believe their subordinates' cashflow forecasts are too high, then the obvious response would be to lower these forecasts, not to raise the discount rate; the two actions are equivalent only in the case of a perpetual project with constant cashflows.

Third, an internal control premium seems inconsistent with any sort of sustainable equilibrium. If project managers do inflate cashflow forecasts, it must be because they have an incentive to do so. That being the case, once they learn that their attempts are being confounded by the imposition of higher discount rates from above, their obvious response is to further inflate cashflow forecasts, thereby triggering a further rise in discount rates, and so on. In the end, this process pushes both expected cashflows and discount rates to plus infinity, and everything is worth nothing!

To conclude, the presence of market frictions and timing options suggest that project-specific risks add to the cost of investment. In practice, competitive firms use discount rates far higher than can be explained by systematic risk alone. Unless one is prepared to believe that these firms consistently forgo profits by under-investing, their behaviour points strongly to the view that project-specific risk matters, both in theory and in practice. Because the firm's investment budget can always be put to other uses, regulation that prohibits the firm from earning a return consistent with these risks may well lead to under-investment. In particular, shareholders can decide not to invest in any of the projects available to the firm and have capital returned to them. NGC is currently implementing a capital return programme.

Appendix II : Qualifications and Experience

Glenn Boyle

I am Professor of Finance at the University of Otago. I currently teach courses in finance theory and advanced finance theory to undergraduates and graduate students respectively, and a readings course in corporate finance and investments to honours students. My current research interests include real options, optimal asset allocation, deposit insurance, 'principal' performance and the discipline of competitive labour markets, and NZ executive compensation.

My academic qualifications are PhD (Finance) from the University of Texas, and MA (Economics) and BA (Economics/History) from the University of Canterbury. My PhD thesis focused on the role of money in asset pricing models, a topic on which I have published papers in the *American Economic Review, Journal of Political Economy, Journal of Finance,* and *Journal of Financial Economics*, among others.

I am a Consulting Principal for LECG and provide advice in the areas of real options, cost of capital, and other finance-related issues. Between 1995 and 2001, I was a member of the NZ Debt Management Office's Advisory Board.

Tony van Zijl

I am Professor of Accounting & Financial Management at Victoria University of Wellington. At present my teaching is mainly in financial reporting and my research interests include capital markets, valuation, financial reporting, and performance measurement and reporting.

My academic qualifications are PhD (Finance), BSc (Mathematics), BCA(Hons) (Economics) and DipAcc (Accounting). My PhD thesis dealt with theoretical aspects of the Capital Asset Pricing Model (CAPM) and my academic publications include a number of papers on that topic.

I am a member of the Institute of Chartered Accountants of New Zealand (Fellow Chartered Accountant) and also a member of the Institute of Finance Professionals of New Zealand (Certified Securities Analyst Professional).

In February 2002 I was appointed Chairman of the ICANZ Financial Reporting Standards Board, having earlier been a member of the Board from 1989 to 1999. I was a member of the Accounting Standards Review Board from 1991 to 2001 and I was Director of Research for the Institute of Chartered Accountants of New Zealand from 1985 to 1988.

I have served on a number of government working parties, including on securities law reform, capital charging for tertiary education institutions, and value-based reporting for state-owned enterprises. I have been a member of the Valuation & Property Standards Board of the New Zealand Property Institute since 1998.

I am a Director of LECG and provide consulting advice and litigation support in the areas of financial reporting, financial management, capital markets and cost of capital and

valuation. I have given expert evidence on these matters in High Court proceedings and arbitrations.

Ryno Verster

I am a managing consultant in LECG's Auckland office. My academic qualifications are MSc (Engineering) and BSc (Engineering) from the University of Stellenbosch, South Africa and MBA from the University of Otago. My MBA thesis dealt with the valuation of intangible assets.

I am primarily involved in the analysis of organisational structure and strategy and the development of complex financial models, with a special focus on intangible assets. In addition, I provide strategic and financial advice to a broad range of industry clients in New Zealand and Australia.

Prior to joining LECG, I held senior engineering and project management positions and founded and managed a consulting engineering company.

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