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Report for the Australian Competition and Consumer Commission

Empirical Evidence on Proxy Beta Values for Regulated Gas Transmission Activities

Final Report

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Chapter One

Introduction and Overview

1.1 The Brief

The Australian Competition and Consumer Commission (ACCC) commissioned The Allen Consulting Group to provide the Commission with a review of the available empirical evidence on equity betas for the Commission to draw upon when deriving a proxy beta for regulated gas transmission companies in Australia. The principal output was to be survey of beta estimates from public sources for sufficiently comparable firms in Australia, and in other relevant jurisdictions. As well as empirical beta estimates, the survey was to include the associated information that is required in order to apply those empirical estimates in a consistent manner.

The particular components of the project were to be follows.

- a discussion of the concept of systematic risk and the possible factors that may influence systematic risk, including a discussion of the relevance of the threat of 'asset stranding' for the level of systematic risk;
- a survey of the available listed entities in the relevant markets, with a sufficient discussion of their activities to enable their suitability as a comparable entity to be assessed, and the criteria for assessing the comparability of companies described;
- a presentation of the most recent empirical estimates of equity betas for the comparable entities from reliable, publicly available sources of beta estimates, with the methodology employed by the various sources for estimated equity betas assessed as to its suitability;
- a discussion of the relevance of adjustments that may be made to raw beta estimates, as well as a discussion of the issues associated with using beta estimates for foreign firms (measured against their home share markets) to inform the discussion on proxy betas for Australian firms; and
- reporting of the levels of gearing employed by the comparable entities over the period during which the equity betas were estimated, and a discussion of the different approaches that exist for adjusting equity betas to reflect different levels of financial leverage (ie the levering/de-levering approach).

The Group was also asked to comment on other studies into proxy betas for regulated Australian gas transmission activities, namely a report by NECG that was commissioned by GasNet, and a report by the Brattle Group that was commission by Epic Energy.

1.2 Overview of the Report

Chapter 2 discusses the concept of the cost of capital in general terms, and then focuses on the distinction between the portion of risk associated with an asset that shareholders can remove at no cost through diversification, and the remainder that cannot be removed. This distinction is important because, in competitive capital markets, investors can only command a return for the portion of risk that they cannot remove at no cost – and so only the non-diversifiable component of risk affects an asset's cost of capital.[1]

The chapter then discusses some of the factors that may be expected to affect an asset's cost of capital – although it is noted that it is difficult to know the quantitative impact of any given factor and, as an asset's non-diversifiable risk will be a product of every conceivable event that has a market wide effect, no list can ever be complete.

Lastly, the chapter introduces the Capital Asset Pricing Model (CAPM), which is a model drawn from finance theory, for estimating the cost of capital associated with an asset. It is noted that, in practice, the model is only used to estimate the cost of capital associated with the equity financed portion of the asset, as the promised yield to debt providers is used as a proxy for the expected return to debt providers.

The CAPM, in effect, provides an estimate of the risk premium required by equity investors to continue to hold a particular asset, which is a function of the risk premium required to hold a diversified portfolio of equities (commonly referred to as the equity premium), and the level of non-diversifiable risk associated with a particular asset relative to that market average – which is often referred to as the 'beta' of that asset. As discussed above, the core output of this report is the presentation of information relevant to the assumption about the 'beta' associated with the equity-financed portion of regulated Australian gas transmission activities.

Chapter 3 discusses the conceptual issues associated with the estimation of equity betas, and their use for the derivation of a beta for regulated Australian gas transmission activities. The four main categories of issues discussed are: the concept and selection of a group of comparable entities; the technical issues associated with the estimation of equity betas; the adjustments that may be made to equity beta estimates to take account of differences in financial leverage; and techniques that may be applied to attempt to improve the precision or otherwise improve the predictive power of equity beta estimates.

[1] Non-diversifiable risk is commonly also referred to as systematic risk, systemic risk, market risk, beta risk and covariance risk. The converse – diversifiable risk – is commonly also referred to as unique risk and project risk.

Regarding comparable entities, it is noted that, in practice, betas for particular entities are normally derived from estimates of betas from other entities that are considered to have a comparable level of non-diversifiable risk. This is necessary for any entity that is not listed on a stock exchange, as the empirical estimation of betas requires continuous observations of economic returns.[2] However, even where a particular entity is listed, it is common practice to take account of the beta estimates of other entities in order to improve the precision of the beta estimate. Throughout this report, a beta for a particular activity that is derived wholly or in part from observations of other firms is referred to as a proxy beta.

The characteristics of assets that may affect their level of non-diversifiable risk are discussed first. These include whether the asset is price-regulated, the characteristic of demand for the services provided by the asset, the level of contractual cover for inputs and outputs, and the degree of financial leverage first then discusses a hierarchy of criteria that are considered relevant for deciding whether entities are sufficiently comparable to regulated Australian gas transmission activities. It is noted that the permissiveness of the criteria that are adopted for any market needs to reflect the pool of potentially comparable entities that would result – essentially, a trade-off between potential bias and the level of precision in the derivation of a proxy beta for a particular activity. The pool of potentially comparable entities has implied that the most stringent selection criteria have been applied in North America, and the most permissive in the UK, with the criteria for Australia sitting between.

A particular issue that needs to be considered is whether it is appropriate to use equity beta estimates for foreign firms (measured against their home equity markets) in the derivation of a proxy beta for the activities of Australian firms – such as regulated gas transmission activities. It is noted that there are a number of reasons why betas for the same activity may differ between countries, and no simple adjustment for differences between markets, but that nevertheless, they may still provide useful information. Accordingly, it is recommended that regard be had to equity beta estimates for foreign firms, at least as a secondary source of information (with equity beta estimates for Australian firms the primary source of information).

Turning to the estimation issues, it is noted that there are a number of methodological choices that need to be made when estimating the beta for a particular equity, different decisions on some of which may have a profound effect on the resulting beta estimate. A 'best practice' for these different methodological choices is identified, and the different beta estimation services evaluated against these criteria. The preferred sources for the US, UK and Australia are the Ibbotson service, the London Business School service for the UK, and the AGSM Risk Management Service for Australia. The Bloomberg service was used for the Canadian betas given the absence of a suitable alternative.

[2] The term 'economic return' is used to refer to the sum of the yield on a share, and the capital gain or loss over a period. This is also commonly referred to as the total return.

Regarding adjustments for financial leverage, it is noted that there are a range of potential adjustments that may be used, and little guide from theory as to which may be the most appropriate in each circumstance, although it is noted that consistency in application is important. It is recommended that, in any particular case, the results produced by the range of levering/de-levering approaches be tested.

One consequence of the use of different levering/de-levering methodologies is that the comparison of asset beta estimates is open to interpretation error. In order to minimise the scope for interpretation error, **it is recommended that the focus be upon the re-levered equity beta that is consistent with a gearing assumption of 60 per cent debt-to-assets**. As Australian energy regulators have accepted a standard benchmark gearing assumption of 60 per cent debt-to-assets, equity betas consistent with this gearing level are comparable with previous regulatory decisions. Should the Commission continue with this benchmark gearing assumption, then the re-levered equity betas presented are also consistent with the inputs the Commission requires to estimate the costs of equity associated with regulated Australian gas transmission activities.

Regarding the adjustments to improve the precision of estimates, it is recommended that the simplest of approaches be adopted – which is to have regard to the average of the raw equity beta estimates for the comparable entities (after making adjustments for financial leverage). It is concluded that the two adjustments that are often made to equity beta estimates – the Vasicek adjustment and Blume adjustment are inappropriate where the proxy beta is required for regulated Australian gas transmission activities, and this proxy beta is based upon estimates from a carefully set of comparable entities.

Using the Vasecik adjustment is considered redundant, as this it is just an alternative means of combining the beta estimate for a particular firm with that of a set of comparable entities (and, under certain assumptions, the adjustment would not result in a different proxy beta estimate). Regarding the Blume adjustment, to the extent it is undertaken to improve the precision of the equity beta estimates, it is considered likely to introduce bias. To the extent that the Blume adjustment is undertaken to take account of the regression tendency of equity betas, it is considered to reflect a tendency that is inconsistent with the use for which the proxy beta is required (which is for Australian regulated (pure-play) gas transmission activities).

Chapter 4 then presents the empirical results that follow from the principles discussed in chapter 3. The comparable entities are presented first. There were 4 comparable entities from Australia, 21 *preferred* comparable entities from the US, 4 from Canada, and 11 from the UK. The majority of the *preferred* US comparable entities have gas distribution as their main activities, the Canadian firms are a mixture of gas transmission and distribution, the UK firms are a mixture of gas transmission and distribution, and electricity and water distribution, and the Australian firms cover entities that have as their main activities gas transmission, gas distribution and electricity distribution.

While there are a large number of major transmission pipelines in the US, most are held by listed entities for which non-regulated activities – mainly gas production and energy trading – account for a substantial share of their overall businesses. However, as the Commission's responsibilities are with respect to gas transmission, beta estimates are also provided for three such companies. However, the substantial share of non-gas transmission activities for these entities implies caution should be exercised when interpreting the beta estimates.

This chapter then presents the empirical estimates of equity betas, and the implied asset betas, for the groups of comparable entities in the different markets. As noted above, there is a range of plausible levering/de-levering approaches that may be used, and the betas implied by the use of the different available methodologies are reported. The re-levered equity betas (for a benchmark gearing assumption of 60 per cent debt-to-assets) are shown in Table 1.1 below. The figures represent the proxy equity betas obtained by taking the simple average of the asset betas derived for the individual firms in each of the markets and re-levered to the regulatory-standard gearing level (with the figures and parentheses showing the average if the negative equity beta observations are excluded).

Table 1.1

RE-LEVERED EQUITY BETA ESTIMATES DERIVED FROM AVERAGE ASSET BETAS – 60% DEBT-TO-ASSETS

Beta Estimates	Tax Term Excluded from Levering Formula		Tax Term Included in Levering Formula	
	Debt Beta = 0	Debt Beta = 0.15	Debt Beta = 0	Debt Beta = 0.15
Australian Companies [3]	0.69 (0.69)	0.66 (0.66)	0.68 (0.68)	0.66 (0.66)
USA Companies	0.16 (0.25)	0.10 (0.19)	0.17 (0.26)	0.10 (0.20)
Canadian Companies	0.02 (0.23)	0.02 (0.25)	0.03 (0.25)	0.02 (0.26)
UK Companies	0.15 (0.29)	0.06 (0.19)	0.14 (0.29)	0.05 (0.18)

The report notes (in **section 4.3**) that there are sound arguments for relying upon the latest market evidence when deriving a proxy beta for the regulated activities of a regulated gas transmission entity. Exclusive reliance on the latest Australian market evidence would imply adopting a proxy equity beta (re-levered for the regulatory-standard gearing level) of 0.7 (rounded-up) for these activities. Moreover, regard to evidence from North American or UK firms as a secondary source of information does not provide any rationale for believing that such a proxy beta would understate the beta risk of the regulated activities. Rather, the latest evidence from these markets would be more supportive of a view that the Australian estimates overstate the true betas for these activities, although concerns are expressed with the reliability of the beta estimates from these other countries.

[3] There were no negative equity beta observations for the Australian firms.

That said, however, the report cautions against exclusive reliance on this evidence at this point in time. It is noted that most Australian energy regulators have used a proxy equity beta in the range of 1 (for the regulatory-standard gearing level of 60 per cent debt-to-assets) when assessing or setting regulated charges. The use of a proxy beta of 0.7 would represent a substantial reduction in the estimates of the costs of capital associated with these activities compared to the assumptions previously adopted. While such a revision would be warranted in the face of reliable, objective evidence, it cannot be concluded definitively that this quality of evidence exists at this time.

First, the primary source of evidence – which derives from the listed Australian entities – consists of a group of only four firms, and a full period (four years) of observations is only available for two of these. Secondly, we are concerned about the magnitude of the beta estimates derived for firms operating in other countries. In particular, the re-levered equity betas for the US firms are substantially lower than the estimates that have been derived for different time periods. It may be that the recent events on US share markets may have affected the beta estimates, which may produce a bias if those events were not considered by investors to be normal events; however, it is impossible to prove or disprove such a conjecture.

Accordingly, in the near term, while noting that how the Commission chooses to exercise its discretion is for it alone to decide, it is recommended that it adopt a conservative approach, which is suggested to imply not using a proxy equity beta that is too far from the range of previous, relevant regulatory decisions. That said, this report has demonstrated that no implication can be drawn from current market evidence that the proxy betas that Australian regulators have adopted are likely to understate the 'true' beta – rather, as noted above, the current evidence suggests regulators systematically have erred in the favour of the regulated entities.

In the future, however, the recent listings of energy utility firms on the Australian Stock Exchange imply that more information from the Australian capital market will be available in the future, and so greater reliance on market evidence should be possible over time.

Chapter 5 then provides a number comments upon the two reports noted above, that is, the report by NECG that was commissioned by GasNet, and the report by the Brattle Group that was commissioned by Epic Energy.

Regarding the NECG report, we have concerns about the adjustments to betas that were employed, as well as the set of comparable entities to which that report has regard. In particular, we disagree with the use of the Blume adjustment (as discussed in chapter 3), and with exclusion of Envestra from the set of comparable entities, and the inclusion of other companies that do not have substantial regulated energy infrastructure activities. It is also noted that the NECG report refers to three sets of information, which essentially are the same – that is, empirical beta estimates for Australian companies, just obtained from different sources. It is argued that it is undesirable to select between different beta estimation sources, and preferable to draw beta estimates from a reliable, publicly available source and to use the latest market evidence.

Regarding the Brattle Group report, it is noted that its estimation methodology is a valid response to one of the problems with drawing beta estimates from foreign firms to derive a proxy beta for Australian firms. However, it is noted that the adjustment that was undertaken inevitably is an approximation, and that the problem – that of different market weights – is only one of the problems associated with relying upon beta estimates for foreign firms.

We are concerned, however, about the companies that were included in the proxy group, in particular, that most had substantial interests in unregulated – and probably higher risk – activities. More importantly, it was noted that evidence from the Australian capital markets should be treated as the primary source of information, and the results presented by the Brattle Group – and unadjusted foreign-sourced betas – be used as a secondary source of information.

Chapter Two

Estimation of the Cost of Capital

2.1 What is the Cost of Capital?

The cost of capital that is associated with an asset is the return that investors would expect to receive from a project in order to justify committing funds to that investment. That is, it is a level of return on invested capital that is just sufficient to motivate the capital investment in a particular asset and attract the capital away from alternative investments. In this sense, the cost of capital is an opportunity cost of capital – the return on capital available to investors in the next-best investment opportunities, taking into account the relative risk of the projects.

Capital, i.e. investment funds, can be regarded as a tradable commodity with price determined by supply and demand. The cost (price) of capital is dependent upon the aggregate demand and supply of investment funds, and the risk in cash flows potentially generated by the asset relative to the risk associated with other assets. The cost of capital for an asset or activity is not determined by the owner of the asset, the provider of the capital or, in the case of regulated utilities, by a regulator – it is a market price for investment funds.

In practice, assets that are employed by a firm are normally financed in part by debt, with the residual portion financed by the equity holders. Of the returns that flow from a particular asset, part is paid to the debt providers and part to the equity holders. Hence, the term 'weighted average cost of capital' (WACC) is often used to refer to the average cost of debt and equity capital, weighted to proportions of debt and equity finance to reflect financing arrangements for assets.

2.2 What 'Risk' is Reflected in the Cost of Capital?

As indicated above, the cost of capital for an activity reflects not only an aggregate supply and demand for investment funds, but also the relative risk associated with the cash flows generated by a particular asset. An important issue when estimating the cost of capital is to distinguish between portion of risk that affects an asset's cost of capital and that portion which does not.[4]

A cornerstone of modern financial economics is that much of the risk that is associated with the returns to a particular asset can be eliminated at no cost, merely by holding that asset together with a broad portfolio of other assets. The act of combining assets into a portfolio in order to reduce the volatility of average returns is known as diversification.[5]

[4] The term 'risk' is used in this report to refer to the volatility (or variance) associated with the returns to a particular asset. In the context of the CAPM, investors are only concerned about the expected (average) return (a higher average return being good), and the variance in returns (higher variance, implying higher risk, being bad).

[5] The benefits from diversification were first formalised Markowitz in 1952, for which be later earned a Nobel prize, although the concept of diversification was earlier commented upon by Bernoulli and earlier still by

However, diversification cannot eliminate all risk. This is because part of the volatility in expected returns may arise from economy-wide events that affect all assets similarly, albeit some more than others. This portion of the risk is often referred to as non-diversifiable risk.[6]

It is the non-diversifiable risk, that an investor cannot eliminate at no cost, which affects the cost of capital associated with an asset. As the risk associated with events unique to a particular asset can be eliminated at no cost, competition in capital markets will ensure that a return is not provided in respect of this portion of risk.[7] This distinction between diversifiable and non-diversifiable risk is a well accepted component of modern finance theory and practice. By way of example, Brealey and Myers, a leading text for finance practitioners, commented upon implications of the different types of risk as follows:

> '[t]here are two kinds of risk - those you can diversify away and those you can't. You can measure the non-diversifiable, or market, risk of an investment by the extent to which the value of the investment is affected by the changes in the aggregate value of all the assets in the economy. This is called the beta of an investment. The only risks that people care about are the ones they can't get rid of - the non-diversifiable ones. This is why the required return increases in line with its beta'.[8]

2.3 Estimation of the Cost of Capital – the CAPM

Unlike the price for most goods and services, the market price for investment capital cannot be observed directly. That is, while the price at which cabbages are sold at a market may vary from week to week, and even during the market day, the price of the transaction is disclosed, and (in principle at least) can be observed. The same applies to virtually all goods and services. In contrast, however, while the price at which shares are traded can be observed, the future dividend stream and capital gains assumed by investors when buying the shares – and hence, the return required by investors to hold the relevant asset – cannot.

As a result, the cost of capital associated with an asset can only be *estimated* from the available information from the capital markets, such as share prices, dividend payments, and so forth. Moreover, as with any estimation process, a model needs to be applied that links these observed parameters to the cost of capital associated with an asset, which may reflect theory about how asset prices are determined, coupled with simplifying assumptions about such matters as the preferences of investors, and the workings of capital markets.

Shakespeare: see Rubenstein, M., 2002, 'Markowitz's "Portfolio Selection": A Fifty-Year Retrospective', *The Journal of Finance*, Vol. LVII, No. 3, pp.1041-1045.

[6] As noted above, synonyms for non-diversifiable risk include systematic risk, systemic risk, market risk, beta risk and covariance risk.

[7] The non-diversifiable risk associated with an asset is also the incremental risk borne by an investor when an asset is added to a well-diversified portfolio of assets. This result follows simply from the observation that the diversifiable portion of an asset's total risk disappears when it is combined with the well-diversified portfolio, leaving only the non-diversifiable portion.

[8] Brealey and Myers, *Principles of Corporate Finance*, Fourth Edition, McGraw-Hill Companies Inc, 1991, page 916.

The Capital Asset Pricing Model (CAPM) is widely used in Australia and elsewhere for estimating the cost of capital associated with assets, and it is assumed in this report to be the model that is used to estimate the cost of capital associated with the relevant regulatory activities.[9] Under the CAPM, the required return for any asset is expressed as the sum of the return available on a risk free asset, together with a premium required to accept the risk associated with the asset. This risk premium, in turn, is a function of two inputs:

- the return that investors would require in order to hold a widely diversified portfolio of assets, which is also the return that an investor would require in order to hold an asset which has an 'average' level of risk; and
- a ranking of the risk associated with the particular asset relative to the risk associated with the well-diversified portfolio of assets – which is the beta of the asset (where the beta for the asset of average risk, and the beta for the market portfolio, is one).

Thus, the risk premium investors would require in order to hold a particular asset is estimated by scaling up, or scaling down, the risk premium required for the well-diversified portfolio of assets according to the beta measure of that asset's relative risk.

While in its pure form, the CAPM would provide a direct estimate of the required return for a project, in practice, betas for projects cannot be observed or measured directly. Estimating a beta requires historical information on the economic returns to an asset (comprising the value of the returns plus the change in the market value of the asset), and on the economic returns to the well-diversified portfolio of assets. This type of information is only available on assets that are traded on a stock exchange, and hence to the equity share of a project.

Therefore, in practice, the CAPM is used to estimate the required return to the equity share of an asset, and stock market indices are used as a proxy for the market portfolio. Accordingly, the more common formulation of the CAPM is the following expression relating to the return on equity:

$$R_e = R_f + \beta_e (R_m - R_f)$$

where R_e is the required return on equity and β_e is the equity beta.

Given an estimate of the cost of equity associated with a project, a proxy for the expected return to debt financiers is typically taken as the promised yield on the debt (which may be observed or a proxy may be taken from the yield on similar instruments).[10] The cost of capital for the project is then estimated as the weighted average of the costs of equity and debt finance, that is (abstracting from any adjustments for taxation):

[9] The brief for this project was to provide empirical evidence on equity betas relevant to regulated Australian gas transmission activities, which necessarily assumes the use of the CAPM. A full analysis of the assumptions underpinning the CAPM, and of potential alternative models for estimating the cost of capital associated with a particular asset, is beyond the scope of this report. However, attachment 3 summarises three other models that are in use amongst finance practitioners for estimating the cost of capital, which are the Fama-French three-factors model, Arbitrage Pricing Theory, and the Dividend Growth Model (also known as the Discounted Cash Flow method).

[10] The promised yield on debt will overstate the expected return to debt providers, however, by the size of the default premium included in the yield.

$$WACC = R_e \frac{E}{V} + R_d \frac{D}{V}$$

where R_d is the cost of debt, and E/V and D/V are the shares of equity and debt, respectively, in the financing structure.

2.4 What May Affect an Asset's Level of Systematic Risk (ie Beta)?

As noted above, the degree of non-diversifiable risk associated with a particular asset depends upon the extent to which the returns to that particular asset are move with returns to the market as a whole. Intuitively, this would suggest that the beta should depend upon the extent to which an asset's returns are affected by events that affect the market as a whole. This intuition is correct – it can be shown that, under a number of assumptions, the beta of an asset can be expressed as a linear function of the sensitivity of its returns to each market-wide factor multiplied by the sensitivity of the overall market return to that factor. That is:

$$\beta_j = b_{1,j} \frac{Cov(F_1, R_m)}{Var(R_m)} + b_{2,j} \frac{Cov(F_2, R_m)}{Var(R_m)} + \ldots$$

where b_{ij} is the sensitivity of the return to asset j to factor i, F_i refers to factor i, and the other terms are as defined above.[11] As these factors are also inputs into an alternative asset pricing model, the Arbitrage Pricing Theory – research has been undertaken into the identity of these economy-wide factors, with the likely factors including unexpected changes in real aggregate income, inflation, proxies for risk aversion and long term real interest rates.[12]

In contrast, events that are unique to a particular asset or small group of assets, are unlikely to have an impact on systematic risk, and able to be diversified away by holding a well-diversified portfolio of assets.[13]

[11] This is taken from Lally, M., 2000. *The Cost of Equity Capital and Its Estimation*, McGraw-Hill Series in Advanced Finance Volume 3, Sydney: McGraw-Hill, p 26. The original source is Dybvig, P. and S. Ross, 1985, 'Yes, the APT is Testable', *The Journal of Finance*, Vol.XL, No.4, p.1181.

[12] Chen, N., Roll, R., and Ross, S., 1986. Economic forces and the stock market, *Journal of Business* 59: 383-403.

[13] One of the assumptions underpinning the Arbitrage Pricing Theory – and hence the decomposition of the beta into economy-wide factors – is that each asset is in small supply (Dybvig, P. and S. Ross, 1985, 'Yes, the APT is Testable', *The Journal of Finance*, Vol.XL, No.4, p.1175). Where a market has entities with a large weight, then events that are unique to that asset will also affect the returns to the market overall, and so contribute to non-diversifiable risk. Unlike the Arbitrage Pricing Theory, the CAPM does not require an assumption that every asset be in small supply.

The Commission requested that a comment be made as to whether 'stranded asset risk' is an event that would be expected to contribute to the non-diversifiable risk associated with a particular project. The term 'stranded asset risk' is interpreted to refer to the market value of the assets used to provide regulated services falling below the regulatory value of those assets at some time in the future. This may occur because of a fall in market demand (and where the revenue loss associated with that fall cannot be made up elsewhere), or where the regulator writes down the regulatory value of the assets without permitting the amount written-off from being recovered from customers (that is, the reduction in the regulatory value of the assets between two points in time exceeds the depreciation allowance factored into regulated charges over that period).

In principle, there may be a systematic component to asset stranding, although for the most part, such events are likely to be largely unique to a particular asset. That is, to the extent that the reduction in demand that leads to the fall in the market value of the assets is related to market wide events – such as national income, or real interest rates – then such an event may imply greater beta risk. However, if the event that would cause asset stranding is largely to the customers served by the network, or if the stranding is regulator-driven, then it would not affect beta risk.

That said, it is impossible to tell for certain whether or not a particular event would be characterised as giving rise to diversifiable or non-diversifiable risk, or to the division between the two. Empirical beta estimates provide insight only into the beta risk associated with the totality of events that affected an asset over the estimation period – they do not provide a breakdown of the risk into events.

2.5 Empirical Beta Estimates

Formerly, the beta value for equity j is defined as the covariance between its return R_j and the return of the market portfolio R_m,[14] standardised by dividing by the variance of the return of the market portfolio.[15] Under standard econometric assumptions, the beta for an equity can be estimated as the slope coefficient in a regression of the entity's return on that of the market:[16]

$$R_j = \alpha_j + b_j R_m + e_j$$

where α_j is the intercept and e_j is a mean zero residual.

[14] The covariance between the returns an asset and the market overall is a statistical measure of the extent to which the returns tend to move together – which is the non-diversifiable portion of the risk, discussed above.

[15] Dividing the covariances by the variance of the market portfolio implies that the average beta (which is the beta of the market portfolio) will be one, with assets with a lower than average covariance having a beta of less than one, and assets with a higher than average covariance having a beta greater than one.

[16] Lally, M., 2000. *The Cost of Equity Capital and Its Estimation*, McGraw-Hill Series in Advanced Finance Volume 3, Sydney: McGraw-Hill, p 26.

As noted above, the estimation of equity betas requires continuous information on the economic returns for a particular equity, which restricts the estimation of betas only to stocks that are traded on an exchange. Accordingly, where the target firms is not listed – or even where it is listed, but the activity for which an estimate of the cost of capital is required is not its sole activity – then the common practice is to derive a proxy equity beta, which is based upon estimated equity betas for other, listed, entities that have similar assets and that are considered to face similar levels of systematic risk.

Moreover, the statistical precision of individual equity beta estimates is typically very low – indeed, theory predicts that the beta for many stocks should only explain a small part of its total risk.[17] The average standard error across the equity betas for Australian stocks, as estimated by the Risk Management Service of the AGSM, is approximately 0.3 (using the March 2002 estimates), which would imply that the 95 per cent confidence interval for the true beta would, on average, be the point estimate, plus or minus 0.6 (that is, if the point beta estimate were one, then the 95 per cent confidence interval would be between 0.4 and 1.6). Accordingly, even where a particular activity is listed, it is common practice to combine individual beta estimates with other information, such as beta estimates for comparable entities, in order to improve the precision of the estimated beta for a particular activity.

The empirical estimation of equity betas for a proxy group of comparable listed entities is the subject of this report. The methodologies for selecting a relevant group of proxy entities and for making empirical estimates of equity betas are discussed in some detail in the next chapter.

One of the questions for which asset stranding may be relevant is whether investors would be expected to receive the return intended by the regulator on average, having regard to all conceivable events. This matter is discussed next.

2.6 The Relevance of 'Asymmetry' and Excluded Events

When designing price controls, there are two quite different questions that a regulator implicitly has to answer, which are related to the uncertainty of future events, which are as follows:

- First, given that future returns may be higher or lower than forecast, by how much does the average return to investors need to exceed the risk free rate of return in order to induce investors to hold the asset in question (ie what expected return should the regulatory arrangements be designed to deliver investors)?[18]
- Secondly, what return would investors receive under the regulatory arrangements, on average, given all potential future events or states of nature (ie what expected return do the regulatory arrangements actually provide to investors)?

[17] This follows because the theory assumes – and observation confirms – that much of the risk associated with individual assets can be removed through diversification.

[18] The term 'expected' refers to a mathematical expectation, that is, the probability-weighted average across all conceivable future events or states of nature.

The CAPM provides an answer to the first question – the cost of capital is the return that investors would need to receive, on average, in order to hold a particular asset.

The second question is quite different – in principle at least, it requires an examination of the implications of all potential events (or states of nature), as well as the approach the regulator has used to forecast future expenditure requirements, demand, and commitments as to assess future regulatory decisions (such as how regulatory asset values will be determined at future price reviews). The objective is to ensure that the expected return under the regulatory arrangements is the same as the expected return intended by the regulator (that is, its estimate of the cost of capital), which is approximately equivalent to ensuring that forecasts of future expenditure requirements and revenue (price and quantity) are expected values.

The concept of asymmetry may be important in this matter. This is because there will inevitably be a number of events that are excluded from consideration when deriving price controls. If the impact of these excluded events on returns is symmetric, however, there is no concern – not considering these events explicitly will not change the expected return. However, if the excluded events are asymmetric, then failing to consider such events will change the expected return. That said, as noted above, as well as the excluded events, it is necessary to examine the implications of the regulatory regime, including the approach taken by the regulator. One relevant matter is the tendency for regulators to adopt a conservative approach to the assumptions used when deriving price controls, either consciously as a response to uncertainty, or arising from the regulated entity's information advantage.

While arguments have been made that a margin should be added to the regulator's estimate of the cost of capital in order to make allowance for such events, this is an inappropriate response. Without some analysis of the implications of future events, as well as the implications of the approach the regulator has taken to forecast the necessary inputs into the price controls, it is impossible to know whether the expected return is biased above or below the regulator's target, or by how much. This is consistent with the advice from finance theory as to how such events should be addressed. For example, in criticising the Office of the Regulator-General's (and, implicitly, the Commission's) decision to add a margin to its estimate of the cost of capital to allow for such excluded events specifically in relation to the excluded events in its 1998 gas decision, Lally comments as follows:[19]

> The concept is to adjust the beta estimate rather than the cash flows, so as to affect the valuation estimate [of major infrastructure disruptions] appropriately. However, such an approach is potentially flawed because, if the cash flow adjustment is unknown, then the appropriate beta adjustment cannot possibly be known. It would be preferable to attempt to quantify the adjustment to the cash flow stream.

This is also consistent with advice to finance practitioners. For example, Brealy and Myers comment as follows:[20]

[19] Lally, M., 2000. *The Cost of Equity Capital and Its Estimation*, McGraw-Hill Series in Advanced Finance Volume 3, Sydney: McGraw-Hill, p 29.

[20] Brealy and Myers, *Principles of Corporate Finance*, 6th Edition, McGraw Hill, 2000, pp.239.

> Now, of course, you can figure out the right fudge factor to add to the discount rate to apply to the original $1 million forecast to get the right answer. But you have to think through the possible cash flows in order to get that fudge factor; and once you have thought through the cash flows, you don't need the fudge factor.

A different concern with the potential 'asymmetry' in expected cash flow is that the CAPM may not provide the correct estimate of the return that investors require on average (ie the cost of capital) for holding an asset under these circumstances. This issue is a more complex matter, and is addressed in the response to a comment in the NECG report, in section 5.1.

Chapter Three

Empirical Estimation of Beta Values – Conceptual Issues

This chapter discusses the conceptual issues associated with the estimation of equity betas, and their use for the derivation of a beta for regulated Australian gas transmission activities. The four categories of issues described in this section are:

- the selection of a set of listed entities (a proxy group) that are considered to have a comparable level of non-diversifiable risk;
- the methodology used to estimate equity betas for the proxy group of listed entities;
- adjustment of equity beta estimates to correct for differences in the financial leverage of the entities in the proxy group and the level of gearing (or assumed level of gearing) for the regulated entity; and
- the techniques that may be used to 'pool' the information from a range of equity beta estimates, or otherwise adjust the equity beta estimates, in order to improve the precision or predictive power of the proxy beta estimate.

These are addressed in turn.

3.1 Selecting a Group of Comparable Entities

Characteristics that Explain Non-Diversifiable Risk

As indicated in the previous chapter, in most cases it will not be possible to estimate an equity beta for a particular regulated entity, as equity beta estimates can only be derived for activities that are listed on the stock exchange. In this case, the normal practice is to derive a proxy beta from beta estimates for firms considered to have a comparable level of non-diversifiable risk. Moreover, even if the regulated activity is a separately listed business, the lack of precision in individual equity beta estimates implies that it is common to 'pool' an equity beta estimate with the information provided by other equity beta estimates – and common methodologies use the information from beta estimates for firms with a comparable level of non-diversifiable risk.

As discussed above, the degree of non-diversifiable risk associated with a particular asset depends upon the extent to which the returns expected from that asset are affected by economy-wide events, such as unexpected changes in real aggregate income, inflation, risk aversion and long term real interest rates.[21] Differences in beta values between entities reflect differences in sensitivities of returns to these factors.

[21] Chen, N., Roll, R., and Ross, S., 1986. Economic forces and the stock market, *Journal of Business* 59: 383–403.

Accordingly, the task of identifying the group of comparable entities implies identifying the group of companies considered to have a similar sensitivity to economy-wide events. In turn, this requires an assumption about the characteristics of companies that affect the sensitivity to economy-wide events and therefore affect the beta values for those companies. There is a large empirical literature on the characteristics of assets that may affect their level of non-diversifiable risk. Some of the more important of which include the following.[22]

- *Presence of regulation* – firms with regulated prices tend to have lower sensitivity to shocks in real income because prices (and hence revenues and returns) cannot be increases in response to the associated increase in demand.
- *Nature of a firm's output* – the returns of firms producing products with low sensitivity to economic shocks (i.e. with low income elasticity of demand), should have lower sensitivity to economic shocks than firms producing products with high sensitivity to economic shocks (high income elasticity of demand). All other things being equal, the greater the similarity between the products produced by a set of firms and their markets for those products, the more similar should be the beta values for those firms.
- *Degree of monopoly power* – some studies have suggested that increased market concentration gives rise to lower beta values, although results are mixed and inconclusive.
- *Durations of a firm's contracts with suppliers and customers* – firms with greater duration of contracts should have lower exposure to economic shocks, because input and output prices will not respond as quickly (or at all) to such shocks.
- *Operating leverage* – firms with greater operating leverage (higher ratios of fixed to total costs) should have greater sensitivity to real income fluctuations because net revenues and returns are more sensitive to changes in demand and output.
- *Capital structure* – firms with greater financial leverage will tend to have higher beta values as cash flows to equity holders are more sensitive to output and revenues, and hence more susceptible to economic shocks that affect demand.
- *Real Options of Firms* – the existence of real options permitting expansions of the firm (adopting a new product, expanding existing operations) should increase the firm's sensitivities to real income shocks because the values of growth options should be more sensitive to real income shocks than the equity value exclusive of them, and conversely for firms with options permitting contractions of the firm.
- *Market weight* – the greater a firm's weight in the market, the more the individual firm will influence the market proxy against which the firm's beta is defined, and so the closer the firm's beta will be to a value of one.

[22] This summary of the characteristics of assets that may affect their non-diversifiable risk is taken from Lally, M., 2000. *The Cost of Equity Capital and Its Estimation*, McGraw-Hill Series in Advanced Finance Volume 3, Sydney: McGraw-Hill, pp 27–29.

Application to the Selection of a Proxy Group

The only of the characteristics describe above for which a rigorous adjustment for differences between individual companies is possible is for the level of financial leverage, which is discussed in section 3.3.

In principle, the other characteristics that affect non-diversifiable risk could be taken into account by selecting firms that undertake activities and have characteristics that are identical to the relevant regulated gas transmission activities. In practice, however, it is only ever possible to find firms that have *similar* characteristics. There are very few firms that undertake only regulated activities, and the characteristics of the regulated activities across firms inevitably differ. Moreover, a reasonable number of comparable entities (and hence equity beta estimates) is required in order to obtain a reasonable level of precision in the proxy beta.

Thus, in practice, an approximation to the level of non-diversifiable risk for a particular regulated gas transmission activity is only possible, with a trade-off existing between the desire to minimise the potential for bias in the proxy beta (which argues for a more constrained set of comparable entities) and the desire to maximise the degree of precision in the estimate (which argues for an expanded set of comparable entities).

The objective of this report is to provide empirical beta estimates relevant to regulated Australian gas transmission activities. While there are problems with using equity beta estimates for foreign companies (measured against their home market portfolios) for Australian activities, it is recommended in this report that, nevertheless, regard be had to these beta estimates, at least as a secondary source of information (this issue is discussed below). However, betas for foreign companies are restricted to those operating in economies with comparable legal systems to Australia, which has limited the group of comparable entities to companies from North America (USA and Canada), the UK, and Australia.

It was not possible to restrict the proxy group to transmission-only companies in any of the markets. As discussed in section 4.1, even in the US where there a large number of privately owned gas transmission pipelines, most of these assets are held by entities that have substantial interests in other activities that may be expected to have differing levels of non-diversifiable risk.

In this report, a hierarchy of activities has been defined (comparable activities) that are considered (increasingly) indicative of the level of non-diversifiable risk associated with regulated gas transmission activities, and entities only included in the proxy group where that comparable activity accounts for a substantial share of their activities. The number of comparable activities covered by the proxy group in any market then depends upon the number of relevant listed entities in that market, with the set of comparable entities only being expanded to include lower-order comparable activities where there are already insufficient entities in the proxy group. The hierarchy of activities that has been used in this report is as follows:

- regulated gas transmission;
- regulated gas distribution;
- regulated energy transmission / distribution; and

- regulated transmission / distribution network activities for other essential services (namely water and sewerage services).

In the US, the proxy group includes only firms that undertake the first two activities; for the UK, firms undertaking all four defined activities have been included; and the Australian proxy group has been restricted to firms undertaking only the first three activities.

The firms selected in each market are discussed in section 4.1.

Relevance of Beta Estimates for Foreign Companies

Caution needs to be exercised when using betas for overseas firms (with the betas measured against their home share markets) as a source of information for a proxy beta for a domestic entity. As discussed above, betas are a measure of the strength of the relationship between returns to individual stocks and the share market as a whole.[23] Therefore, an implicit assumption is the use of a beta for a foreign firm (measured against its home index) as a proxy for a domestic firm is that the strength of this relationship is approximately constant across share markets.

While, on the face of it, this may seem a reasonable assumption, there are a number of factors that may influence the strength of the relationship between the returns to a regulated gas transmission provider and the overall market, which may vary across markets. Differences in the weights of the different market sectors may affect the covariance of the return of any asset to the market as a whole. Even apart from market weight effects, the sensitivity of the returns to a regulated gas transmission entity to macro-economic shocks may differ across countries – for example, reflecting institutional factors within each country (including the policies of governments), and betas also may be affected by differences in taxation regimes, as well as differences in market-average levels of gearing. In practice, it is difficult to adjust for all of these factors.[24]

One adjustment that is not recommended for beta estimates for foreign companies is an adjustment that was proposed in submissions to an earlier price review undertaken by the then Victorian Office of the Regulator-General.[25] Empirical evidence was presented suggesting that the beta of the Australian market measured against the US and UK markets was less than one. As a consequence, it was argued that the beta estimates for foreign firms measured against their home-portfolios need to be adjusted for Australia by dividing the estimated beta by the beta of the Australian market against the foreign market to deliver the same return on equity across markets. Hence, a mark-up would be added to betas drawn from the US and UK markets.

[23] Formerly, the covariance between the returns to the stock and the overall market, standardised by the variance of the returns to the overall market, and the relevance of market average gearing levels is discussed below.

[24] An attempt to adjust for the influence of industry weights is discussed under the comments on the Brattle Group report, in section 5.2.

[25] The adjustment was proposed in Gray, S., 1999, Response to Consultation Paper No. 4: Cost of Capital Financing, pp. 12-14; and ABN AMRO, 1999, Submission to the Office of the Regulator General, Victoria Regarding 2001 Electricity Distribution Price Review: The Cost of Capital Financing (Consultation Paper No. 4), p. 3, and it is understood that the adjustment has also been proposed to other regulators.

A number of illogical implications flow from this adjustment, however. First, one consequence of this adjustment is that if the returns to the Australian and foreign markets were uncorrelated, then an *infinite* beta for Australia would be implied which is not sensible.[26] Secondly, if the betas for Australian industry groups were derived from applying this adjustment to equivalent industry groups in the other countries, the implied average beta for the Australian market would exceed one – which is also not sensible. More generally, there is no logical reason that the measured correlation *between markets* would provide information on differences in the sensitivity of returns to an individual stock and overall returns *within each market*. Accordingly, this adjustment is not recommended.

One of the factors noted above for which an adjustment is possible is the difference in average levels of gearing across countries. Lally has shown that if the beta between ungeared assets and a market portfolio of ungeared assets is the same across countries, then a difference in the average gearing across markets alone will lead to a different equity beta in the different markets.[27]

An adjustment that could be made in this case is to derive 'double ungeared' asset betas for each market, and then to re-lever this to take account of the target entity's level of gearing, as well as the market's average level of gearing. The first de-gearing stage derives a beta for a wholly equity-financed entity, measured against a portfolio of geared entities; the second de-gearing stage derives a beta for a wholly equity-financed entity, measured against a portfolio of wholly equity-financed entities.

The difficulty with obtaining information on market-average levels of gearing precluded such an adjustment in this report. However, the following simulation will show the potential size of the implications of average market leverage.

- If an equity beta of 0.6 is estimated for a firm with a level of gearing of 50 per cent debt-to-assets, in a market where the average gearing is 30 per cent, this translates into an asset beta of 0.30, and a 'double un-geared' beta of 0.43 (using the simplest de-levering formulae).
- The re-geared equity beta for 60 per cent debt-to-assets with no adjustment for differences in average gearing across markets (or in a market with an average gearing level of 30 per cent) is 0.75.
- However, if the average gearing in the target market is 40 per cent, the 'true' re-geared beta is 0.64, whereas if the average gearing in the target market is 20 per cent, the 'true' re-geared beta is 0.86.

Thus, for reasonably modest variations in gearing from the source market – ± 10 percentage points – the impact on the re-geared beta is approximately 0.10, with the changes in the average market gearing level and equity beta moving in opposite directions. Such variations underscore the reason to be cautious about the level of reliance placed upon betas drawn from foreign entities (measured against their home share markets).

[26] This observation was made in a submission to the Office of the Regulator-General by Dr Lally: Lally, M., 2000, Response to 2001 Electricity Distribution Price Review Draft Decision, pp. 5-7.

[27] Lally, M., 1998. Correcting betas for changes in firm and market leverage, *Pacific Accounting Review* 10(2): 97–115.

3.2 Methodological Issues with the Estimation of Equity Betas

The usual method for estimation of an equity beta for an entity is a time series regression of the returns to that equity against returns to the market. Within this broad methodology, variation exists in measurement of variables and assumptions of the regression. The principle elements and variations in methodology are described by Brailsford et al.,[28] and summarised below.

Methodological Issues

Measurement of Returns

A regression of returns to a stock against market returns requires time-series measures of both returns. Differences in measurement techniques occur in respect of several factors as follows.

- Discrete versus continuously compounded returns.

  Discrete returns are calculated as the value of returns in a given period from changes in the price of the stock and dividends, relative to the price of the initial stock. Continuously compounded returns are calculated as the natural logarithm of one plus the discrete return.

- Raw versus excess returns

  Returns may be measured as the actual returns on the stock arising from changes in the stock price and payment of dividends (raw values) or measured as the returns in excess of a benchmark risk-free asset – such as a government bond.

- Nominal versus real returns

  Returns are typically expressed in nominal terms, but in principle, betas should be estimates with returns converted to real terms. However, the infrequency of publication of inflation indices generally precludes this in practice.

Definition of the Market Index

- Portfolio weighting scheme.

  As a beta is estimated as the regression of a return on a single stock against return on a market portfolio of stocks, compilation of a market portfolio is required. Generally, a value-weighted portfolio is preferred because it is more consistent with the true market portfolio as defined in the theory of the CAPM.

- Breadth of the market index.

  While under the assumptions of the CAPM, the market portfolio comprises an index of all risky assets in existence, a practical requirement is to utilise a limited portfolio of assets as the proxy for the market. This typically involves the use of a stock market index. In principle, the stock market index should be as broad as possible.

[28] Brailsford, T.J., Faff, R.W. and Oliver, B.R., 2000. Research design Issues in the Estimation of Beta, McGraw-Hill Series in Advanced Finance Volume 1, Sydney: McGraw-Hill.

As was discussed above, the composition and weighting of the market portfolio can affect beta estimates, particularly for stocks that comprise a substantial proportion of the total market value.[29]

Length of the Estimation Period

Selection of a length of period for estimation of a beta involves a trade-off between the need for a sufficiently large data sample to increase the statistical significance of results, and a potential loss in relevance of a beta estimate for current company and market conditions. The loss in relevance would arise from changes in company and market circumstances over long periods of estimation. When monthly data is being used, a four to five year period is typically regarded as an appropriate trade-off between the number of observations and the stability of the beta estimate.

That said, shorter estimation periods do not imply that beta estimates are biased, but rather that the estimates generally will be less efficient (that is, have higher standard errors). Accordingly, where there are few comparable entities, it may be appropriate to include firms with a shorter trading history than the desired four or five year period.[30]

Length of the Sampling Interval

The sampling interval is the frequency of observations of returns on individual stocks and the market portfolio. Beta estimates can be sensitive to the sampling interval with studies suggesting that as the sampling interval is lengthened, betas of thinly traded stocks (and small firms) increase, and betas of frequently traded stocks (and large firms) decrease.

Monthly sampling intervals are commonly seen as the least susceptible to bias.

Corrections for Thin Trading of Stocks

Thin trading of stocks can introduce errors into the estimation of equity betas as a result of infrequent adjustments in stock values to reflect changes in the value of the underlying assets. The general result is that standard ordinary least squares beta estimates tend to be downward biased for thinly traded stocks and upward biased for frequently traded stocks. Techniques to correct for the effects of thin trading have been developed, typically involving the extension of the ordinary least squares regression to include lagged and leading market returns.[31]

[29] Lally, M., 2000. *The Cost of Equity Capital and Its Estimation*, McGraw-Hill Series in Advanced Finance Volume 3, Sydney: McGraw-Hill, p 29.

[30] Where the standard errors of the various beta estimates differ, it may be appropriate to attribute different weights to the individual betas, depending upon the precision of each beta estimate. An approximate set of weights for this task was discussed in: Office of the Regulator-General, 2000, Electricity Distribution Price Determination 2001-2005, Volume 1, Statement of Purpose and Reasons, pp.273-274. The weighting method discussed in that report was based upon a suggestion from Dr Lally.

[31] Scholes, M. and Williams, J., 1977. Estimating betas from non-synchronous data, *Journal of Financial Economics* 24: 121–58. Dimson, E., 1970. Risk measurement when shares are subject to infrequent trading, *Journal of Financial Economics* 7: 197–226. Fowler, D. and Rorke, C., 1983. Risk measurement when shares are subject to infrequent trading: comment, *Journal of Financial Economics* 12: 279–83.

Methodologies adopted by the Common Beta Estimation Services

Table 3.1 summarises the methodological approaches adopted by four commonly used beta estimation services on these matters, as well as the adjustment to raw betas that each presents with the standard output (this issue is discussed in section 3.4 below). The beta estimation services reviewed are:

- Ibbotson Associates, Chicago, which provides beta estimates for companies listed on the US share markets;
- London Business School, which provides beta estimates for companies listed on the UK share market;
- Australian Graduate School of Management Risk Measurement Service, which provides estimates for companies listed on the Australian share market; and
- Bloomberg, which can provide beta estimates for listed entities in any significant market.

Table 3.1

METHODOLOGY USED BY COMMON BETA ESTIMATION SERVICES

Source of Beta Estimate	Sample Period (months)	Sample Interval	Return Measure	Market Proxy	Adjustment to Raw Beta	Thin Trading Estimates
Ibbotson	60 (min 36 months if 60 months data unavailable)	Monthly	Discrete returns with re-invested dividends	USA: S&P 500	Vasicek, peer group is the relevant industry[32]	Sum beta (modified version of Scholes & Williams and Dimson, single lag variable)
London Business School (LBS)	60 (min 10 months if 60 months data unavailable)	Monthly	Continuously compounded returns with re-invested dividends	FT All Share Index, value-weighted (700 firms)	Vasicek, peer group is all companies	Dimson (single lag variable)
Bloomberg[33]	User selected	User selected	Discrete returns excluding dividends	User selected. Home market indices are: USA: S&P 500 UK: FTSE 100 Can: S&P TSX Composite Aust: S&P ASX 200	Blume (weight of 0.67 to raw beta)	None
AGSM – Risk Measurement Service	48 (min 20 months if 48 months data unavailable)	Monthly	Continuously compounded returns with re-invested dividends	Value weighted index of all listed companies in the relevant market.	None	Scholes & Williams (single lag variable)

[32] The industry is defined in terms of its two-digit SIC code. The relevant 2 digit industry for gas transmission is Electric, Gas, and Sanitary Services.

[33] The Bloomberg service is a flexible service that permits the user to select the sample period, sampling interval and market index.

Thus, most of the services adopt a similar methodology. With the exception of Bloomberg, all services adopt one-month sample intervals and a sample period of four or five years (and these assumptions can be selected in the Bloomberg service). The definition of returns differ – with the LBS and AGSM services using continuously compounded returns, whereas Ibbotson and Bloomberg adopt discreet returns, although, as noted above, this difference is unlikely to affect substantially the resultant beta estimates. Of more concern is that the Bloomberg service excludes dividends from its measure of returns. While this may not affect estimates in a material manner for the majority of stocks (given the typically low average dividend yields), it may have more significance for beta estimates for utility stocks (which generally promise higher dividend yields and lower growth than average).

Regarding the market portfolio used, the Ibbotson, LBS and AGSM adopt a reasonably wide portfolio of assets as the market portfolio – with the LBS and AGSM services including most or all of the shares. In contrast, while the index adopted by Bloomberg for the US market has a reasonably broad coverage, the default indices for Australia and UK include substantially fewer companies than the portfolios adopted by the AGSM and LBS services. While the various portfolios are often highly correlated, it is difficult to know whether, in any particular instance, the choice of portfolio may have a noticeable effect on beta estimates.

For the purpose of this report, the Ibbotson service has been used to obtain beta estimates for the US firms, the LBS service for the UK companies, and the AGSM service for the Australian firms. These services are considered to offer the most robust estimation methodologies, are widely used for each of those markets, and have the advantage of being relatively easy to access. However, there is no easily accessible beta estimation service for the Canadian companies. Accordingly, the Bloomberg service has been employed these firms, with the betas estimated against the default Canadian market portfolio (described above) and with a monthly sampling interval over five years of observations.

All services, with the exception of the Bloomberg, also provide an alternative beta estimate if one of the 'thin trading' biases is considered likely to be significant. However, only the AGSM service provides a test statistic that indicates whether 'thin trading' is a concern. Accordingly, for the beta estimates from all services except the AGSM service, the normal OLS beta estimates will be used, although the implications of using the 'thin trading' betas will be reported. As the AGSM service includes a test statistic indicating whether 'thin trading' is a concern, the thin 'trading beta' will be used if significant 'thin trading' is indicated, and not otherwise.[34]

[34] While thin trading betas are unbiased even if thin trading is not a concern, these estimates generally are less efficient than OLS betas (have higher standard errors). Thus, OLS betas should be preferred where thin trading is not a concern.

Lastly, with respect to the minimum number of observations permitted, as noted above, the Ibbotson service requires the most observations before a beta estimate is provided (36 observations), whereas the LBS service requires the least (10 observations), and the AGSM service sits between (20 observations). For the purpose of this report, the AGSM cut-off will be used for Australia, the UK and Canada, so that beta estimates with less than 20 observations will not be considered. For the US, the abundance of comparable entities implies that there is little reason to include companies with limited observations, and so the Ibbotson cut-off of 36 observations is considered appropriate.[35]

3.3 Adjustments for Financial Leverage

As noted in section 4.2, the equity beta of a company is affected by its financial leverage or gearing, i.e. the level of debt in its financial structure. Comparison of beta values across companies requires the beta estimates to first be corrected (de-levered) for differences in gearing. This is undertaken by converting equity beta estimates to asset beta values taking into account the gearing levels of the individual companies, and then re-levering the asset beta values to equity beta values using a consistent assumption as to the level of gearing.

The relationship between equity betas and the level of leverage – and hence, the appropriate de-levering and re-levering adjustments – is a matter of some conjecture, however. The derivation of the appropriate levering/de-levering formula requires assumptions about three factors, which are:[36]

- whether the debt policy is *active* (debt is maintained at a constant proportion of the market value of assets) or *passive* (debt is maintained at a constant level);
- the marginal tax advantages associated with debt (reflecting both company tax considerations, and the relative personal taxation of debt and equity); and
- whether or not debt is risky (or materially risky), the implication of which is whether or not debt providers share some of the beta risk associated with the project.

The first two of these assumptions will be addressed first, and the issue of debt betas discussed thereafter.

Levering / Dev-Levering Formulae

The general formula for the relationship between equity betas, asset betas and leverage in the presence of *passive debt management* is as follows:

$$\beta_e = \beta_a\left(1+\left(1-T^*\right)\frac{D}{E}\right)-\beta_d\left(1-T^*\right)\frac{D}{E}$$

[35] In the US there is little reason for including companies with fewer than four or five years of observations. However, as the standard output from the Ibbotson service does not include the number of observations used, its cut off of three years of observations has been adopted.

[36] Lally, M., 1998. Correcting betas for changes in firm and market leverage, *Pacific Accounting Review* 10(2): 99.

where β_e is the equity beta, β_a is the asset beta, D is the value of debt, E is the value of equity and T^* is the tax advantage of debt over equity (or alternatively, the gain in the market value of assets associated with an increase in the proportion of debt).

An implicit assumption in this formula, however, is that the level of debt is constant, and so the future tax deductions are certain.[37] If it is assumed that the firm seeks to maintain debt levels as a constant proportion of the market value of assets, then the gains from debt in future periods are uncertain, and the increase in firm value associated with debt falls. In the case of this active debt management, the term T^* is replaced with:

$$T^* \frac{r_d}{1+r_d}$$

where r_d is the cost of debt finance for the firm. If the firm's borrowing cost were 7 per cent, and the corporate tax rate is 30 per cent, then active debt management would imply a maximum for the adjusted tax term of approximately 2 per cent, which would not have a discernable impact on the derivation of a proxy beta.

The maximum value for T^* in a classical tax system (such as the US) is the marginal company tax rate. For Australia, the existence of dividend imputation implies that the maximum value for T^* is given by:

$$T^* = (1-\gamma)T_C$$

where γ reflects the value of franking credits created, and T_c is the corporate tax rate.

However, as Miller (1977) has shown, the relative gain associated with debt also depends upon the level of personal tax on equity income compared to personal tax on interest. The proportionate gain from leverage (equivalent to T^*) is given by:[38]

$$T^* = \left[1 - \frac{(1-T_C)(1-T_{PS})}{1-T_{PB}}\right]$$

where T_c is the corporate tax rate, T_{PS} is the personal tax rate on share (equity) income, and T_{PB} is the personal tax rate on income from bonds (interest). In most countries around the word (including Australia and the US), capital gains are taxed at a lower rate than interest income, which would imply that T^* would be somewhat less than the corporate tax rate (or, for Australia, the corporate tax rate as modified by the value of imputation credits).

All of the formulae defined above can be compared to the formula that would exist in a world under which returns to equity and debt providers are taxed equally, which is as follows:

$$\beta_e = \beta_a\left(1+\frac{D}{E}\right) - \beta_d \frac{D}{E}$$

[37] Miles, J., and J. Ezzell, 1985, 'Reformulating Tax Shield Valuation: A Note, *The Journal of Finance*, Vol.XL, No 5, p.1488.

[38] Miller, M, 1977, 'Debt and Taxes', *The Journal of Finance*, Vol.XXXII, No.2, p.267.

that is, the tax term disappears.[39]

The practical implication of assuming a material tax advantage to debt is that equity betas would be predicted not increase as quickly as otherwise with the level of leverage (for a given asset beta). Equally, the estimated asset beta will be higher for a given equity beta. This implication is of little practical significance for equity betas estimated within the home-market. In this case, it is essential that the same levering/de-levering approach be used for estimated asset betas and then when re-levering asset betas into equity betas for the target level of gearing – and the impact of the tax term virtually cancels out.

In contrast, however, it is appropriate to take account of the implications of different tax systems for the relationship between equity betas and leverage when observing betas for foreign firms. In particular, it is appropriate to take account of the foreign tax system when deriving asset betas in foreign markets, but then taking account of the Australian tax when re-levering those asset betas into Australian proxy equity betas. Where betas are derived from jurisdictions where there is a larger tax advantage to debt than Australia – which may be expected to be the case – allowing for differences in the taxation regimes would result in a *higher* proxy beta for Australian firms than otherwise.

That said, the discussion above would suggest that it may not be inappropriate to assume a near zero tax term in the levering/de-levering equation for all markets. First, the debt management policies of firms are likely to be somewhere between active and passive management. As noted above, the assumption of active debt management would imply that the tax term virtually disappears. Secondly, the marginal corporate tax rate is likely to overstate the tax benefits of debt given the tax advantages that equity providers receive for the capital gains portion of their income. Lastly, the imputation system in Australia magnifies these effects in Australia – with the regulator-standard gamma assumption of 0.50 implying a tax term of approximately half of what it otherwise would have been.

However, for the purpose of this report, the results are shown for the range of possible assumptions about taxation. The extreme assumption for classical taxation economies is that the proportionate value-gain from debt is the corporate tax rate, and for Australia, the extreme assumption (consistent with the regulator-standard 'gamma' assumption of 0.5) is that the proportionate value gain is half of the marginal corporate tax rate. As noted above, this assumes passive debt management and equal personal taxation of equity and debt income. The resultant levering equations are:

$$\beta_e = \beta_a\left(1+(1-T_C)\frac{D}{E}\right)-\beta_d(1-T_C)\frac{D}{E}$$

for all countries except Australia, and

$$\beta_e = \beta_a\left(1+(1-T_c(1-\gamma))\frac{D}{E}\right)-\beta_d(1-T_c(1-\gamma))\frac{D}{E}$$

[39] This formula can be rearranged as $\beta_a = \beta_e\frac{E}{V}+\beta_d\frac{D}{V}$, which just implies that the asset beta is a weighted average of the equity and debt betas.

for Australia, with 'gamma' assumed to be 0.50.

The other extreme is that equity betas do not reflect any tax gain from debt. For the reasons provided above, values closer to this extreme are considered more plausible. The resultant levering equation for all countries is:

$$\beta_e = \beta_a\left(1+\frac{D}{E}\right)-\beta_d\frac{D}{E}$$

In all cases, the foreign country de-levering equation is used to derive proxy asset betas in the foreign country, and the Australian re-levering equation is used to derive proxy equity betas in Australia.

As the level of gearing for an entity inevitably will change during the period over which equity betas are estimated, an issue arises as to the level of gearing that should be used to de-lever equity betas. The correct approach, in principle, would be to incorporate the gearing level at each point in time into the estimation of betas – in effect, estimating asset betas directly. However, such an approach requires gearing observations of the same frequency as observations of share returns (in this report, monthly). Such an approach also is not possible if public sources for beta estimates are used. It has been shown that a close approximation to the correct in-principle approach is to use the average gearing level over the period during which the equity betas were estimated,[40] which is used in this report.

Debt Betas

If the expected return on debt is known, then debt beta can be estimated be reverse-engineering the CAPM, that is:[41]

$$E(R_d) = R_f + \beta_d(R_m - R_f) \Rightarrow \beta_d = \frac{E(R_d)-R_f}{R_m - R_f}$$

The difficulty with this methodology is establishing the expected return on debt. While the promised yield on debt is typically taken as the expected return on debt for the purposes of estimating the WACC, to the extent that this includes a premium for default or a liquidity premium, then it will overstate the expected return to debt providers.[42] However, this expression can establish bounds for the debt beta.

If the entire margin over the risk free rate is a premium for default or liquidity premium, then the debt beta will be zero (i.e. the only risk faced by debt providers is non-systematic or diversifiable risk). In contrast, if there is no default premium and the entire margin is a reward for bearing systematic risk, then the yield on debt can be inserted into the equation above, which establishes an upper bound for the debt beta. If the Commission's typical WACC-inputs are used (equity premium of 6 per cent and cost of debt margin of 1.2 per cent), then the upper bound for the debt beta is 0.17.

[40] Lally, M., 1998. Correcting betas for changes in firm and market leverage, *Pacific Accounting Review* 10(2): 107-108.

[41] The cost of equity that is estimated by the CAPM is also an expected return. While the expectations notation is normally dropped for ease of expression, it is included here to emphasise the difference between the expected return to debt providers and the promised yield.

[42] This also implies that the use of the promised yield on debt will result in an estimate of the WACC that is biased upwards:

In a recent draft decision, the Victorian Essential Services Commission (ESC) has referred to recent research that may shed some light on the size of the default premium embedded in the yields on corporate bonds, and thus provide more insight into the likely magnitude of the debt beta.[43] Elton *et al*. have provided estimates of the breakdown of the yield on US corporate bonds of different credit ratings and terms into the default premium, risk premium and tax premium (the last factor has less significance for Australia) for debt of different terms and credit ratings.[44] The ESC interpreted this research as implying that a default premium of 0.28 percentage points would apply for debt with a ten year term and BBB+ credit rating. If liquidity premia were negligible, then this would imply an expected return to debt of 0.92 per cent (using the assumptions noted above), and a debt beta of approximately 0.15. However, as we do not know the size of any potential liquidity premium, this remains an upper limit of the debt beta.

Accordingly, for the purposes of this report, a range for the debt beta of 0 to 0.15 will be used.

Should the Concern be with Asset Betas or Equity Betas?

Where asset betas are estimates for a group of comparable entities, and (for example) the average asset beta for the group is then re-levered for an assumed financing structure to be used as a proxy beta, care needs to be taken to adopt consistent assumptions between the de-levering and re-levering stages. There may be sound reasons for using a different levering methodology for the different stages in some instances – for example, to take account of differences in taxation regimes across countries. However, it is possible to misinterpret empirical data if inconsistent levering/de-levering approaches are used in the different stages without sound reasons or inadvertently (with different assumptions about the debt beta particularly important).[45]

In order to avoid the potential for misinterpretation of empirical data, this report will focus on the proxy equity beta that is consistent with the standard benchmark gearing assumption of 60 per cent debt-to-assets.

[43] Essential Services Commission (Victoria), 2002, Review of Gas Access Arrangements: Draft Decision, pp.231-233.

[44] Elton, E., M. Gruber, D. Agrawal, C. Mann, 2001, 'Explaining the Rate Spread on Corporate Bonds', *Journal of Finance*, Vol. LVI, No. 1, pp.247-277.

[45] This point was illustrated by the former Office of the Regulator-General. It showed that the proxy equity beta (for a gearing assumption of 60 per cent debt-to-assets) derived from a hypothetical but plausible set of empirical observations could vary from 1.0 to 1.6 if inconsistent assumptions about debt betas were made between the de-levering and re-levering stages. The resultant effect on the estimated cost of capital is substantial: Office of the Regulator-General, 2000, Electricity Distribution Price Determination 2001-2005, Volume 1, Statement of Purpose and Reasons, p.268.

Equity betas can only be compared for consistent assumptions about gearing, which is why it is common practice to derive asset betas (that is, to eliminate gearing as a confounding factor). However, as all Australian energy regulators have accepted an assumption of 60 per cent debt-to-assets as the standard gearing benchmark, the equity betas assumed by various energy regulators are directly comparable.[46] In contrast, however, different regulators' assumed asset betas *may not be comparable* if those betas reflect different de-levering/re-levering approaches (and, in particular, different assumptions about the magnitude of debt beta). Moreover, as the CAPM is only being used to estimate the cost of capital for the equity financed portion of regulated Australian gas transmission activities, it is the equity beta – not the asset beta – that is the relevant input into the cost of capital estimation.

3.4 Pooling of Beta Estimates

As discussed in section 2.5, even where a beta estimate is available for a particular stock, it is common practice to 'pool' that beta estimate with those of a set of comparable entities in order to improve the precision of the beta estimate. Where a beta estimate for a particular activity is not available (for example, because the entity undertaking the activity is not listed on a stock exchange), the use of comparable entities to derive a proxy beta is made necessary.

The most common method of 'pooling' various beta estimates is to focus on one of the measures of central tendency for the beta estimates for the set of comparable entities, with the simple average of the beta estimates a common measure. The standard error of the average beta across a proxy group will be lower than the average standard error of the individual betas, with the precision of the average of the proxy group rising (ie standard error falling) with the number of firms added to the proxy group.[47] The simple average of the set of proxy betas will be used in this report as the principal means of pooling betas.

One issue that arises when using an average (or even other measured of central tendency, such as the median) is whether beta estimates that are negative should be excluded from consideration. There are two potential responses to this finding.

- A negative beta could be interpreted as outside of the reasonable bounds for a beta for regulated gas transmission activities (or any other utility activity), and thus excluded to minimise the likelihood that extreme observations could bias the beta estimate.
- Alternatively, where the expected beta is low, and the standard error is high, a certain proportion of negative betas should be expected. Moreover, for every point estimate of an equity beta that is at the lower-end of a confidence interval, there may be others are the upper end. Thus, excluding only betas at the lower end of the confidence interval (ie the negative betas) may lead to bias in the beta derived from the proxy group.

[46] This gearing assumption was proposed by the utility and accepted by the regulators in the first major decisions on the cost of capital under the Gas Code (the 1998 Victorian decisions), and has been adopted in almost all energy decisions since that time.

[47] The standard error of the average beta of the proxy group will depend upon the pair-wise correlations between the various beta estimates, which is not available from commercial beta estimation services, as used in this report.

In this report, no view is taken on the relative merits of these two arguments, rather, average beta estimates with and without any observed negative betas will be reported.

One of two more sophisticated adjustments to beta estimates are made by some of the common beta estimation services, which are often referred to as the Vasicek adjustment and the Blume adjustment. Both of these adjustments may have merit when adjusting a particular beta estimate for a firm, and when projecting a future beta for a particular firm. The Vasicek adjustment is useful where the goal is to derive a beta estimate for a particular stock, for which a beta estimate can be observed individually, and the Blume adjustment may be a convenient means of responding to expected management tendencies over a future period. However, neither of these adjustments is considered appropriate where the objective to derive a proxy beta for (pure-play) regulated gas transmission activities, and this proxy beta is based upon estimates from a carefully selected set of comparable entities.[48]

The *Vasicek* adjustment[49,50] takes the weighted average of the beta estimate for an individual company, and the simple average for a 'peer group' of entities (the prior distribution), with the weighting in inverse proportion to the variances of the distributions from which the estimates are drawn.

To the extent that the 'peer group' that is used by the beta estimation service in the Vasecik adjustment is similar to the group of comparable entities used to derive the proxy beta, the application of the Vasecik adjustment is likely to have little effect on the average of the group.[51] However, to the extent that the peer group differs – and betas for entities that undertake activities that were judged not to be sufficiently comparable to regulated gas transmission activities would be taken into account – then bias to the estimate of the proxy beta may be introduced.

As noted in section 3.2, the relevant peer group employed by the Ibbotson service most relevant to gas transmission are firms classified in the two-digit industry code Electric, Gas, and Sanitary Services. While this will include a number of firms that are not considered sufficiently comparable to regulated gas transmission activities, any bias introduced may not be substantial – and, indeed, the average of the Ibbotson adjusted betas is not substantially different to the average of the raw betas. In contrast, the London Business School service uses all listed companies as the peer group, which may introduce bias in the beta estimate.

[48] The discussion in this section draws upon Lally, M., 1998, 'An Examination of Blume and Vasicek Betas,, *The Financial Review*, Vol.33, pp 183-198; and Lally, M., 2000. *The Cost of Equity Capital and Its Estimation*, McGraw-Hill Series in Advanced Finance Volume 3, Sydney: McGraw-Hill, p33-35.

[49] Vasicek, O., 1973. A note on using cross-sectional information in bayesian estimation of security betas, *Journal of Finance* 26: pp 123–129.

[50] Lally, M., 2000. *The Cost of Equity Capital and Its Estimation*, McGraw-Hill Series in Advanced Finance Volume 3, Sydney: McGraw-Hill, p 34.

[51] If the standard errors of the beta estimates for all of the firms in the peer group are identical, then the average of the Vasecik adjusted betas will be identical to the average of the raw betas. In any other case, the average of the Vasecik betas will place more weight upon the beta estimates that have a lower standard error.

The *Blume* adjustment[52,53] also involves taking a weighed average of individual betas and a prior distribution, except that the prior distribution comprises all firms (that is, an equity beta of one).[54] Further, one of the rationales for the Blume adjustment is to take account of a tendency for beta values of firms to tend to a value of one over time. That is, the adjustment is based upon two prior beliefs about betas:

- in the absence of any information, a reasonably prior belief is that a beta of a stock is one – being the market average beta; and
- empirically, betas tend to get closer to one over time.

With respect to the first of these reasons for the Blume adjustment, as with the Vasicek adjustment, the use of a prior distribution that includes all firms may introduce bias into the proxy beta that is derived. Certainly, taking account of information from all firms is somewhat at odds with carefully selecting the group of comparable entities that is used to derive the proxy beta.

Regarding the tendency of betas to regress towards one over time, it is accepted that there is empirical support for the phenomenon of beta convergence (even after the potential for the estimation method to find a spurious relationship is taken into account).[55] However, these studies attribute the regression in equity betas to conscious behavioural decisions of management – for example, by undertaking investment projects with less extreme risk characteristics, or by manipulation of financial structures (eg by equity issues, leveraged buy-outs and equity carve-outs).[56] Indeed, in a Reserve Bank of Australia working paper, Sheutrim finds a motive for the manipulation of equity betas by managers, finding a positive relationship between events that may be adverse to managers – namely, the probability of the firm being delisted.[57]

While allowing for such a management tendency may well be reasonable when projecting forward the estimated equity beta for an actual entity, it has less relevance for the estimation of the cost of capital for the regulated activities of gas transmission entity. In particular, as the objective is to derive the cost of capital associated with a pure-play gas transmission business, any prospective change to the equity beta arising from diversification into other activities would be introducing irrelevant information. Likewise, regarding changes to leverage, a better approach is to adjust betas explicitly for changes to gearing (using the theoretical relationship between equity betas and gearing, discussed above). It is noted, however, that if the 'regression' of equity betas over time and the associated change to gearing were both taken into account, the asset beta that would be derived would most likely remain unchanged.

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[52] Blume, M., 1971. On the assessment of risk, *Journal of Finance* 26, pp 1–10. Blume, M., 1975. betas and their regression tendancies, *Journal of Finance* 30, pp 785–95.

[53] Lally, M., 2000. *The Cost of Equity Capital and Its Estimation*, McGraw-Hill Series in Advanced Finance Volume 3, Sydney: McGraw-Hill, p 34.

[54] As noted in section 3.2, a Blume-adjusted beta is provided in the standard output from the Bloomberg service.

[55] The existing empirical evidence – as well as further evidence – is presented in: Sheutrim, G, 1998, Systematic Risk Characteristics of Corporate Equity, Research Discussion Paper 9802, Reserve Bank of Australia, Sydney.

[56] Brailsford, T.J., Faff, R.W. and Oliver, B.R., 2000. Research design Issues in the Estimation of Beta, McGraw-Hill Series in Advanced Finance Volume 1, Sydney: McGraw-Hill, p28; Sheutrim, G, 1998, Systematic Risk Characteristics of Corporate Equity, Research Discussion Paper 9802, Reserve Bank of Australia, Sydney, p. 8.

[57] Sheutrim, G, 1998, Systematic Risk Characteristics of Corporate Equity, Research Discussion Paper 9802, Reserve Bank of Australia, Sydney, p. 23.

Accordingly, this report uses the raw beta estimates produced by each of the beta estimation services.

Chapter Four

Empirical Estimation of Beta Values – Results

This chapter reports the results from the application of the methodology described in chapter 3. The sections in this chapter are set out as follows.

- First, the proxy group of companies is identified. As noted earlier, this includes Australian, North American (US and Canadian) firms, and UK firms.
- Secondly, the most recent equity betas for each of these companies from the beta estimation service discussed in section 3.2 is presented.
- Thirdly, corrections are made for the financial leverage of the comparable entities compared to the assumed standard regulatory benchmark of 60 per cent debt to assets.
- Fourthly, the empirical results are interpreted.

4.1 The Proxy Group of Listed Companies

As noted in section 3.1, a hierarchy of 'comparable activities' has been used in this report to select the set of comparable entities, with the higher-order activities considered more indicative of the level of systematic risk of regulated Australian gas transmission activities. This hierarchy is as follows:

- regulated gas transmission;
- regulated gas distribution;
- regulated energy transmission / distribution; and
- regulated transmission / distribution network activities for other essential services (namely water and sewerage services).

The 'comparable activities' covered in the set of comparable entities depends upon the number of firms that operate in any market. In general, the set of comparable entities has not been expanded to include further comparable activities if there are already six firms in the set of comparable entities.

As also noted in section 3.1, virtually every entity that undertakes one of the 'comparable activities' also undertakes other activities – many of which are unregulated activities. This is particularly the case for the companies that own and operate transmission pipelines in the US, where most have substantial production and energy trading interests. As noted in section 3.1, entities have only been included in the proxy group if the particular comparable activity or activities accounts for a substantial share of the entity's activities.

Applying this criterion in practice is difficult, however. In principle, the assessment of whether the comparable activities are sufficiently substantial should focus on the market values associated with the various activities. However, market evidence on the market values of business units within a listed entity are only available in special cases, and estimates of the market values of segments are not generally available. In this report, a number of proxies have been used to infer the relative market values of the different activities, which include:

- the share of revenue associated with the different activities;
- the share of earnings before interest and tax (EBIT) associated with the different activities;
- the share of net income associated with the different activities; and
- the share of tangible assets attributable to the separate activities.

Inevitably, a degree of judgement with the application of criteria such as those noted above is required. First, each of the criteria potentially is subject to potential bias, which needs to be taken into account.[58] Secondly, there are substantial differences in the reporting of results for business segments across companies, even within each market. Lastly, the segments for which companies report separate results often are not aligned perfectly with the 'comparable activities'. For example, most of the gas distributors in the US also retail gas, but these activities are generally combined in the segment reporting.

Tables 4.1 to 4.4 show the 'comparable entities' that have been used in this study for Australia, the US, Canada and the UK, together with a short description of the entity's activities, and the entity's 'comparable activities'. For the US, Table 4.2 also includes the US companies involved in gas transmission but for which gas transmission does not account for the majority share of their activities.

Information on companies was obtained from the following sources:

- Form 10-K and Form 10-Q filings to the USA Securities and Exchange Commission, ValueLine *Profile Summary Reports*, produced by Value Line Inc, New York, and Standard and Poor's Stock Reports (USA companies); and
- company web pages and annual reports.

As noted in section 3.2, beta estimates are only used in this report where there are more than 20 observations for Australian, Canadian or UK companies, or 36 observations for US companies. Accordingly, companies not fitting these criteria are excluded. However, for Australia, the two companies that would be considered to be appropriate comparable entities once sufficient trading history to permit stable beta estimates to be derived are also summarised (although no beta estimates are provided).

[58] For example, shares of revenue will overstate the contribution of high turnover but low yield activities, such as retailing and energy trading. EBIT shares may understate the contribution of regulated utility activities, as earnings would be capitalised at a lower discount rate than other activities, but then it would be appropriate to allocate more of the company's stock of debt to these activities, which would imply a bias in the other direction.

More detailed descriptions of the companies, and information on the contributions of the various segments, are provided in Appendix A.

Table 4.1

COMPARABLE AUSTRALIAN COMPANIES

Company	Description of Activities	Last Reported Annual Operating Revenue (AU $'m)	Comparable Activities
Comparable Entities – Existing			
AGL	Gas transmission and distribution, electricity distribution, gas and electricity retailing, LPG retailing, and electricity generation	3,498	Gas transmission, gas distribution, electricity distribution
Australian Pipeline Trust	Gas transmission	239	Gas transmission
Envestra	Gas distribution and transmission	254	Gas transmission and distribution
United Energy[59]	Electricity distribution, gas distribution (through part ownership of AlintaGas), energy retailing, energy trading and risk management, telecommunications networks, back-office services, network operation services, network construction services	488	Gas and electricity distribution
Comparable Entities – Future (Note: beta estimates are not presented for these entities)			
AlintaGas Limited	Gas distribution and retailing, LPG trading and retailing	390	Gas distribution
Gas Net Australia Trust	Gas transmission	50	Gas transmission

Table 4.2

COMPARABLE USA COMPANIES

Company	Description of Activities	Last Reported Annual Operating Revenue (US $'m)	Comparable Activities
Comparable Entities – Preferred Group			
AGL Resources Inc	Distribution of natural gas, natural gas retailing and other allied services, such as wholesale and retail LPG	1,049	Gas distribution
Atmos Energy Inc	Distribution and retail of natural gas, energy management services, underground gas storage fields, electrical power generation	1,442	Gas distribution
Cascade Natural Gas Corp	Distribution, transmission and retailing of natural gas and related services	336	Gas distribution and transmission
Delta Natural Gas Company Inc	Distribution, production and storage of natural gas.	71	Gas distribution
EnergySouth Inc	Natural gas distribution, retail and storage	100	Gas distribution
Laclede Group Inc	Natural gas distribution, transmission, storage, retailing, insurance, and real estate development.	1002	Gas distribution
Nicor Inc	Natural gas distribution, energy retailing, freight transport.	2544	Gas distribution
Northwest Natural Gas Co. Inc	Natural gas distribution and retailing	650	Gas distribution
Peoples Energy Corp	Natural gas distribution and retailing, electricity	2,270	Gas distribution

[59] United Energy's sale of its interests in Pulse and its UtiliMode and EdgeCap business units has reduced its interests in energy retailing and risk management and service provision. However, this sale – announced on 2 July 2002 – post-dates the period over which its equity beta has been estimated.

Company	Description of Activities	Last Reported Annual Operating Revenue (US $'m)	Comparable Activities
	generation and retailing, energy management services		
Piedmont Natural Gas Co. Inc	Natural gas distribution, transmission, retailing, energy marketing and gas appliance marketing	1,108	Gas transmission and distribution
RGC Resources Inc	Natural gas distribution and retailing, gas appliance marketing, energy services.	117	Gas distribution
Southwest Gas Corp	Natural gas transmission, distribution and retailing, pipeline construction	1,397	Gas transmission and distribution
Southern Union	Natural gas distribution; natural gas and energy retailing	1,933	Gas distribution
WGL Holdings Inc	Natural gas distribution and retailing and other energy related services	1,940	Gas distribution
New Jersey Resources Corp	Natural gas distribution, transmission, storage, retailing and domestic LNG production	2,048	Gas transmission and distribution
Ni Source Inc	Natural gas transmission, distribution, storage, exploration and production, electricity services	9,459	Gas transmission and distribution
Northern Borders Partners	Natural gas transmission, gathering and processing, coal slurry pipeline.	464	Gas transmission
SEMCO Energy Inc	Natural gas transmission, distribution storage, LPG retailing, distribution pipeline construction, telecommunications.	446	Gas transmission and distribution
Sempra Energy	Natural gas transmission, distribution, trading and storage, electricity retailing and oil trading; commodity trading	8,029	Gas transmission and distribution
Chesapeake Utilities Corp	Natural gas transmission, distribution and retailing; LPG retailing and trading, information services	330	Gas transmission and distribution
NUI Corp	Natural gas distribution, energy retailing.	1,134	Gas distribution
Entities with Transmission Interests, but Diversified (Not Preferred)			
Duke Energy	Diversified energy business with activities including natural gas production, gathering, processing, storage, transmission and distribution; oil production, processing storage and transmission; electricity generation, transmission, distribution; energy trading; communications networks and services; land management and real estate development; venture capital investment and financial services	59,503	Gas transmission and distribution, electricity transmission and distribution
El Paso Corp	Diversified energy business with activities including natural gas production, gathering, processing, storage and transmission; LNG production; energy trading.	57,475	Gas transmission
The Williams Companies Inc	Gas and oil exploration, production and processing; petroleum products and services; gas transmission; energy marketing and trading.	11,035	Gas transmission

Table 4.3

COMPARABLE CANADIAN COMPANIES

Company	Description of Activities	Last Reported Annual Operating Revenue (CDN $'m)	Comparable Activities
BC Gas Inc.	Natural gas distribution and retailing, water services, international consulting.	1,666	Gas distribution
Enbridge	Crude oil and natural gas transmission, natural gas distribution and retailing.	1,082	Gas transmission and distribution
Pacific North Gas	Natural gas distribution and retailing.	139	Gas distribution
TransCanada	Natural gas transmission, electricity generation	5,249	Gas transmission

Table 4.4

COMPARABLE UNITED KINGDOM COMPANIES

Company	Description of Activities	Last Reported Annual Operating Revenue (UK £'m)	Comparable Activities
Lattice Group	Natural gas transmission and distribution (holding company of Transco, the owner and operator of most of the UK transmission and distribution system)	3,153	Gas transmission and distribution
International Energy Group Ltd	LPG and natural gas transmission, distribution and trading for domestic customers in Guernsey, Jersey, Isle of Man, Portugal and UK.	49	Gas transmission and distribution
National Grid Group	UK, US and international electricity transmission and distribution, gas transmission in New York, telecommunications infrastructure	4,660	Electricity transmission and distribution
Scottish and Southern Energy	Electricity generation, transmission and distribution, energy services, gas trading	4,056	Electricity transmission and distribution
Scottish Power	Diversified utilities company with principal activities of electricity generation, transmission and distribution, and minor activities of gas supply and coal mining	6,337	Electricity transmission and distribution
Viridian Group	Electricity transmission, distribution and trading, gas trading, engineering services, telecommunications services, IT services, infrastructure construction.	732	Electricity transmission and distribution
United Utilities	Water and sewerage services, electricity generation and distribution	1,876	Electricity distribution and water and sewerage services
Anglian Water	Water services and infrastructure management services in utilities, transport and public sector markets	1,813	Water services
Kelda Group	Water and sewerage services	800	Water and sewerage services
Pennon Group	Water and sewerage services and waste management	374	Water and sewerage services
Severn Trent	Water and sewerage services	900	Water and sewerage services

4.2 Beta Estimates

The equity beta estimates for each of these companies from the sources discussed in section 3.2 are provided in Appendix B. This Appendix also provides the average gearing and marginal tax rate assumptions for each company used in the de-levering/re-levering calculations.

The equity betas for all companies reflect the latest information available at the time of writing this report. For the US and Australian companies, this is the period until the end of March 2002, whereas for the Canadian and UK companies, this reflects the relevant period until the end of June.

Average debt and equity levels of companies were determined by obtaining annual point observations on net debt (calculated as long term debt plus short term debt minus cash) and equity (market capitalisation) and taking simple averages of these values over the periods of beta estimation. The average taxation rates for USA companies were taken as a simple average of the marginal company tax rates provided by the Ibbotson Associates service over the period of beta estimation. For the Australian, Canadian and United Kingdom companies, average tax rates were assumed to be the highest marginal tax rates in each country (averaged over the period where tax rates changed).

A summary of the aggregate information implied by the beta estimates obtained for the firms in each market are provided in Tables 4.5-4.7. Table 4.5 shows the averages for equity betas, gearing and marginal tax rates across each market (the figures in parentheses show the averages when the firms with negative beta estimates are excluded).

Table 4.5

AVERAGE EQUITY BETAS, GEARING LEVELS AND MARGINAL TAX RATES

	Equity Beta	Gearing Level (D/A)	Marginal Tax Rate
Australian Companies[60]	0.61 (0.61)	53% (53%)	34% (34%)
USA Companies	0.12 (0.19)	45% (45%)	29% (30%)
Canadian Companies	0.05 (0.27)	60% (64%)	26% (26%)
UK Companies	0.07 (0.16)	36% (32%)	30% (30%)

Table 4.6 shows the implied simple average of the asset betas for the firms in each of the markets, for the different de-levering assumptions described in section 3.3 (with the figures in parentheses again showing the averages when the firms with negative beta estimates are excluded).

[60] The thin trading test statistic for the Australian Pipeline Trust equity beta indicated that thin trading bias may be significant, and so the thin trading beta estimate is used for this company.

Table 4.6

AVERAGE ASSET BETA ESTIMATES

Beta Estimates	Tax Term Excluded from Levering Formula		Tax Term Included in Levering Formula	
	Debt Beta = 0	Debt Beta = 0.15	Debt Beta = 0	Debt Beta = 0.15
Australian Companies	0.27 (0.27)	0.35 (0.35)	0.30 (0.30)	0.37 (0.37)
USA Companies	0.06 (0.10)	0.13 (0.17)	0.07 (0.11)	0.13 (0.17)
Canadian Companies	0.01 (0.09)	0.10 (0.19)	0.01 (0.11)	0.09 (0.20)
UK Companies	0.06 (0.12)	0.11 (0.16)	0.06 (0.13)	0.11 (0.16)

Lastly, Table 4.7 shows the re-levered equity betas for the regulatory-standard gearing benchmark of 60 per cent debt-to-assets, for the re-levering assumptions described in section 3.3 (with the figures in parentheses again showing the averages when the firms with negative beta estimates are excluded). In all cases, an equivalent re-levering assumption is used to that employed to estimate the asset beta (that is, the same debt betas are used, as well as the same assumption as to whether to include a tax term in the re-levering formula).

Table 4.7

RE-LEVERED EQUITY BETA ESTIMATES DERIVED FROM AVERAGE ASSET BETAS – 60% DEBT-TO-ASSETS

Beta Estimates	Tax Term Excluded from Levering Formula		Tax Term Included in Levering Formula	
	Debt Beta = 0	Debt Beta = 0.15	Debt Beta = 0	Debt Beta = 0.15
Australian Companies [61]	0.69 (0.69)	0.66 (0.66)	0.68 (0.68)	0.66 (0.66)
USA Companies	0.16 (0.25)	0.10 (0.19)	0.17 (0.26)	0.10 (0.20)
Canadian Companies	0.02 (0.23)	0.02 (0.25)	0.03 (0.25)	0.02 (0.26)
UK Companies	0.15 (0.29)	0.06 (0.19)	0.14 (0.29)	0.05 (0.18)

The information in the tables above for the US companies is restricted to the preferred set of comparable entities, and so excludes the diversified entities with transmission interests. Table 4.8 shows the implied re-levered equity betas (for gearing of 60 per cent debt-to-assets) for these other companies.[62]

Table 4.8

RE-LEVERED BETA ESTIMATES – DIVERSIFIED US TRANSMISSION COMPANIES

Beta Estimates	Tax Term Excluded from Levering Formula		Tax Term Included in Levering Formula	
	Debt Beta = 0	Debt Beta = 0.15	Debt Beta = 0	Debt Beta = 0.15
USA Diversified Pipelines	0.58 (0.92)	0.51 (0.86)	0.57 (0.91)	0.50 (0.86)

Thus, the average re-levered beta for these firms is higher than for the preferred set of comparable entities. However, it is impossible to conclude whether this difference in the re-levered equity beta reflects the non-regulated activities of these firms, or a difference in the non-diversifiable risk of gas transmission and distribution activities.

[61] There were no negative equity beta observations for the Australian firms.

[62] Note that this group is comprised of only three companies, or two when the negative equity beta observation is excluded.

The average of the re-levered betas (for a 60 per cent debt-to-asset ratio) for the comparable entities for each of the markets vary between 0.02 and 0.69 if the negative values are included, or between 0.18 and 0.69 if the negative values are excluded. The implied proxy beta derived from beta estimates for Australian firms is the highest across the markets in all cases.

The results show that the assumption about whether a tax term should be included in the levering formula has only a minor impact on the resultant proxy beta. In contrast, the assumption about the magnitude of the debt beta has a discernable impact on the proxy beta derived from the US and UK markets (with a lower debt beta implying a higher re-levered beta), although the absolute magnitude of the difference in the proxy beta estimates – in the order of 0.06 for the US and 0.09 for the UK – is not large, given the level of precision with which betas are estimated. For the Australia, the choice of debt beta had virtually no impact on the re-levered proxy equity beta.

4.3 Application the Empirical Beta Estimates

The purpose of this report, as described in section 1.1 has been to provide the Commission with a review of the current market evidence on the magnitude of the beta for regulated Australian gas transmission activities, for it to draw upon when assessing reference tariffs for these entities. This section includes a few brief comments on how this market evidence should be used.

There are sound arguments for relying upon the latest market evidence when deriving a proxy beta for the regulated activities of a regulated gas transmission entity. Estimates of equity betas for individual firms inevitably will vary over time, as will the average beta across a proxy group – this merely reflects the level of precision (or lack of it) in the beta estimates. By committing to rely upon the latest evidence, the temptation for either the regulator or the regulated entities to select the time-period of market observations that are considered to provide the 'best' beta estimate is avoided.

In reality, where beta estimates vary over time as the 'sampling window' is moved forward in time,[63] there is no way of testing which of the estimates is the 'correct'. Hence, while a commitment to use the latest evidence may imply that the proxy beta used to assess reference tariffs may vary over time, the rule nevertheless should lead to a proxy beta that is unbiased. Moreover, reliance upon the most recent market evidence – particularly where betas are drawn from a credible independent beta estimation service – is also a rule that can be replicated across price reviews and industries, and thus go some way towards reducing the uncertainty associated with the regulatory process.

[63] As beta estimates are based upon historical information, successive beta estimates merely imply that some old observations are dropped from the regression analysis, which and are replaced by new observations. For example, the difference in the quarterly beta estimates produced by the AGSM reflect the dropping of the three last observations (out of 48), and replacing them with three new observations.

Exclusive reliance on the latest Australian market evidence would imply adopting a proxy equity beta (re-levered for the regulatory-standard gearing level) of 0.7 (rounded-up). Moreover, regard to evidence from North American or UK firms as a secondary source of information does not provide any rationale for believing that such a proxy beta would understate the beta risk of the regulated activities. Rather, the latest evidence from these markets would be more supportive of a view that the Australian estimates overstate the true betas for these activities.

That said, however, we would caution against exclusive reliance upon the latest market evidence at this point in time.

To date, most Australian energy regulators have used a proxy equity beta in the range of 1 (for the regulatory-standard gearing level of 60 per cent debt-to-assets) when assessing or setting regulated charges, and a substantially higher assumption has been adopted in a number of decisions (including those of the Commission). The use of a proxy beta of 0.7 would represent a substantial reduction in the estimates of the costs of capital compared to the assumptions previously adopted. While such a revision would be warranted in the face of reliable, objective evidence, it cannot be concluded definitively that this quality of evidence exists at this time.

First, the primary source of evidence – which derives from the listed Australian entities – consists of a group of only four firms. Moreover, only two of the firms have been in existence for long enough to permit the AGSM's-preferred four years of observations to be used,[64] with the beta estimate of one of these – the Australian Pipeline Trust – being based upon only 21 observations (just above the cut-off that the AGSM Risk Management Service applies for providing beta estimates).[65]

Secondly, we are concerned about the magnitude of the beta estimates derived for firms operating in other countries. The re-levered equity betas for the US firms, in particular, are substantially lower than the estimates that have been obtained from past time 'sampling windows'.[66] It could be hypothesised that the recent events on US share markets – such as the large surge in the values of high-technology stocks and then their subsequent fall – may have affected the beta estimates, and which may have biased the estimate of the forward-looking beta risk of these firms if those events were not considered by investors to be normal events. However, it is impossible to prove or disprove such a conjecture.

[64] The two firms are AGL and Envestra. The United Energy beta estimated used 46 observations (out of a preferred set of 48).

[65] It should be noted, however, that the beta estimate for the Australian Pipeline Trust was the highest out of any firm across all of the markets surveyed, but also had the highest standard error.

[66] In a submission (commissioned by BHP) to the Commission and the then Office of the Regulator-General in 1998, Dr Jeff Makholm of NERA noted that the average beta of the gas companies he included in his sample at that time was 0.66 for an average gearing level of 34 per cent debt-to-assets, which implied an equity beta of 0.81 for the 'regulatory-standard' gearing level of 60 per cent: Makholm, J., 1998, The Cost of Capital for Gas Transmission and Distribution in Victoria, p.18. This re-levered equity beta is almost identical to that reported for all US gas distributors for an earlier period: Morin, R., 1994, *Regulatory Finance: Utilities' Cost of Capital*, Public Utilities Reports, Virginia, p.352.

Accordingly, while it inevitably is a matter for the Commission to decide how it exercises its discretion, it is recommended that, in the near term, it adopt a conservative approach, and not assume a proxy equity beta that is too far from the range of previous, relevant regulatory decisions. As noted above, these decisions typically have assumed a proxy beta (for the regulatory standard gearing assumption) of around 1. That said, this report has demonstrated that no implication can be drawn from current market evidence that the proxy betas that Australian regulators have adopted are likely to understate the 'true' beta – rather, as noted above, the current evidence suggests regulators systematically have erred in the favour of the regulated entities.

In the future, however, it should be possible for greater reliance to be paced upon market evidence when deriving a proxy beta for regulated Australian gas transmission activities. There are currently six firms listed on the Australian Stock Exchange that could be used as comparable entities when deriving a proxy beta – AlintaGas, AGL, the Australian Pipeline Trust, Envestra, GasNet and United Energy. Beta estimates are already available from the AGSM Risk Management Service for four of these entities, and estimates will be available for all six within a couple of years.[67] Moreover, should any of the currently-mooted stock market listings of energy utilities proceed, then the information available from Australian capital markets will expand even further.

[67] The last of these entities to list was GasNet, which listed on the Australian Stock Exchange in December 2001. The AGSM service should provide its first beta estimate for this firm in its September 2003 publication.

Chapter 5

Comment on other Studies' Estimates of Proxy Beta Values for Australian Gas Transmission Pipelines

As required by the brief, this section comments on the empirical estimates of betas and related comments in two papers, namely:

- Network Economics Consulting Group (NECG), 23 November 2001. *GPU Gas Net Asset Equity and Debt Beta*; and
- The Brattle Group Ltd, October 1999. *The Cost of Capital for the Dampier to Bunbury Natural Gas Pipeline*.

These papers are addressed in turn.

5.1 NECG Gas Net Asset Equity and Debt Beta

The NECG paper derived a plausible range for the asset beta for GasNet's regulated activities drawing upon four sources of information (which are discussed further below). The range derived from each source, and its plausible range, is shown in Table 5.1.

Table 5.1

NECG ESTIMATED ASSET BETA VALUES

Source of Beta Estimate	Asset Beta Estimate	Implied Equity Beta (60% Debt-to-Assets)
Regulatory decisions	0.50 – 0.65	1.07 – 1.44
QCA beta estimates	At least 0.45	At least 0.94
AGSM beta estimates	At least 0.60	At least 1.31
NECG beta estimates	At least 0.55	At least 1.19
Suggested plausible range	0.45 – 0.70	0.94 – 1.56

NECG did not disclose the assumption it made about the magnitude of the debt beta, which makes the interpretation of its asset beta range difficult. As noted in section 3.3, it is important to adopt consistent assumptions about debt betas when deriving a proxy asset beta from empirical estimates of equity betas and when reversing the process to derive a proxy equity beta for the desired level of gearing. Indeed, given that all Australian energy regulators have adopted 60 per cent debt-to-assets as the standard benchmark financing assumption, it has been suggested that interpretation-errors can be minimised by focussing on the proxy equity beta that is derived for the standard financing assumption of 60 per cent debt-to-assets.

For the purposes of interpreting NECG's asset beta range, it has been assumed that it has used a debt beta of 0.12.[68] Using this assumption, Table 13 also shows the range for the proxy equity beta that is consistent with the standard gearing assumption of 60 per cent debt-to-assets for each of the NECG sources, and for its suggested plausible range. The implied suggested plausible range for the proxy equity beta is between 0.94 and 1.56.[69]

From the results presented in this paper, it is considered difficult to sustain even the lower end of this range *if exclusive reliance were placed upon current market evidence* for the derivation of the proxy beta for Australian gas transmission companies' regulated activities. That said, it has also been suggested that it may be inappropriate to move to quickly from previous regulatory benchmarks for beta values given the limited evidence presently available from the Australian capital market, which would support an assumption of a proxy equity beta towards the lower end of the NECG range. It is noted, however, that it will be appropriate to place greater reliance upon empirical beta estimates (and less on previous regulators' decisions) at future price reviews as beta estimates become available for the recently listed energy utilities.

The four pieces of information drawn upon by NECG to establish its range were recent decisions by Australian energy regulators; beta estimates of the Queensland Competition Authority (QCA) in a recent decision; beta estimates obtained from the Risk Management Service of the Australian Graduate School of Management; and its own beta estimates. In interpreting the beta estimates, NECG had regard only to Australian companies, rejected the use of Envestra as a comparable entity (but included a number of companies that were not included in the proxy group used in report) and applied the Blume adjustment to the raw beta estimates.

Four specific aspects of the NECG analysis are commented upon below, which are:

- the relevance of the four sources of information on equity betas;
- the set of comparable entities NECG has used to derive the proxy beta for a regulated Australian gas transmission activity; and
- the use of the 'Blume' adjustment to raw equity betas.

A number of comments on miscellaneous matters then follow.

[68] NECG rejected the notion of a zero debt beta (p.10), and appeared to accept that some adjustment to the promised yield on debt is required when reverse-engineering the CAPM for the reasons discussed in section 3.3. The only adjustment referred to by NECG is 0.50 percentage points – being the adjustment the ACCC has used previously – which has been used. The debt beta of 0.12 is derived using the 0.5 percentage point adjustment, together with the ACCC's previous assumptions about the cost of debt (1.2 per cent margin over the risk free rate) and the equity premium (6 per cent).

[69] This uses the Monkhouse formula (discussed in section 3.3) which NECG adopted in its report (pp.7, 16, 17). This formula also requires assumptions about the marginal tax rate, value of franking credits and the cost of debt, none of which were disclosed (although the assumptions on these matters are of less importance). For the purpose of this report, it has been assumed that NECG used values consistent with the ACCC's previous decisions, that assumptions of is 30 per cent, 0.5 (expressed as a proportion of face value) and 6.0 per cent (being a 1.2 per cent margin plus the average 5 year bond rate over the 40 days to 23 November 2001 of 4.8 per cent), respectively.

Four sources of information

While NECG has presented four separate pieces of information on proxy betas for regulated transmission activities, in interpreting these pieces of information, it needs to be borne in mind that at least three of these are not independent sources of information. Rather, the AGSM Risk Management Service beta estimates, those presented by the QCA and those undertaken by NECG are all empirical estimates of betas, all drawing upon (substantially) the same capital market observations. Accordingly, the only implication that can be drawn from having regard to each of the separate beta estimates is on the implications of different methodological choices for the resulting equity betas estimates, and the implications of changing the observations that are included in the regression analysis.

It is recommended in this report that the ACCC have regard to the equity beta estimates produced by the AGSM Risk Management Service. This reflects the fact that these estimates are produced using a sound and transparent methodology, and are generally well regarded and widely used. The use of a widely available and frequently-updated beta estimation service also permits the same beta estimation methodology to be used across decisions and industries, and thus reduce the uncertainty associated with the regulatory process. As discussed in section 3.2, what look like minor methodological changes can have profound results on empirical beta estimates. By committing to use a credible, independent source for beta estimates, the likelihood that regulators or regulated entities may seek (or appear to seek) to cherry-pick the methodological choices to produce their desired result should be reduced, and thus reduce the uncertainty and controversy associated with price reviews. These considerations would imply placing little weight upon either the QCA or NECG equity beta estimates.[70]

It is also recommended in this report that the most recent equity beta estimates be used to avoid the temptation to 'pick-and-choose' the time period that is considered to provide the better proxy beta estimate. This recommendation would imply updating the AGSM equity beta estimates referred to by NECG in its report with the latest information, as presented in this report.

It is difficult to comment specifically upon the equity beta estimates presented by NECG in its report. As noted above, the difference in the estimates can only reflect different methodological choices, or a difference in the period of observations that were included in the regression analysis; however, none of the assumptions used in the estimation (apart from the identity of the companies) were disclosed.[71]

[70] The QCA has noted that its equity beta estimates for Envestra were very similar to those produced by the AGSM Risk Management Service when measured over the same time interval (Queensland Competition Authority, Proposed Access Arrangements for Gas Distribution Networks: Allgas Energy Limited and Envestra Limited, Final Decision, October 2001, pp.374-375). Thus, there is no a priori reason that the QCA's equity beta estimates would be systematically above or below those provided by the AGSM over time.

[71] NECG also did not disclose the assumptions it used about the entities' gearing levels when deriving asset betas, and it is difficult to reconcile many of the asset beta estimates presented in table 4 with the Blume-adjusted equity betas presented. For example, AlintaGas' gearing level is approximately 45 per cent debt-to assets – which would imply an asset beta of 0.5 using the NECG levering methodology (and the assumptions noted in footnote 69), rather than 0.76 (which re-levers to an equity beta of 1.25 for 60 per cent gearing); the Australian Pipeline Trust had a gearing level of approximately 55 per cent, which implies an asset beta of 0.58 rather than 0.73 (which re-levers to 1.07); and United Energy had a gearing level of approximately 46 per cent, which implies an asset beta of 0.50 rather than 0.64 (which re-levers to 1.06).

Regarding the fourth piece of information – the assumptions adopted in previous regulators' decisions – it needs to be noted that these beta observations reflect the judgements reached by others (and by the ACCC at other points in time), and are not empirical estimates of equity betas.[72]

That said, it is suggested in this report that it may be appropriate not to move too quickly from the range of proxy equity betas that have been adopted by other regulators and previously by the ACCC based upon current equity beta estimates. The recommendation reflects the fact that there still is only limited information available from the Australian capital markets on the relative risk of regulated gas transmission entities (although the level of information available will increase over the next few years given the recent listings of energy utility entities). Thus, this information is relevant to the Commission in deciding how to exercise its discretion in response to the uncertainty that exists with estimating costs of capital.

Comparable Entities

Foreign Firms

NECG has restricted its observation of comparable entities only to Australian listed entities, noting that 'the most meaningful beta estimates can generally only be derived using domestic comparators',[73] and that '[a]djustment mechanisms proposed to correct for market conditions are currently unproven'.[74]

We agree with both of these observations – domestic listed entities will provide more reliable estimates of betas than foreign entities, and some of the adjustments that previously have been suggested to adjust for differences between markets are nonsensical, as discussed in section 3.1. However, it is considered that, given the absence of a large pool of comparable entities for the regulated gas transmission activities in Australia, it is appropriate for regulators to have regard to estimates of equity betas from other countries (with those betas measured against the home-market for the relevant firm), at least as a *secondary* source of information.

As noted in section 3.1, the implicit assumption with the use of beta estimates for foreign firms for an Australian activity is that the strength of the relationship between the returns to the foreign comparable entity and the diversified portfolio of equities traded in its home market is the same as the strength of the relationship between the returns to the Australian activity and the returns to the diversified portfolio of equities in the Australian market. A number of factors may cause the strength of this relationship to differ between markets, which were discussed in section 3.1. However, the assumption required for equity beta estimates for foreign entities to be relevant is not so restrictive as to imply that these estimates would not provide any information on betas for activities in Australia.

[72] These assumptions are also not independent of empirical estimates of equity betas, given that regulators have taken these into account in previous decisions.
[73] NECG Report, p.3.
[74] NECG Report, p.3.

In discussing the exclusion of beta estimates for foreign firms, one of NECG's reasons was that 'systematic risk is largely country specific'.[75] While the exact meaning of this phrase is not completely clear, on one interpretation it implies that the use of beta estimates for foreign entities requires an assumption that asset prices are determined with reference to an internationally diversified portfolio of assets – that is, one of the forms of the international-CAPM holds. However, such an implication would be incorrect. In this report, equity betas for US firms have been measured against the US market, UK betas have been measured against the UK market, and so forth. The implicit assumption is that asset prices are determined by forces within each market – that is, that the standard domestic (segregated market) CAPM holds. As noted above, the assumption implied by the use of beta estimates for foreign firms is that the sensitivities of returns *within each market* are the same between markets.

Australian Comparable Entities

With respect to the Australian comparable entities, while NECG has not defined a set of comparable entities and used this group consistently throughout its analysis, it has:

- excluded Envestra from the QCA estimates presented, from the AGSM average that is reported, and from the average presented from its own equity beta estimates; and
- has included beta estimates for Energy Development and Origin Energy in the reported average derived from its own estimates.

Regarding the exclusion of Envestra, the reasons provided by NECG include the following:

- it had loss making operations over the period;[76]
- it was involved in a merger over the period that doubled its size;[77]
- the company was only listed in August 1997 and so there are insufficient observations from which to obtain reliable beta estimates;[78] and
- estimates of its beta from different sources vary widely – and have large standard errors.[79]

None of these arguments are considered to provide any reason to exclude Envestra from the group of comparable entities that is used to derive a proxy beta for Australian regulated gas transmission activities. Each is addressed in turn.

[75] NECG Report, p.11.
[76] NECG Report, p.15.
[77] NECG Report, p.15.
[78] NECG Report, p.15.
[79] NECG Report, p.17.

- *Loss making operations* – while Envestra has made accounting losses over the period since its listing, it made large distributions to shareholders in every year (consistent with its prospectus forecasts), and so there no strong grounds for considering that Envestra is going through an unusual period that would distort the market's valuation of its securities. In addition, Envestra's accounting losses are driven, in part, by the structure of its securities, which are a stapled[80] ordinary share and interest-bearing loan note (with a right to interest accruing only if there is sufficient available cash). As the loan notes cannot be traded separately and sit only above ordinary shares in priority in the case of liquidation, then (with the exception of personal taxation considerations) the loan notes are in substance equivalent to ordinary equity.[81] However, accounting standards require the loan notes (and payments of interest on loan notes) to be treated as debt (and an operating expense). If loan notes were treated as equity (consistent with their economic substance),[82] then Envestra would have made a profit before tax in every year of operation.[83]

- *Merger* – Envestra was not involved in a merger, but rather bought one of the privatised Victorian gas distribution businesses in March 1999. While the purchase may have raised the standard error of its beta estimate (depending upon the market's view of whether or not it paid a fair price for the asset), there is no necessary reason for considering that this may have caused a bias in the beta estimate. Moreover, as noted below, notwithstanding its purchase of the Victorian gas distribution business, as noted below, the standard error of the beta estimate for Envestra is not high relative to those for the other Australian firms, or the market average.[84]

- *Only listed in August 1997* – Envestra was listed before United Energy (March 1998) and Origin Energy (February 2000), which NECG has included in its proxy group. Moreover, there are now more than four years of observations available for Envestra, which is sufficient to provide reliable beta estimates (and is all that is used by the AGSM Risk Management Service).

[80] The term 'stapled' means that they cannot be traded separately.

[81] The only other difference between loan notes and ordinary equity is that the former (effectively) includes a binding commitment to a minimum distribution if there is sufficient available cash.

[82] The treatment of loan notes effectively as equity also implies that the value of loan notes should be excluded from the value of debt that is used to derive its gearing ratio. Loan notes have been excluded from debt when deriving the gearing ratio for Envestra in this report, which produces a current gearing level of approximately 80 per cent debt-to-assets, not the 95 per cent reported by NECG (p.15).

[83] Envestra. 2000-01 Annual Report, p.13. High accounting depreciation charges are the other reason for Envestra's low initial accounting profits. However, having large accounting depreciation charges early in the life of an infrastructure asset (or in the life of a re-valued asset, as in the case of Envestra) is typical for an infrastructure provider, and not something that the market would find it difficult to interpret. Indeed, Envestra's rationale for its stapled loan note security (which is a common form of security for infrastructure firms in the US, and was also used by United Energy) is that this form of security permits distributions to be made to shareholders when the firm has plenty of cash, but is making accounting losses.

[84] As the AGSM service uses four years of observations, the beta estimate for Envestra presented earlier in this report uses observations between the start of March 1998 and the end of March 2002. Accordingly, approximately three quarters of the observations are drawn from the period after Envestra's purchase of the Victorian gas distribution business.

- *Beta estimates vary between sources and have high standard errors* – the only variability in the beta estimates for Envestra appears to be between the NECG estimates and those from all other sources, as the QCA and AGSM estimates are very similar.[85] In addition, the comment that the standard error for equity beta estimates for Envestra is high is factually incorrect. The standard error of the equity beta estimate for Envestra in the March 2002 AGSM Risk Management Service beta estimates was 0.27, whereas the standard error for AGL was 0.34 and the standard error for United Energy was 0.47.[86] The relativity was similar at the time at which NECG produced its report in 2001.[87] Moreover, the standard error of the March 2002 equity beta estimate for Envestra was lower than the market average, which was approximately 0.32.

In contrast, it is considered that there are a number of reasons for the inclusion of Envestra.

- First, it is virtually a pure play gas distribution entity (that is, it does not produce or retail gas). In contrast, all of the other comparable entities have substantial unregulated activities (which reduces their appropriateness as comparables for regulated businesses).
- Secondly, virtually all of its activities are regulated.
- Thirdly, all of its regulated networks are regulated under price caps or average revenue caps (revenue yield). None are subject to either revenue caps, or to 'rate of return' regulation.

Regarding Energy Development and Origin, neither of these companies is considered sufficiently comparable to a regulated gas transmission entity. Energy Development's main activity is the supply and operation of electricity generation plant in regional areas, with little distribution or transmission infrastructure. Origin Energy's main activities are as a producer of oil and gas, retailer of gas and electricity and appliances, supplier of LPG, and operation under contract (and on a cost-plus basis) of gas distribution infrastructure. It does not own any significant regulated gas or electricity transmission or distribution infrastructure.

Blume Adjustment

As discussed in section 3.4 above, the use of the 'Blume adjustment' to raw equity betas is not considered appropriate when deriving proxy equity betas for regulated Australian gas transmission activities. The reasons for this, in summary, are as follows.

- With respect to the *pooling* motive for the Blume adjustment, it was concluded that taking an average beta across a carefully selected set of comparable entities is a more appropriate means of pooling individual beta estimates in order to reduce the standard error of the resultant estimate.

[85] As discussed in footnote 70, the QCA noted explicitly that its equity beta estimates for Envestra were very similar to those produced by the AGSM Risk Management Service when measured over the same time interval (Queensland Competition Authority, Proposed Access Arrangements for Gas Distribution Networks: Allgas Energy Limited and Envestra Limited, Final Decision, October 2001, pp.374-375).

[86] The standard error of Envestra's equity beta was lower than the overall market average in March 2002 (which was approximately 0.32).

[87] In June 2001, the standard error of the beta estimates for Envestra, AGL and United Energy were 0.27, 0.31 and 0.55 respectively, and in September 2001 were 0.27, 0.30 and 0.55 respectively.

- With respect to the *regression tendency* motive, it was concluded that, while the empirical evidence may support such a tendency (at least in aggregate), such a tendency is likely to reflect factors (or management decisions) that are not relevant for the derivation of a proxy equity beta for regulated Australian gas transmission activities.[88] In particular:
  - as the objective is to derive a proxy beta for a pure-play gas transmission activity, it is inappropriate to take account of the tendency for firms to diversify into activities in order to pull their equity betas towards one; and
  - as explicit assumptions are made about gearing (and equity betas adjusted accordingly), it is inappropriate to adjust the beta to take account of the tendency for firms to alter their gearing in order to pull their equity betas towards one (indeed, if betas were adjusted to reflect this tendency, then it would also be necessary to adopt a consistent gearing assumption).

NECG state that '[h]istorically, regulatory bodies in Australia have implicitly adopted the Blume adjustment'. This may overstate the level of support that regulators have offered for this adjustment.

- First, it is understood that only the Victorian Essential Services Commission (ESC, formerly the Office of the Regulator-General) and the Queensland Competition Authority (QCA) have considered the adjustment explicitly. To the extent that others have relied upon AGSM Risk Management Service beta estimates, it is unlikely that a 'Blume adjustment' would not have been made.
- Secondly, while the QCA has had regard to 'Blume adjusted' betas, it has expressed concern with the adjustment (for similar reasons to those discussed in this report), and stated that it has had regard to both adjusted and unadjusted betas.[89]
- Thirdly, while the ESC had regard to 'Blume adjusted' betas in a 2000 decision, it criticised the adjustment and had regard to both adjusted and unadjusted betas, noting that its reluctance to reject the Blume adjustment reflecting a lack of opportunity to subject the appropriateness of the adjustment to full consultation.[90] In its most recent draft decision, the ESC has rejected the Blume adjustment, and had regard only to raw betas.[91]

Other Matters

This section makes a number of comments on other statements made in the NECG report, including on:

- the problems with the CAPM and asymmetric risk; and

[88] It was noted, however, that equity beta was being used as an input into the valuation of a specific firm, then it would be appropriate to take account of a regression tendency in betas (although it may be more efficient to make specific assumptions about the likely change in the mix of projects or gearing of the firm than to just use the aggregate estimated regression tendency).

[89] Queensland Competition Authority, Proposed Access Arrangements for Gas Distribution Networks: Allgas Energy Limited and Envestra Limited, Final Decision, October 2001, pp.226-227.

[90] Office of the Regulator-General, Electricity Distribution Price Determination 2001-05, Volume 1, Statement of Reasons and Purpose, September 2000, pp.274-275.

[91] Essential Services Commission, Review of Gas Access Arrangements – Draft Decision, July 2002, pp.234-235.

- the relative risk of GasNet.

Concerns with the Capital Asset Pricing Model and 'Asymmetric Risk'

NECG commences its report with the following statement:

> The Capital Asset Pricing Model (CAPM) assumes that all returns are normally distributed, that all specific risks are diversifiable and the only risk for which CAPM acknowledges a need for commensurate reward is market risk. CAPM is therefore an under-specified model. Types of asymmetric risk that will be rewarded in the market place but are not captured by the CAPM include liquidity, default risk and asset stranding risk. Accordingly it is necessary to supplement the CAPM to take account of these factors.

In interpreting these comments, two different concerns need to be distinguished, which are as follows:

- First, the concern that the CAPM will not provide an accurate estimate of the return that investors will require, on average, in order to hold a particular asset; and
- Secondly, the concern that the effect of all components of the regulatory arrangements is that the return that investors will get on average is less than the return the regulator intends to provide (for example, because the expenditure forecasts may not have taken account of a low probability but high cost event).

Asymmetry in cash flows potentially may affect both of these issues. If cash flows are strongly asymmetric, then the CAPM may not provide an unbiased estimate of the cost of capital (as investors may take account of higher moments of the distribution when valuing assets).[92] In addition, if cash flows are asymmetric and a regulator uses forecasts of normal (or modal) cash flows, then the expected return would depart from the regulator's estimate of the cost of capital.

Only the first of these concerns can be interpreted as an argument that there be a reward for asymmetry (or asymmetric risk) – the second of the concerns only implies that the risk premium quantified by the regulator actually be delivered.[93] However, most of the events identified by NECG – such as asset stranding and default (presumably by a retailer) – relate to the second concern, and are independent of the risk premium required for investors to commit capital to GasNet's regulated activities.[94]

[92] Formerly, as the CAPM assumes mean-variance utility functions, it requires either the assumption of quadratic utility functions – in which case any distribution of asset returns is permissible – or that asset returns be normally distributed. However, as quadratic utility functions display increasing absolute risk aversion (which is typically not considered realistic), the assumption of normal returns is generally taken as the more relevant assumption.

[93] The term 'risk premium' is used to refer to the difference between the expected return and the certainty equivalent, consistent with its usage in mainstream expected utility theory.

[94] The Victorian Essential Services Commission refers to the second concern as 'excluded events' to emphasise the distinction between the risk premium required, and whether the price controls provide the intended risk premium (see Essential Services Commission, Review of Gas Access Arrangements – Draft Decision, July 2002, pp.271-281).

Regarding the second concern (that is, whether the expected return may depart from the regulator's estimate of the cost of capital), this can only be considered in the context of each specific case. In undertaking this analysis, it is necessary to take account of all of the events that may occur, all implications of the particular regulatory regime, as well as the approach taken by the regulator when setting price controls (ie the method used to forecast demand and future expenditure requirements). Analysis of these matters is outside of the brief for the current report.

Regarding the first of the concerns, it is impossible to disagree with the proposition that the CAPM relies upon a number of restrictive assumptions, which may not hold for all assets, or indeed, any asset. However, it would be incorrect to assume that any departure from the CAPM assumptions implies that a higher return is required. The central input into the CAPM is the equity premium, whose magnitude (as used by regulators) is independent of theory – it is just an estimate of the risk premium required for investors to hold the relevant portfolio of assets.

Accordingly, for every asset that requires a higher return than derived from the CAPM there need to be corresponding assets that require a lower return than derived from the CAPM to be consistent with the assumed equity premium. Thus, the relevant matter is not how a particular asset may differ from the CAPM assumptions, but how it differs from other assets.[95] There also needs to be some form of model for quantifying the impact of that difference (and which takes account of any portfolio effects). While there are many models in the finance literature that seek to take account of the weakening of CAPM assumptions, none are broadly accepted, widely used and readily implemented. Professor Officer recently commented on the CAPM as follows.[96]

> It has become almost conventional to use the CAPM for estimating a required or expected return to equity. The CAPM is testimony to the adage that in finance and economics, in fact in all social sciences, "models that are to be used but never to be believed". There are far more academic papers around showing the inadequacies of the CAPM as a means of estimating expected or required returns to equity capital than there are papers illustrating its value. The problem is finding a robust alternative to the CAPM. It just does not exist at the moment.
>
> The severest critics of the CAPM are the academics. However, from a practical point of view these critics take the assumptions underlying the derivation of the CAPM far to[o] seriously. From a practitioner's point of view all the CAPM needs to provide is a means of deriving an expected return for the non-contractual financial obligations of the company. In this context, it is best looked at as a base rate of return which is widely recognized (the surrogate for the risk free rate e.g. a government bond rate) plus a risk premium which is provided by a readily identifiable risky bench mark (the market index) which is then scaled (the β) by some measure of the relative (to the index) risk of the asset or investment.
>
> …

[95] NECG refers to liquidity as one factor that is not reflected in the CAPM. While this is true, any liquidity premia on shares will be reflected in their economic returns (ie as such premium would reduce share prices, it would raise the measured dividend yield), and so an empirically-derived equity premium will reflect the average liquidity premium across the market. Accordingly, liquidity is only relevant to the extent that a share is more or less liquid than the average.

[96] Officer, R, 2001, The Cost of Capital: R.S Gynther Memorial Lecture, October, pp. 8-9.

> All of the parameters of the CAPM have been subject to a great deal of investigation and criticism in empirical investigations of the model. The problem has been to find an adequate substitute. The simplicity of the model and the strong theoretical backing to β as a relative risk measure is strong. Moreover, the ability to take such measures from one set of investments and apply them to other investments gives a robustness and practical value to the model …

Statements about the relative risk of GasNet

NECG pointed to a number of factors or pieces of evidence that it considered relevant for the assessment of the relative risk of GasNet, which included the following:

- there is empirical evidence provided by a World Bank working paper that betas for gas utilities are consistently higher than for electricity utilities;[97]
- the use of price-caps (as employed by Australian gas pipeline regulators) rather than revenue caps implies greater systematic risk and hence a higher beta value;[98]
- GasNet does not have its transportation revenue secured under long term contracts, in contrast to other gas transmission pipelines.
- there is increasing competition in the natural gas market, caused by greater interconnection and convergence between gas and electricity.[99]

Regarding the first of these, it is considered that the results presented in World Bank working paper suggest that it is more likely that gas distributors have lower systematic risk than electricity distributors. First, the simple average of all of the asset beta estimates provided in the report for electricity distribution (34 observations) was 0.45, which exceeded the simple average of the asset beta estimates for the gas distributors of 0.33 (18 observations). Secondly, in the only country where multiple gas and electricity distributors can be compared – the US – the average asset beta for electricity distribution of 0.30 (9 observations) exceeded that for gas distribution of 0.20 (12 observations).[100]

Regarding the second and third of the matters raised, it needs to be borne in mind that if primary reliance is placed upon objective market data when deriving a proxy beta, then the relevant matter is how the target entity (GasNet in the case of the NECG Report) differs to the firms in the group of comparable entities. With respect to the form of price control and the existence of contracts:

- all of the Australian energy utilities are regulated under price caps (or average revenue caps), and none are regulated under revenue caps or rate of return regulation; and
- only the Australian Pipeline Trust has a significant share of its revenue fixed under contracts – that is, the distribution activities of AGL, Envestra and United Energy all have a similar contractual situation to GasNet.

[97] NECG Report, p.14.
[98] NECG Report, p.19.
[99] NECG Report, pp.21-22.
[100] Alexander, I, C. Mayer and H. Weeds, Regulatory Structure and Risk: An International Comparison, prepared for PSD/PPI, World Bank, January 1996, pp.45-56.

In principle, the fact that most of the Australian comparable entities do not have contractual cover may suggest that the proxy beta derived from the group of Australian energy utilities would overstate their level of systematic risk. However, as discussed in section 4.3, we would caution against attempting to make ad hoc adjustments to proxy betas on account of perceptions of differences in non-diversifiable risk given the absence of empirical evidence on the size of the required adjustment (and whether any adjustment may be warranted at all).

A more relevant concern with the use of the Australian energy utilities is that all of the companies except for Envestra undertake significant non-regulated activities, which would be expected to have higher systematic risk. Thus, the simple average of the betas across the proxy group is more likely to overstate the proxy beta for a pure-play regulated entity. Again, however, it is not considered that attempts should be made to adjust for such matters given the absence of empirical evidence on the size of the required adjustment.

Lastly, regarding competition, to the extent that this may affect the level of systematic risk for regulated transmission activities, then this effect is likely already to be reflected in the empirical estimates of betas for the Australian energy utilities, given that competition has been gradually increased over a number of years (and was first committed to in 1994).[101]

However, it is not clear that competition need have a significant impact on the level of systematic risk borne by GasNet. Much of the increase in competition will be between retailers and producers, which will not have an obvious effect on GasNet – any gas sold to Victorian households and businesses will still need to travel through its system, irrespective of the identify of the retailer and source of the gas. Indeed, additional interconnection and access to gas supplies should reduce the likelihood that Victorian will run out of gas – and hence its 'stranded asset risk' (although would not be expected to affect its level of systematic risk). The only competitive threat for GasNet is the by-pass of its system – and it is hard to see how GasNet may be threatened with substantial bypass.

5.2 The Brattle Group Cost of Capital Report for the Dampier to Bunbury Natural Gas Pipeline

The Brattle Group paper produced estimates of the proxy beta for an Australian gas transmission company by estimating the equity betas for a sample of US firms, but measured against the US market re-weighted to resemble the Australian market. The asset beta estimated by the Brattle Group, and the implied re-levered equity beta for the standard benchmark gearing assumption of 60 per cent debt-to-assets is shown in Table 5.2.[102]

[101] Indeed, as all but one of these utilities has substantial retail interests – where competition has increased – these beta estimates are likely to overstate any increase in systematic risk for a regulated pure-play transmission entity arising from an increase in competition.

[102] The Brattle Group assumed a debt beta of 0.12, which has been used to derive the re-levered estimate. Brattle's preferred levering methodology is also used in the table, although it also demonstrated the impact of different methodologies.

Table 5.2

BRATTLE GROUP ESTIMATED ASSET BETA AND IMPLIED EQUITY BETA

Asset Beta	Re-Levered to 60% Debt-to-Assets
0.58	1.27

The group of comparable entities used by the Brattle Group were five US companies with gas transmission activities: Coastal Corp., El Paso Energy Corp., Enron Corp., Sonat Inc., and Williams Companies Inc.

While the methodology undertaken by the Brattle Group has a number of desirable attributes, we have a number of comments on its analysis.[103]

First and foremost, it must be borne in mind the Brattle Group beta estimates remain estimates for foreign firms and are measured against a foreign market (albeit one that has been reconstructed to resemble Australia). Thus, while it may be appropriate for a regulator to use their results as a *secondary* source of information when deriving a proxy beta, primary regard should be had to estimates of betas for Australian firms measured against the Australian market.

Our remaining comments are provided in turn.

Selection of the Proxy Group

As discussed in section 4.1 above, we have not included *any* of the US firms used by the Brattle Group in our group of comparable entities. While all of these companies have some interest in pipeline operations, all also have substantial interests in non-gas transmission activities that would be expected to have substantially different levels of systematic risk. By way of example, some of the activities undertaken by these firms include the following:[104]

- El Paso, with gas exploration, production and trading activities, with pipeline activities only contributing a small share of revenue, EBIT and total assets (approximately 5 per cent, 34 per cent and 30 per cent in 2001, respectively);
- The Williams Companies, with activities of gas and oil exploration, production and processing; petroleum products and services; energy marketing and trading, and only a small share of revenue derived from gas transmission activities and minority shares of profit and total assets associated with this activity (17 per cent, 28 per cent and 24 per cent in 2001, respectively);

[103] Consistent with the brief for this project, we have not audited nor sought to replicate the study undertaken by the Brattle Group, and accordingly cannot give any assurance as to their reported results.

[104] The discussion in this section focuses on the current share of each firm's activities (namely, for the 2001 calendar year). The activities of many US energy-related firms have changed substantially over the last decade, particularly with the rise in significance of wholesale market trading activities. Accordingly, it would be expected that the various activities undertaken by these firms may have changed the last decade. In addition, El Paso's purchase of Sonat and Coastal would have raised the significance of its non-pipeline activities.

- Coastal and Sonat Inc both had a high level of activity in oil and gas exploration and production (Sonat was bought by El Paso in 1999, and Coastal merged with El Paso in 2001); and
- Enron's activities included trading and the provision of risk management products across all energy sources as well as in other industries areas (such as water and spectrum rights), the construction of power plants in the US and overseas, and exploration and production of gas and oil.

Our criticism of this particular set of comparable entities is consistent with the advice from NERA to the Australian Competition and Consumer Commission in 1998.[105]

Methodology – Change in Market Weights

The Brattle Group's concern with the use of the US market as the relevant market portfolio was that the difference in the weights of the various market sectors between the US and Australia may imply that a project in the US would have a different beta to an identical project in Australia.[106]

This concern follows simply from the fact that a project's beta reflects the covariance of its returns with those of the market overall. Accordingly, if an entity is part of a sector that has a large representation on the stock exchange, then its returns would have a higher covariance – and hence beta – than would be the case if its sector had a lower weight.[107] More broadly, if an entity responds to macro-economic shocks in a similar manner to firms that have a large representation on the stock exchange, then that firm would be expected to have a higher equity beta than if those similar firms had a lower weight. Accordingly, the Brattle Group's adjustment of the US market to resemble Australia is considered a valid attempt to correct for the impact of market weights.

That said, it is impossible to know the accuracy of the adjustment for the difference in market weights. The sectors that the Brattle Group had regard to were broad industry groupings, and the composition of the industry groupings may vary substantially between Australia and the US. Accordingly, the adjustment for the change in market weights can only be considered an approximation. Moreover, the Brattle Group Report did not include estimates of equity betas for its comparable entities measured against the US stock market (using the same time period of observations). Accordingly, the impact of the change in market weights alone cannot be identified.

[105] Makholm, J, Note on the Toof Comments Regarding My Cost of Capital Submission to the ORG and ACCC, July 1998.

[106] Its particular concern appeared to be that firms whose returns vary significantly with macroeconomic shocks have a higher weight on the US market than in Australia, so that firms whose returns vary less with macroeconomic shocks (such as utilities) have a lower beta in the US than in Australia: Brattle Group Report, p.23.

[107] Consistent with this, the weighted average of the March 2002 AGSM equity beta for the gold, other metals and diversified resources sectors on the Australian stock exchange was 1.32.

In addition, the impact of weights of the various market sectors is only one of the factors that may cause the beta for the same project to vary depending upon the country in which it is situated. Another factor is the sensitivity of asset prices in any market to macroeconomic shocks within that particular market, which will depend upon a number of matters, such as institutional factors and government policies. Accordingly, it is considered that these estimates should remain a secondary source of information, with primary regard to be had to evidence from the Australian market.

One other statement made by the Brattle Group deserves comment. It argued that the 'Australian market as a whole is less risky than the US market'.[108] While no empirical evidence was advanced to support this view, such a belief would imply that the equity premium in Australia is lower than that in the US, given that the equity premium is a reward for bearing risk. However, the equity premium that commonly is used by the ACCC of 6 per cent is higher than the equity premium implied by the long term average of equity returns in the US of 5.6 per cent.[109]

[108] Brattle Group Report, p.23.

[109] Fama, E. and K. French, 2002, 'The Equity Premium', *The Journal of Finance*, Vol LVII, no. 2, p.641, table 1. This estimate of the premium is an arithmetic average over the period 1872-2000 measured against 6 month securities. Thus, the premium measured against bonds (as is the common assumption in Australia) would be lower (by the historical average of the spread between 6 month bills and bonds).

Appendix A

Company Descriptions

A.1 Australian Companies – Existing Comparators

AGL

Australian Gas Light (AGL) is a holding company with interests in electricity distribution and natural gas transmission and distribution, electricity and gas retailing, electricity generation, and service provision.

It wholly owns AGL Energy Networks, which operates 22,534 km of gas distribution pipes delivering natural gas to a number of energy retailing organisations. Through this business, AGL distributes gas to over 809,000 sites in cities and towns across New South Wales.

AGL's Energy Network's electricity network service area covers 950 square kilometres of north-west Greater Melbourne and includes Melbourne's international airport and major transport routes. Through this business, AGL has around 7,000 km of electricity distribution wires and over 95,000 poles, delivering energy to about 261,000 electricity sites for a number of energy retailers.

AGL also has other interests in Australia, New Zealand and Chile including Agility (an infrastructure management services group), AGL Retail Energy (a retailer, wholesaler and trader of natural gas, electricity and energy-related services), AGL Power Generation, Australian Pipeline Trust, Elgas (LPG distributor), and Natural Gas Corporation Holdings (a New Zealand gas transporters).

AGL's utility activities are subject to price regulation by various state and federal authorities. The table provides various indicators of the relative significance if its network activities. Its international activities are a substantial share of its activities, which includes network activities. It also has investments, which include network activities (including its investment in the Australian Pipeline Trust). Therefore, for illustrative purposes, the table also shows the share of network activities on the assumption that half of its international results are attributable to network activities.

FINANCIAL PERFORMANCE FOR YEAR ENDED 30/06/2001[110]

	Consolidated	Network	Per cent	Network + ½ Investments, International	Per cent
Revenue	$3,540.3m	$738.3m	21	$1817m	51
EBIT (I)	$295.3m	$292.7m	99		
EBIT (II)[111]	$461.4m	$292.7m	63		
Total Assets	$6,003.2m	$2268.5m	38	$3483.9m	58
Long Term Debt	$1,588.9m				
Share Equity	$1.905.9m				
Market Cap	$3,051.1m				

Australian Pipeline Trust

Australian Pipeline Trust (APA) is a company with interests in natural gas transportation activities. The responsible entity for APA is Australian Pipeline Ltd (APL) which comprises three independent directors, including the Chairman, as well as two AGL directors and one Petronas director.

The principal activity of APA is the ownership of gas transmission pipelines located throughout Australia. APA has interests in about 7,000km of pipelines, which transport about 25% of Australia's annual natural gas consumption.

Some of APA's pipelines are regulated by federal and state regulators, although a number of not regulated.

FINANCIAL PERFORMANCE FOR YEAR ENDED 30/06/2001

	APT	Pipelines Transport	Per cent
Operating Revenue	$239.3m	$173.8m	72.63
Operating Income[112]	$57.0m		
Profit/Loss on Ordinary Activities after tax	$33.2m		
Identifiable Assets	$1,391.2m		
Long Term Debt	$735.0m		
Total Equity	$454.1m		
Market Cap	$612.9m		

Envestra (ASX: EVN)

Envestra is an Australian listed company that distributes gas to 875,000 homes, and owns a number of pipelines. Envestra operates in South Australia, Victoria, Queensland, New South Wales and Northern Territory.

Envestra's revenue is almost entirely derived from its regulated gas distribution networks and transmission pipelines. Envestra owns over 17,500km of distribution networks, and 1,110 kilometres of transmission pipelines.

[110] AGL, 2001, Full Financial Results 2001, p.9.
[111] This excludes the loss on international activities reported for the year.
[112] Profit from ordinary activities before income tax expense

Five statutory bodies regulate Envestra, including the South Australian Independent Pricing and Access Regulator, Queensland Competition Authority and the Victorian Office of the Regulator General.

FINANCIAL PERFORMANCE IN BRIEF TO 31/6/2001

	Envestra
Revenue from Operating Activities	$253.9m
EBITDA	$175,8m
Profit/Loss on Ordinary Activities after tax	-$31.9m
Identifiable Assets	$1,704.1m
Long Term Debt (Net of Loan Notes)	$1776.6m
Total Equity	$107.4m
Market Cap	$493.6m

United Energy

United Energy is a company owned by Aquila Inc. (formerly UtilitCorp United) and AMP and public shareholders.

United Energy's core business is the distribution of electricity in Melbourne's south, east and the Mornington Peninsula, and management of approximately 600,000 gas connections in Melbourne's east.

United Energy also has interests in energy retailing, energy trading and risk management, fibre optic networks through Uecomm, and the principal gas distributor and retailer in Western Australia through part ownership of AlintaGas.

Its electricity and gas distribution activities are regulated by respective state authorities.

FINANCIAL PERFORMANCE IN BRIEF TO 31/12/2001[113]

	United Energy	Distribution	Per cent
Revenue	$488.3m	$325.0m	67
EBIT (I)	$87.7m	$142.2m	162
EBIT (II)	$146.0m	$142.2m	97
Total Assets	$2,219.8m	$1,602.7m	72
Long Term Debt	$745.4m		
Total Equity	$913.5m		
Market Cap	$1,005.9m		

A.2 Australian Companies – Future Comparators

AlintaGas Limited (ASX:ALN)

AlintaGas Limited is a company with the business units AlintaGas Networks and AlintaGas Sales

[113] United Energy, 2002, 2001 Financial Report, p.12.

AlintaGas Networks operates and maintains approximately 11,000 km of gas distribution network in Western Australia. AlintaGas Sales buys, markets and sells natural gas to 442,000 industrial, commercial and residential customers in Western Australia.

Tariffs charged by AlintaGas Networks are regulated by the Western Australian Independent Gas Access Regulator.

FINANCIAL PERFORMANCE FOR YEAR ENDED 30/06/2001[114]

	AlintaGas
Operating Revenue	$389.8m
Profit/Loss before tax	$66.3m
Profit/Loss on Ordinary Activities after tax	$42.2m
Total Assets	$816.6m
Long Term Debt	$428.4m
Share Equity	$314.0m
Market Cap	$574.4m

GasNet Australia Trust

GasNet Australia Trust is a trust established to invest in a regulated gas transmission provider, GasNet.

GasNet owns and maintains a 1,930 km high-pressure transmission pipeline networks, which transports natural gas to over 1.4 million homes and 43,000 industrial and commercial users in Victoria. The responsible entity of the Trust is GasNet Australia Limited.

Its transmission activities are subject to price regulation by the ACCC.

FINANCIAL PERFORMANCE IN BRIEF AS AT 31/12/2001

	GasNet
Revenue from Operating Activities	$50.3m
Operating Income	$9.4m
Profit/Loss on Ordinary Activities after tax	$9.4m
Identifiable Assets	$977.0m
Long Term Debt	$150.0m
Total Equity	$269.6m
Market Cap	$273.1m

A.3 USA Companies

AGL Resources Incorporated (NYSE: ATG)

AGL Resources Inc is a holding company whose principal business is natural gas distribution to the southern regions of the United States. AGL Resources is the second-largest natural gas-only distributor in the United States

[114] AlintaGas reports results by segments, but the information is not provided in a way that is easy to interpret.

The company owns and operates the natural gas distribution subsidiaries: Atlanta Gas Light (AGL) Co; Virginia Natural Gas; and Chattanooga Gas Company. Its principal subsidiary is Atlanta Gas Light Co (AGLC), a regulated distributor of natural gas to more than 1.8 million customers in Georgia and Southern Tennessee

AGL Resources is also involved in non-regulated activities (through subsidiaries Georgia Natural Gas Services) including natural gas marketing and other allied services, such as wholesale and retail propane. Other business subsidiaries include Sequent Energy Management (an energy marketing and trading business) and AGL Networks (a telecommunications infrastructure services business).

AGL's gas business is subject to price regulation by the Georgia Public Service Commission.

FINANCIAL PERFORMANCE FOR YEAR ENDED 30/09/2001

	AGL Resources	Distribution Operations	Per cent
Operating Revenue	$1,049m	$914.3m	87
Operating Income	$613.6m		
Net Income	$88.9m		
Identifiable Assets	$3,191.9m		
Long Term Debt	$845.0m		
Total Equity	$671.4m		
Market Cap	$1,100.4m		

Atmos Energy Corporation (NYSE: ATO)

The Atmos Energy Corporation is engaged primarily in the distribution and sale of natural gas through five regulated natural gas utility divisions.

Energas Co. in West Texas (316,000 customers); Western Kentucky Gas Co. (180,000 customers); Atmos Energy Louisiana (359,000 customers); Greeley Gas (204,000 customers); and United Cities Gas (309,000). In addition, Atmos Energy also transports natural gas for other companies through its distribution system. Atmos Energy's customers is comprised of residential (50 per cent), commercial (26 per cent) and industrial (24 per cent).

Atmos Energy also engages in non-regulated activities including: providing energy management and gas marketing services in industrial customers, municipalities and other local distribution companies (Atmos Energy Marketing,); owning or holding an interest in underground storage fields in Kansas, Kentucky and Louisiana (Atmos Pipeline Storage); and providing electrical power generation to meet peak load demand from a municipality regulated by the Tennessee Valley Authority.

Atmos Energy is subject to price regulation by local or state authorities.

FINANCIAL PERFORMANCE FOR YEAR ENDED 30/09/2001

	Atmos Energy	Utilities	Per cent
Operating Revenues	$1,442.3m	$1,380.1m	96
Operating Income	$130.3m	$127.9m	98
Net Income	$56.1m	$49.9m	89
Identifiable Assets	$1,959.4m	$1,732.3m	85
Long Term Debt	$692.4m		
Total Equity	$583.9m		
Market Cap	$881.1m		

Cascade Natural Gas Corporation (NYSE: CGC)

The Cascade Natural Gas Corporation is principally engaged in the distribution of natural gas to customers in the states of Washington and Oregon.

Approximately 82% of the company's gas distribution revenues are derived from customers in the State of Washington. The gas utility distributes natural gas to more than 162,000 residential and 28,000 commercial and industrial customers. Cascade Natural Gas owns nearly 4,700 miles of distribution mains, and also operates some 215 miles of transmission mains, and about 3,200 miles of service lines.

Cascade Natural Gas is subject to price regulation by the Washington Utilities and Transportation Commission and the Oregon Public Utilities and Commission.

FINANCIAL PERFORMANCE FOR YEAR ENDED 30/09/2001

	Cascade
Operating Revenues	$335.8m
Operating Income	$37.0m
Net Income	$17.2m
Identifiable Assets	$364.3m
Long Term Debt	$125.0m
Total Equity	$126.1m
Market Cap	$238.6m

Delta Natural Gas Company Incorporated (NYSE: DGAS)

The Delta Natural Gas Company Incorporated is engaged primary in the distribution, transmission, storage and production of natural gas through facilities located in central and southern eastern Kentucky. Delta Natural Gas Company Incorporated's subsidiary companies include Delta Resources, Delgasco Incorporated and Enpro Incorporated.

Delta Natural Gas Incorporated operates a 2300-mile pipeline system that distributes gas to 40,000 retail customers. The majority (99 per cent) of customers are residential and commercial.

Delta is subject to regulation by Public Service Commission of Kentucky.

FINANCIAL PERFORMANCE FOR YEAR ENDED 30/06/2001

	Delta Corp	Regulated	Per cent
Operating Revenues	$70.8m	$48.9m	69
Operating Income	$8.7m	$4.7m	54
Net Income	$3.6m	$2.8m	77
Identifiable Assets	$124.2m	$120.7m	97
Long Term Debt	$49.3m		
Total Equity	$32.8m		
Market Cap	$48.9m		

EnergySouth Incorporated (NYSE: ENSI)

EnergySouth Inc is a holding company for a family of energy businesses. The company is engaged principally in the distribution of natural gas to over 100,000 residential, commercial and industrial customers in southwest Alabama through its primary subsidiary Mobile Gas Service Corporation. Mobile Gas has more than 2,000 miles of lines to deliver gas customers. Mobile Gas Service also purchases and sells to customers.

Other EnergySouth subsidiaries are engaged in providing gas pipelines transportation, gas storage, gas marketing and other energy related services.

EnergySouth's primary business (Mobile Gas Service) is regulated by the Alabama Public Service commission.

FINANCIAL PERFORMANCE FOR YEAR ENDED 30/09/2001

Year Ended	Energy South	Gas Distribution	Per cent
Operating Revenues	$107.8m	$99.6m	92
Operating Income	$17.6m	$12.2m	69
Net Income	$6.1m		
Identifiable Assets	$218.9m		
Long Term Debt	$90.6m		
Total Equity	$70.1m		
Market Cap	$107.4m		

Laclede Group Incorporated (NYSE: LG)

Laclede Group Inc is a holding company with interests in the distribution, retail and transportation of natural gas.

The majority of the Group's revenue is sourced from its subsidiary Laclede Gas, which distributes natural gas to more than 620,000 customers in eastern Missouri, of which 67 per cent of revenue is derived from residential customers, 27 per cent from commercial and industrial, 2 per cent from transportation and 4 per cent from other customers.

The Group also operates underground natural gas storage fields and transports and stores propane. Other operations include insurance, gas marketing and real estate development.

Laclede Gas is subject to price regulation by the Missouri Public Services Commission.

FINANCIAL PERFORMANCE FOR YEAR ENDED 30/09/2001

	Laclede Group	Gas Utility	Per cent
Operating Revenue	$1,002.1m	$929.5 m	93
Operating Income	$929.9m	$858.4m	92
Net Income	$30.5m		
Identifiable Assets	$975.9m		
Long Term Debt	$284.5m		
Total Equity	$289.7m		
Market Cap	$453.1m		

Nicor Incorporated (NYSE: GAS)

Nicor Inc is a holding company whose principal subsidiaries are Northern Illinois Gas Company (Nicor Gas), one of the nation's largest distributors of natural gas, and Tropical Shipping, a transporter of containerised freight in the Caribbean.

Nicor Gas is primary engaged in distributing natural gas to more than two million customers in northern Illinois, excluding the City of Chicago. 42.5 per cent of total gas distributed was delivered to residential customers, 25.2 per cent to commercial customers and 32.5 per cent to industrial customers.

Nicor also owns several other energy-related ventures, including a 50 per cent interest in Nico Energy, a retail energy marketing joint venture.

Nicor Gas is subject to price regulation by the Illinois Commerce Commission.

FINANCIAL PERFORMANCE FOR YEAR ENDED 31/12/2001

	Nicor Inc	Gas Distribution	Per cent
Operating Revenue	$2,544.1m	$2,120.8m	83
Operating Income	$243.5m	$223.7m	92
Net Income	$143.7m		
Identifiable Assets	$2,574.8m		
Long Term Debt	$446.4m		
Total Equity	$733.7m		
Market Cap	$1,848.7m		

Northwest Natural Gas Company Incorporated (NYSE: NWN)

Northwest Natural Gas Company Inc is principally engaged in the distribution of natural gas in Oregon and in southwest Washington State.

The company services 523,400 customers, of which 84 per cent of revenues are derived for residential and commercial customers, 11 per cent from industrial and 5 per cent from transportation and other.

Northwest Natural is also engaged in providing natural gas storage facilities, solar electricity generation and has two subsidiaries: NNG Financial Corp and Northwest Energy Company.

The Northwest Natural Gas Company is subject to price regulation by the Oregon Public Utility Commission and the Washington Utilities and Transportation Commission.

FINANCIAL PERFORMANCE FOR YEAR ENDED 30/12/2001

	NWN Gas	Utility	Per cent
Operating Revenue	$650.3m	$639.6m[115]	98
Operating Income	$110.2m	$106.4m	97
Net Income	$50.2m	$47.3m	94
Identifiable Assets	$1,435.0m	$1,391.2m	97
Long Term Debt	$378.4m		
Total Equity	$502.2m		
Market Cap	$643.3m		

Peoples Energy Corporation (NYSE: PGL)

Peoples Energy Corp is a holding company of utility subsidiaries and other energy related subsidiaries. Wholly-owned subsidiaries of People Energy Corp include The Peoples Gas Light and Coke Company (Peoples Gas) and North Shore Gas Company.

The company's core business is the distribution of natural gas. Its two regulated subsidiaries (Peoples Gas Light and Coke, and North Shore Gas) purchase, distribute, sell and transport natural gas to approximately one million retail customers through a 6,000 mile wide distribution system servicing the City of Chicago and northeastern Illinois.

Its non-utilities subsidiaries market natural gas and electricity to commercial and industrial users, and develop and operate independent power plants through partnerships with Dominion Resources and Exelon. Other services include energy management, district heating and cooling, and developing fuelling stations for natural gas vehicles

Peoples Gas and North Shore Gas are subject to price regulation by the Illinois Commerce Commission.

FINANCIAL PERFORMANCE FOR YEAR ENDED 30/9/2001

	Peoples Energy Corp	PGL&C	Per cent	NSG	Per cent
Operating Revenue	$2,270.2m	$1,569.9m	69	$274.5m	12
Operating Income	$162.0m	$151.3m	93	$28.7m	18
Net Income	$97.0m	$75.3m	78	$14.6m	15
Identifiable Assets	$ 2,994.1m	$2,039.2m	68	$273.0m	9
Long Term Debt	$644.3m	$250m	39	$69.3m	11
Total Equity	$805.5m	$620.6m	77	$100.7m	13
Market Cap	$1,407.5m				

[115] Operating Revenues have not been reported however the utility segment reported 98.36% of net operating revenues and this have been used as a proxy.

Piedmont Natural Gas Company Incorporated (NYSE: PNY)

Piedmont Natural Gas Company Inc is primarily engaged in the distribution of natural gas. Operations of the natural gas distribution business are conducted by the parent company and two wholly owned subsidiaries: Piedmont Intrastate Pipeline Company and Piedmont Interstate Pipeline Company.

Piedmont services 710,000 residential, commercial and industrial customers in North Carolina, South Carolina and Tennessee. Forty-seven per cent of revenues were sourced from residential customers, 27 per cent from commercial customers, 12 per cent from industrial customers, 13 per cent from secondary market activity and 1 per cent from other sources.

Piedmont has also invested in a number of non-utility, energy-related businesses; including companies involve din unregulated retail natural gas and propane marketing, interstate and intrastate natural gas storage and transportation. The company also retails residential and commercial gas appliances in Tennessee.

Piedmont Natural Gas is subject to price regulation by the North Carolina Utilities Commission, the Public Service Commission of South Carolina and the Tennessee Regulatory Authority.

FINANCIAL PERFORMANCE FOR YEAR ENDED 31/10/2001

	Piedmont	Gas Distribution	Per cent
Operating Revenue	$1,107.9m	$1,107.9m	100
Operating Income	$94.0 m	$93.9m	100
Net Income	$65.5 m		
Identifiable Assets	$1,393.7m	$1,385.0m	99
Long Term Debt	$509.0m		
Total Equity	$560.4m		
Market Cap	$1,032.3m		

RGC Resources Incorporated (NYSE: RGCO)

RGC Resources Inc provides energy and diversified products and services in Virginia and West Virginia through its operating subsidiaries.

Its subsidiaries Roanoke Gas Company and Bluefield Gas Company carry out the business of retailing and distribution of natural gas. The companies serve approximately 70,000 customers.

Other activities carried out by RGC Resources include selling heating and air-conditioning equipment; other home appliances such as natural gas furnaces and natural gas water heaters; and the provision mapping services

Roanoke Gas Company and Bluefield Gas Company are regulated under price cap arrangements with the Virginia State Corporation Commission and West Virginia Public Service Commission.

FINANCIAL PERFORMANCE FOR YEAR ENDED 30/9/2001

	RGC Resources	Gas Utilities	Per cent
Operating Revenue	$117.4m	$86.2m	73
Operating Income	$6.7m		
Net Income	$2.3m		
Identifiable Assets	$93.3m	$79.8m	85
Long Term Debt	$22.5m		
Total Equity	$30.7m		
Market Cap	$37.4m		

Southwest Gas Corporation (NYSE: SWX)

Southwest Gas Corp is a holding company with interests in natural gas operations and construction services.

Its subsidiary, Southwest Gas Company is responsible for natural gas operations and serves approximately 1.3 million customers in sections of Arizona, Nevada and California. Eighty-three per cent of customers are residential and small commercial, 4 per cent are large commercial and industrial and 13 per cent are transportation. It also owns 2,311 miles of transmission pipeline that supplies the Las Vegas area, and subsidiary Paiute has a transmission pipeline extending from the Idaho-Nevada border to Reno and Lake Tahoe.

Southwest Gas is subject to regulation by the Arizona Corporate Commission, the Public Utilities Commission of Nevada and the California Public Utilities Commission.

FINANCIAL PERFORMANCE FOR YEAR ENDED 30/12/2001

	SWG Corp	SWG	Per cent
Operating Revenue	$1,396.7m	$1,149.9m	82
Operating Income	$134.0m	$125.3m	97
Net Income	$37.2m	$32.6m	94
Identifiable Assets	$2,369.6m	$2,289.1m	97
Long Term Debt	$1,197.0m		
Total Equity	$561.2m		
Market Cap	$726.2m		

Southern Union Company (NYSE: SUG)

The Company's principal line of business is the distribution of natural gas to 1.6 million customers through its operating divisions — Southern Union Gas, Missouri Gas Energy, PG Energy, Atlantic Utilities and New England. Subsidiaries have been established to support and expand natural gas sales and other energy sales and to capitalise on the Company's energy expertise.

Financials for operating segments have not been reported.

FINANCIAL PERFORMANCE FOR YEAR ENDED 30/6/2001

	Southern Union
Operating Revenue	$1,932.8m
Operating Income	$132.9m
Net Income	$57.3m
Identifiable Assets	$2,896.9m
Long Term Debt	$1,329.6m
Total Equity	$721.9m
Market Cap	$1,068.5m

WGL Holdings Incorporated (NYSE: WGL)

WGL Holdings Inc, through its subsidiaries, sells and delivers natural gas and provides a variety of energy related products and services to customers in the metropolitan Washington, D.C., Maryland and Virginia areas and beyond.

The company's core subsidiary, Washington Gas, is involved in the distribution and sale of natural gas to approximately 903,800 customers

The company also offers energy related products and services related to its core business of gas distribution.

Service and rates are regulated by the Public Service Commission of the District of Columbia, the Public Service Commission of Maryland and the State Corporation of Virginia.

FINANCIAL PERFORMANCE YEAR ENDED 30/09/2001

	WGL Holdings	Regulated Utility	Per cent
Operating Revenue	$1,939.5m	$1,446.5m	75
Operating Income	$146.5m	$141.3m	96
Net Income	$82.5m	$89.9m	109
Identifiable Assets	$2,081.1m	$1,954.8m	94
Long Term Debt	$584.4m		
Total Equity	$788.3m		
Market Cap	$1,305.3m		

New Jersey Resources Corporation (NYSE: NJR)

New Jersey Resources Corporation is an energy services holding company for the New Jersey Natural Gas Company (NJNG).

New Jersey Natural Gas distributes natural gas to more than 420,000 residential and commercial customers in mostly suburban central and northern New Jersey. Its 12,000 miles of pipelines handles distribution and transmission, and two LNG plants to supply peak demand. Residential customers provided for 41 per cent of NJNG's revenues, 9 per cent from commercial and other, 3 per cent from firm transportation, 1 per cent from interruptible sales, and 46 per cent from off-system sales.

The holding company's New Jersey Natural Gas subsidiary NJR Energy Services also provides unregulated wholesale natural gas supply, pipelines and storage services.

New Jersey Natural Gas is subject to price regulation by the New Jersey Board of Public Utilities.

FINANCIAL PERFORMANCE FOR YEAR ENDED 30/09/2001

	NJ Resources	NJNG	Per cent
Operating Revenue	$2,048.4m	$1,004.2m	49
Operating Income	$99.8m	$89.3m	89
Net Income	$52.3m	$47.7m	91
Identifiable Assets	$1,192.2m		
Long Term Debt	$353.8m		
Total Equity	$352.1m		
Market Cap	$785.9m		

NiSource Incorporated (NYSE: NI)

NiSource Inc. is an Indiana based energy and utility holding company.

NiSource's regulated operations are conducted under three subsidiaries, Columbia; Northern Indiana Public Service Company (NIPSCO); and Bay State Gas subsidiaries. NiSource's natural gas distribution operations serve more than 3.2 million customers in nine states and operate over 87,379 kilometres (54,612 miles) of pipeline. Columbia, a wholly-owned subsidiary, is the largest business unit and owns five distribution subsidiaries that provide natural gas to approximately 2.1 million residential, commercial and industrial customers in Ohio, Pennsylvania, Virginia, Kentucky and Maryland.

Its subsidiaries are also involved in gas transmission and storage, electric operations, exploration, and production and merchant services.

Rates are regulated by various respective state utility commissions.

FINANCIAL PERFORMANCE FOR YEAR ENDED 31/12/2001

	Ni Source Inc	Gas Trans & Storage	Per cent Trans & Storage	Gas Distribution	Per cent Distribution
Operating Revenue	$9,458.7m	$606.8m	6	$4,241.2m	45
Operating Income	$1,008.9m	$349.0m	35	$380.8m	38
Net Income	$216.2m				
Identifiable Assets	$13,636.2m				
Long Term Debt	$5,780.8m				
Total Equity	$3,469.4m				
Market Cap	$4,782.1m				

Northern Border Partners, L.P. (NYSE: NBP)

Northern Border Partners is publicly-trade limited partnership involved with transporting natural gas imported from Canada to the United States. The company through, a subsidiary limited partnership, owns a 70 per cent general partner interest in Northern Border Pipeline Company and owns the Midwestern Gas Transmission Company.

The interstate natural gas pipelines business segment provides natural gas transmission services in the Midwestern United States. Northern Border Partner owns a 1,214 mile interstate pipeline system that transports gas from the Montana-Saskatchen border to markets in the Midwest. 92 per cent of the firm capacity was contracted to producers and marketers, followed by local distribution companies (5 per cent), interstate pipelines 92 per cent) and end-users (1 per cent).

The company's operations also include natural gas gathering and processing and coal slurry pipeline.

Northern Border Pipeline and Midwestern Gas Transmission transport gas under tariffs regulated by the Federal Energy Regulatory Commission.

FINANCIAL PERFORMANCE FOR YEAR ENDED 31/12/2001

	NBP	Gas Pipelines	Per cent
Operating Revenue	$463.5m	$322.6m	70
Operating Income	$221.0m	$199.8m	90
Net Income	$87.8m		
Identifiable Assets	$2,392.0m		
Long Term Debt	$1,070.8m		
Total Equity	$915.0m		
Market Cap	$1,623.7m		

SEMCO Energy Incorporated (NYSE: SEN)

SEMCO Energy Inc is a diversified energy and infrastructure services company. The company and its subsidiaries operate four business segments: gas distribution, construction services, information technology services and propane, pipelines and storage.

The company's main subsidiary is its gas utility, SEMCO Energy Gas, which distributes natural gas to nearly 270,000 customers in 24 Michigan counties. SEMCO's ENSTAR unit distributes natural gas to nearly 110,000 customers in and around Anchorage, Alaska.

The company's unregulated operations include construction services for pipelines, gas and water mains, and telecommunications projects; propane distribution in Michigan and Wisconsin; pipeline and storage facility operation; and information technology outsourcing. SEMCO is discontinuing its engineering business.

SEMCO's gas distribution activities are regulated by state utility commissions in Michigan and Alaska.

FINANCIAL PERFORMANCE FOR YEAR ENDED 31/12/2001

	SEMCO Inc	Gas Distribution	Per cent
Operating Revenue	$445.8m	$295.4m	66
Operating Income	$44.4m	$50.3m	113
Net Income	($6.4m)		
Identifiable Assets	$863.6m		
Long Term Debt	$339.0m		
Total Equity	$113.8m		
Market Cap	$136.2m		

Sempra Energy (SRE)

Sempra Energy is a holding company for San Diego Gas and Electric Company and the Southern California Gas Company. The Company, through its subsidiaries, purchases, sells, distributes, stores and transports natural gas to areas in San Diego County and Southern California.

Sempra distributes natural gas to some 5.9 million customers and electricity to 1.3 million customers through its utilities.[116]

Unregulated subsidiaries include Sempra Energy International, which serves 2.6 million energy customers (mainly in Latin America), and Sempra Energy Trading, which trades and markets natural gas, power, crude oil, and other commodities in Asia, Europe, and North America.

SEMCO is subject to regulation from a number of state, federal and international regulatory bodies.

FINANCIAL PERFORMANCE FOR YEAR ENDED 31/12/2001

	SEMPRA	SoCalGas	Per cent	SDG&E	Per cent
Operating Revenue	$8,029.0m	$3,716m	46	$1,003m	13
Operating Income	$993.0m				
Net Income	$518.0m	$207m	40	$177m	34
Identifiable Assets	$15,156.0m	$3,762m	25	$5,444m	36
Long Term Debt	$3,436.0m				
Total Equity	$2,692.0m				
Market Cap	$5,019.9m				

Chesapeake Utilities Corporation (NYSE: CPK)

Chesapeake Utilities Corp is a diversified utility company engaged primarily in natural gas distribution and transmission, propane distribution and marketing, and providing advanced information services.

[116] SoCalGas is authorised to earn a rate of return on common equity of 11.6 per cent and a 9.49 per cent return on rate base. These rates remain in effect through 2002 and will continue to be effective until the next periodic review by the CPUC unless interest-rate changes are large enough to trigger an automatic adjustment prior thereto.

Chesapeake's three natural gas distribution divisions serve approximately 42,700 residential, commercial and industrial customers in southern Delaware, Maryland's Eastern Shore and Florida. The Company's natural gas transmission subsidiary, Eastern Shore Natural Gas Company operates a 281-mile interstate pipelines system that transports gas from various points in Pennsylvania to the Company's Delaware and Maryland distribution divisions, as well as to other utilities and industrial customers in Southern Pennsylvania, Delaware and on the Eastern Shore of Maryland.

Chesapeake Utilities' distribution divisions are subject to price regulation by the Delaware, Maryland and Florida Public Service Commissions.

FINANCIAL PERFORMANCE FOR YEAR ENDED 31/12/2001

	Chesapeake Utilities	Gas Dist & Trans	Per cent
Operating Revenue	$330.3m	$108.1m	33
Operating Income	$11.5m		
Net Income	$6.7m		
Identifiable Assets	$210.1m	$153.8m	74
Long Term Debt	$48.4m		
Total Equity	$66.9m		
Market Cap	$107.4m		

NUI Corporation (NYSE: NUI)

NUI Corp is a utility company serving customers in New Jersey and other East Coast states. It is split into three segments Distribution Services, Wholesale Energy Trading and Retail and Business Services.

The distribution services segment distributes natural gas in six states through the company's regulated utility divisions, delivering gas to 380,000 residential and commercial customers.

Non-regulated activities include pipeline operation, natural gas storage, gathering, marketing, exploration and propane distribution.

The company's tariffs are regulated by a number of state utility commissions.

FINANCIAL PERFORMANCE FOR YEAR ENDED 30/09/2001

	NUI Corp	Distribution Services	Per cent
Operating Revenue	$1,134 .0m	$524.2m[117]	46
Operating Income	$67.1m	$55.3m	82
Net Income	$22.7m	NR	
Identifiable Assets	$1,122.0m	$826.4m	74
Long Term Debt	$312.3m		
Total Equity	$289.1m		
Market Cap	$281.0m		

[117] 75% of revenue was generated by utility operations in New Jersey.

A.4 USA Companies – Diversified Energy Companies with Transmission Interests

Duke Energy (NYSE: DUK)

The Duke Energy Company is a diversified energy company with both electricity and gas operations throughout the United States and aborad.

Duke operates five major pipelines in the US. In addition, Duke undertakes franchised (regulated) electricity generation, transmission, distribution and retail; produces, gathers and processes natural gas and liquids; owns and operates merchant electricity generators and undertakes wholesale market trading; and provides engineering, consulting and construction services.

FERC regulated its transmission pipelines, and the Ontario Energy Board (OEB) regulates the prices for Union Gas.

The table below shows the significance of its transmission activities, as well as its franchised electricity business.

FINANCIAL PERFORMANCE FOR YEAR ENDED 31/12/2001[118]

	Duke Energy	Transmission	Per cent	Franchised Electricity	Per cent
Revenue	$59,503.0m	$1,105m	2	$4,746m	8
EBIT	$4,256m	$608m	14	$1,631m	38
Total Assets	$48,375m	$5,027m	10	$12,964m	27
Long Term Debt	$12,321.0m				
Total Equity	$12,923.0m				
Market Cap	$30,505.0m				

El Paso Corporation (NYSE: EP)

El Paso Corp is a company with primary business interests in pipelines, merchant energy, production and field services.

The Pipelines segment provides natural gas through seven wholly owned and eight partially owned interstate transmission systems. It owns or has interest in approximately 60,000 miles of interstate natural gas pipelines in the U.S. and internationally.

El Paso's other major activities are gas and oil exploration and production, and energy commodity trading. Each of its three main activities contributed approximately the same share of earnings before interest and tax (EBIT) in 2001.

Interstate transmission systems are regulated by FERC.

[118] Duke Energy, 2002, *2001 Annual Report*, p.64.

FINANCIAL PERFORMANCE FOR YEAR ENDED 31/12/2001[119]

	ELPASO	Pipelines	Per cent
Operating Revenue	$57,475.0m	$2,748.0m	5
EBIT	$3,900m	$1,372m	34
Identifiable Assets	$48,171.0m	$14, 443.0m	30
Long Term Debt	$13,184.0m		
Total Equity	$9,356.0m		
Market Cap	$23,676.1m		

The Williams Companies Incorporated (NYSE: WMB)

Operations of The Williams Companies, Inc (Williams) are located principally in the United States but the company also has international interests. The company is organized into three industry groups: Energy Marketing & Trading; Gas Pipeline; and Energy Services.

Energy Marketing & Trading buys, sells and transports a broad range of energy products, including power, natural gas, refined products, natural gas liquids, crude oil and more. The unit also provides customers with risk management and other energy related services.

Gas Pipeline is comprised primarily of five interstate natural gas pipelines located throughout the majority of the United States as well as investments in North American natural gas pipeline-related companies. The five Gas Pipeline operating segments have been aggregated for reporting purposes and include Williams Gas Pipelines Central, Kern River Gas Transmission (recently discontinued), Northwest Pipeline, Texas Gas Transmission and Transcontinental Gas Pipe Line.

Energy Services includes five operating segments: Exploration & Production, International, Midstream Gas & Liquids, Petroleum Services and Williams Energy Partners.

Its pipeline activities are subject to price regulation by the Federal Energy Regulatory Commission.

FINANCIAL PERFORMANCE YEAR ENDED 31/12/2001[120]

	Williams Companies	Gas Pipelines	Per cent
Revenue	$11,034.7m	$1,748.8m	17
Operating Income	$2,450.0m	$673.8m	28
Segment Profit	$2,573.7m	$720.1	
Total Assets	$38,906.2m	$9253.0	24
Long Term Debt	$10,620.7m		
Total Equity	$6,044.0m		
Market Cap	$13,155.6m		

[119] El Paso, 2002, *2001 Annual Report*.
[120] The Williams Companies, 2002, SEC Form 10K (for 2001 Financial Year), pp. 75, 132, 133.

A.5 Canadian Companies

B.C. Gas Incorporated

BC Gas Inc. is a shareholder-owned public company whose shares are traded on the Toronto Stock Exchange (BCG).

The Company's natural gas distribution operations are carried out by its subsidiaries BC Gas Utility Ltd and several other small utility operations. BC Gas Utility Ltd. is the largest distributor of natural gas to British Columbia, serving 762,000 customers in more than 100 communities,

BC Gas has other activities, which include non-regulated energy and utility businesses as well as corporate interest and administration charges. The non-regulated businesses include water services and international consulting.

The Company is regulated by the British Columbia Utilities Commission.

FINANCIAL PERFORMANCE FOR BC GAS IN BRIEF TO 31/12/2001 (IN CANADIAN DOLLARS

	Consolidated	Natural Gas Distribution	Per cent
Operating Revenue	$1,666.3m	$1,420.3m	85.2
Operating Income	$295.2m	$234.6m	79.5
Net Income	$91.0m	$67.8m	74.5
Identifiable Assets	$3,705.7m	$2,757.9m	74.4
Market Cap	$1,272.6m		

Enbridge Incorporated (NYSE: ENB)

Enbridge Inc is a Canadian company that transports crude oil and natural gas by pipeline to the U.S., and distributes natural gas. Enbridge conducts its business through a number of business segments: Energy Transportation North; Energy Transportation South; Energy Distribution; International; and Corporate.

Its subsidiary, Enbridge Consumers Gas, is Canada's largest natural gas distribution company, which distributes gas to approximately 1.5 million customers in Ontario, Quebec and New York State. Its 32% interest in Noverco allows access to Quebec and Northeast U.S.; likewise Enbridge Gas New Brunswick allows distribution in New Brunswick.

Energy Transportation North (ETN), covering Canada and the U.S., the world's longest crude oil and liquids pipeline system. Alliance Pipeline and Vector Pipeline represent ENBs' interest in natural gas pipelines. The company is seeking expansion opportunities. Energy Transportation South (ETS) operates in the U.S. states of North Dakota and Toledo, which include pipelines, processing and marketing of natural gas.

Energy Distribution and Energy Transportation activities are subject to regulation by various authorities, including the National Energy Board (NEB), the Federal Energy Regulatory Commission (FERC) and the Ontario Energy Board (OEB). These boards exercise statutory authority over rates and underlying accounting practices, and ratemaking agreements with customers.

FINANCIAL PERFORMANCE FOR ENBRIDGE INC. IN BRIEF TO 31/03/2001[121]

	Enbridge Inc.	ETS	Per cent	Energy Distribution	Per cent
Operating Revenue	$1,081.6m	$316.0m	29.2	$462.4m	42.8
Operating Income	$149.1m	$15.4m	10.3	$55.8m	37.4
Net Income	$113.1m[122]	$14.2m	12.6	$16.3m	14.4
Identifiable Assets	$13,677.4m	$1,544.9m	11.3	$5,351.8m	39.1
Market Cap	$7,068.3m				

Pacific Northern Gas Ltd.

Pacific Northern Gas Ltd. is a subsidiary of Duke Energy and delivers gas to customers in West-Central British Columbia. Its subsidiary Pacific Northern Gas (N.E.) Ltd. delivers gas to customers in the province's northeast.

The former system supplies gas to 23,000 customers, the latter 16,000 customers mostly in the Fort St. John region through its transmission pipelines.

Its operations and tolls are regulated by the British Columbia Utilities Commission.

FINANCIAL PERFORMANCE FOR PACIFIC NORTHERN GAS LTD IN BRIEF TO 31/12/2001 (in Canadian Dollars)

	Consolidated
Operating Revenue	$138.595 m
Operating Income	$55.251 m
Net Income	$5.715 m
Identifiable Assets	$203.247 m
Market Cap	$34.1m

TransCanada

TransCanada is company with interests in natural gas transmission and power generation. It is the largest natural gas pipeline company in Canada. The company is the largest holder of TransCanada Power LP and a general partner of TC Pipelines.

TranCanada operates more than 38,000km of pipelines transporting natural gas in both Canada and the United States. The company transports gas to meet the demands of 2.2 million households.

TransCanada also generates electricity in Canada and the United States and market electricity across Canada and the northern tier of the United States. The company also provides services to manage and support electricity requirements for customers.

TransCanada's Canadian Mainline System is subject to price regulation by the National Energy Board.

[121] All figures in millions of Canadian dollars.

[122] Consolidated Statement of Earnings, Earnings Applicable to Common Shareholders

FINANCIAL PERFORMANCE FOR TRANSCANADA TO 31/12/2001 (in Canadian Dollars)

	Consolidated	Transmission	Per cent	Power	Per cent
Operating Revenue	$5,249m	$3,880m	74	$450m	8.5
Operating Income	$2,135m	$1,901m	89	$67m	3.1
Net Income	$670m	-	-	-	-
Identifiable Assets	$21,391m	$17,269m	81	$2,083m	9.7
Market Cap	9,471m				

A.6 United Kingdom Companies

Lattice Group (LSE:LTA)

Lattice Group is a holding company for a number of infrastructure and technology businesses.

Its main subsidiary is Transco, an owner, operator and developer of the substantial majority of Great Britain's gas transportation system and has 275,000km of national and local transmission and distribution pipelines. Gas is supplied by around 90 companies to consumers across the UK through Transco's integrated gas transportation system.

Transco's services and rates are regulated by the Office of Gas and Electricity Markets.

FINANCIAL PERFORMANCE FOR LATTICE GROUP IN BRIEF FOR 15 MONTHS ENDED 31/03/2002 (ALL FIGURES IN POUND STERLING)

	Lattice Group	Transco	Per cent
Turnover	£3,153m	£2,980m	94.5
Operating Profit	£923m	£844m	91.4
Net Income	£401m	£339m	84.5
Identifiable Assets	£8,011m	£7,540m	94.1
	£6,156.4m		

International Energy Group Ltd (LSE: IEG)

International Energy Group's principal activity is the distribution and transportation of gas to domestic and commercial customers. The company is based in Guernsey, Channel Islands and has interests in the United Kingdom, the Isle of Man and Portugal.

The Group also has property interests based in Guernsey.

Information with regards to the number of customers and the regulatory constraints of the business could not be determined from its Annual Report.

FINANCIAL PERFORMANCE FOR IEG IN BRIEF FOR THE YEAR ENDED 31/12/2001

	IEG Consol	IEG Continuing Operations
Operating Revenue	£49m	£48m
Operating Income	£10m	£8m
Net Income	£10m[123]	
Identifiable Assets	£76m	
Market Cap	£199.1m	

Anglian Water

AWG is a water services and infrastructure management group. AWG provides a range of infrastructure support services to the utility, transport and public sector markets.

[123] Profit for Financial Year

AWG main business is through Anglian Water Services, a provider of water and wastewater services in the UK. Anglian Water serves over five million industrial, commercial and domestic customers.

Other divisions of the group include utility services, governments services, project managements services, developments and commercials services and international services.

FINANCIAL PERFORMANCE FOR AWG IN BRIEF FOR YEAR ENDED 31/03/2002 (ALL FIGURES IN POUND STERLING)

	AWG	UK water and wastewater and utility services	Per cent
Turnover	£1,813.1m	£951.7m	52.4
Operating Profit	£127.6m	-	-
Net Income	-£37.2m	-	-
Identifiable Assets	£5416.0m	-	-
Market Cap	£1,506.3m		

Kelda Group

The Kelda group is a holding company with interests in water utilities.

Its principal subsidiary is Yorkshire Water – one of the ten largest water and sewerage companies in the world. Yorkshire Water provides services to approximately 4.5 million people and 140,000 businesses every day.

Kelda also owns the US water supply business Aquarion - which supplies water to 52 communities in Connecticut, New York, Massachusetts and New Hampshire. Aquarion serves 211,000 homes and businesses, or approximately 677,000 people. Kelda's other interests include a 46% stake in Waste Recycling Group plc.

FINANCIAL PERFORMANCE FOR THE KELDA GROUP IN BRIEF FOR YEAR ENDED 31/3/2002 (ALL FIGURES IN POUND STERLING)

	Kelda Group	UK Regulated	Per cent
Turnover	£799.8m	£559.8	69.9%
Operating Income	£245.0m	-	-
Net Income	£151.3m	-	-
Identifiable Assets	£4,075.3m	-	-
Market Cap	£1,371.5m		

National Grid Group (LSE and NYSE: NGG)

National Grid Group plc is an international networks business.

It key activities are in the regulated electricity industry. National Grid owns and operates the transmission network in England and Wales, and transmission and distribution networks in the north-eastern United States. The Group is the has the largest transmission and distribution network in the New England/New York market, serving 3.2 million customers in Massachusetts, Rhode Island, New Hampshire and upstate New York.

Electricity interests include operating and developing transmission interconnectors in the UK and US, Europe and Australia and joint venture transmission networks in Argentina and Zambia. National Grid also operates a gas distribution network, serving over 500,000 New York customers.

Other activities include the telecoms market with interest including wholly-owned infrastructure businesses in the UK and US.

Its distribution and transmission activities are subject to regulation by various authorities.

FINANCIAL PERFORMANCE FOR NATIONAL GRID IN BRIEF FOR YEAR ENDED 31/3/2002 (ALL FIGURES IN POUND STERLING)

	National Grid	Transmission and Distribution	Per cent
Turnover	£4,660.3m	£3,128.5	67.1%
Operating Income	-£461.7m	-	-
Net Income	-£487.0m	-	-
Identifiable Assets	£17,416.0m	-	-
Market Cap	£8,076.2m		

Pennon Group

Pennon Group Plc is a company that operates and invests primarily in the areas of water and sewerage services and waste management.

Its two main subsidiaries are South West Water Limited and Viridor Waste Limited. South West Water Limited holds the water and sewerage appointments for Devon, Cornwall and parts of Dorset and Somerset, while Viridor Waste Limited is one of the largest waste treatment and disposal businesses in the UK.

Water supply services are subject to economic regulation by the Office of Water Services.

FINANCIAL PERFORMANCE FOR PENNON GROUP IN BRIEF FOR YEAR ENDED 31/3/2002 (ALL FIGURES IN POUND STERLING)

	Pennon Group	Water and sewerage	Per cent
Turnover	£374.8m	£260.4m	69.4
Operating Income	£121.3m	-	-
Net Income	£74.1m	-	-
Identifiable Assets	£2,299.5m	-	-
Market Cap	£820.3m		

Scottish Power

Scottish Power is a diversified utilities company with interests in electricity, gas, water and wastewater in the United Kingdom and the United States.

Its principal activities are electivity generation, transmission, distribution, trading and supply in the United States and the United Kingdom. Its generation portfolio consists of 4,000 MW in Scotland and almost 1,000 MW in England & Wales and includes coal, gas, hydro and renewable sources. The company represents some 7 per cent of the UK generation market. Its US interests include the ownership of PacifiCorp, which is a large electricity distributor in Oregon.

In the United Kingdom the, Scottish Power also supplies gas whilst the US activities include coal mining.

The table below shows the proportionate share of Scottish Power's UK network activities (including power system and its water business), and also the proportionate share of its PacifiCorp business, whose main activity is electricity distribution.

FINANCIAL PERFORMANCE FOR SCOTTISH POWER IN BRIEF FOR YEAR ENDED 31/3/2002 (ALL FIGURES IN POUND STERLING)

	Scottish Power	Network Activities	Per cent	PacifiCorp	Per cent
Turnover	£6,337.2m	£1,077.2m	17	£3,153.8m	50
Operating Profit	£776.6m	£571.2m	74	£225.2m	30
Total Assets	£16,315.4m	£5226.5m	32	£8878.9m	54
Market Cap	£8,440.85m				

Scottish and Southern Energy plc

Scottish and Southern Energy is a large energy group in Britain with interests in electricity generation, distribution, energy services, hydro electricity, and gas retail. It owns three principal subsidiaries: Southern Electric, Scottish Hydro-electric and SWALEC.

Scottish and Southern Energy runs Great Britain's largest electricity distribution business with over 120,000 kms of underground cable and overhead lines, delivering power to nearly 30 per cent of the Great Britains landmass, including over 120 islands serving 3.3 million customers.

SSE's also operates an electricity transmission business in the north of Scotland and operates the high voltage interconnection with Scottish Power over which energy is traded for onward transmission to the energy markets in England and Wales.

FINANCIAL PERFORMANCE FOR SCOTTISH AND SOUTHERN ENERGY IN BRIEF FOR YEAR ENDED 31/3/2002 (ALL FIGURES IN POUND STERLING)

	SSE	Power Systems	Per cent	Generation and Supply	Per cent
Turnover	£4,056.5m	-	-	-	-
Operating Income	£666.5m	£304.1m	45.6	£292.1m	43.8
Net Income	£431.1m	-	-	-	-
Identifiable Assets	£4,737.9m	-	-	-	-
Market Cap	£5,335.6m				

Severn Trent plc.

Servern Trent is a holding company with interests in UK water services.

It's principal subsidiary is Severn Trent Water, a regulated water business that provide water and wastewater services to over three million households and businesses in England and Wales.

Its other activities include waste services and treatment, contaminated land services, systems and IT service, and engineering, property and insurance services.

Its water business is subject to economic regulation by the Officer of Water Services.

FINANCIAL PERFORMANCE FOR SEVERN TRENT IN BRIEF FOR YEAR ENDED 31/3/2002 (ALL FIGURES IN POUNDS STERLING)

	Severn Trent	Water and Sewage	Per cent
Turnover	£1,799.1m	£899.9m	50.0
Operating Income	£357.9m		
Net Income	£157.9m		
Identifiable Assets	£5,931.4m		
Market Cap	£2,379.7		

United Utilities

United Utilities is a utilities business with interests in water, electricity and telecommunications in the UK as well as internationally.

United Utilities operate the water and wastewater treatment network across the region and distribute electricity to more than 2 million customers in the UK's North West. United Utilities Service Delivery owns and operates electricity distribution and water networks in the north west of England. It manages and maintains more than 600 wastewater treatment works and over 100 water treatment works, together with 80,000 kilometres of pipes and sewers. It also maintains almost 60,000 kilometres of electricity cables and nearly 32,000 electricity sub-stations.

Other activities include managing water and wastewater treatment assets in the UK and internationally, managing and operating renewable energy generation projects, provide multi-utility connection services across the UK and telecommunications services.

FINANCIAL PERFORMANCE FOR UNITED UTILITIES IN BRIEF FOR YEAR ENDED 31/3/2002 (ALL FIGURES IN POUNDS STERLING)

	United Utilities	Licensed Utility Operations	Per cent
Turnover	£1,876.4m	£1,208.9m	64.4
Operating Income	£538.8m		
Net Income	£266.6m		
Identifiable Assets	£7,684.7m		
Market Cap	£3,383.75		

Viridian Group Plc

The Viridian Group is a diverse holding company for energy services based in Northern Ireland.

Its principal subsidiary is Northern Ireland Electricity, a retailer, distributor and transmitter of electricity customers across the domestic, commercial and industrial market segments.

Its other activities include telecommunications services, electricity and gas supply, engineering services, IT services and infrastructure construction.

FINANCIAL PERFORMANCE FOR VIRIDIAN PLC IN BRIEF FOR YEAR ENDED 31/3/2002 (ALL FIGURES IN POUND STERLING)

	Viridian	Regulated	Per cent
Turnover	£732.3m	£522.4 m	71.3
Operating Income	£86.2m	-	-
Net Income	£48.3m	-	-
Identifiable Assets	£1420.3m	-	-
Market Cap	£594.45m		

Appendix B

Beta Estimates, Gearing and Tax Assumptions

Table B.1

EQUITY BETA ESTIMATES, GEARING, AND TAX RATES

Company	OLS Equity Beta	Thin Trading Equity Beta	Average gearing	Average Tax rate
Proxy Group – Australia				
AGL	0.47	0.23	34%	34%
Australian Pipeline Trust [124]	0.44	0.93	55%	32%
Envestra	0.65	0.26	75%	34%
United Energy	0.39	-0.48	47%	34%
Proxy Group – USA				
AGL Resources Inc	0.27	0.32	44%	23%
Atmos Energy Inc	-0.17	-0.03	44%	3%
Cascade Natural Gas Corp	-0.02	-0.15	40%	37%
Chesapeake Utilities Corp	-0.01	-0.09	41%	34%
Delta Natural Gas Co. Inc	-0.01	0.04	59%	32%
EnergySouth Inc	0.08	-0.02	38%	35%
Laclede Group Inc	0.04	0.05	44%	10%
New Jersey Resources Corp	0.24	0.12	35%	34%
Ni Source Inc	0.14	0.02	54%	35%
Nicor Inc	0.05	-0.13	28%	33%
Northern Borders Partners [125]	0.05	n/a	51%	30% *
Northwest Natural Gas Co. Inc	0.07	0.03	42%	35%
NUI Corp	0.28	0.49	55%	35%
Peoples Energy Corp	-0.01	-0.11	38%	28%
Piedmont Natural Gas Co. Inc	0.19	-0.03	32%	35%
RGC Resources Inc	0.13	0.24	48%	34%
SEMCO Energy Inc	0.26	0.37	65%	30% *
Sempra Energy	-0.04	-0.01	41%	21%
Southern Union	0.30	-0.08	48%	21%

[124] The test statistic for thin trading provided by the AGSM Risk Management Service indicated that thin trading was likely to be a concern for the Australian Pipeline Trust, but not the other firms. Accordingly, the thin trading beta is used in all calculations for the Australian Pipeline Trust, and the OLS beta is used for the other firms.

[125] The Ibbotson service does not provide an equity beta estimate for Northern Borders Pipeline, even though a full five years of observations are available. The equity beta estimate reported here was obtained from Bloomberg (using five years of monthly data).

Company	OLS Equity Beta	Thin Trading Equity Beta	Average gearing	Average Tax rate
Southwest Gas Corp	0.54	0.82	57%	18%
WGL Holdings Inc	0.23	0.01	35%	35%
Other Companies – USA				
Duke Energy	-0.06	0.00	32%	35%
El Paso Corp	0.67	0.09	45%	29%
The Williams Companies Inc	0.69	0.41	47%	5%
Proxy Group – Canada				
BC Gas Inc	0.15	n/a	62%	26%*
Enbridge Inc	-0.17	n/a	51%	26%*
Pacific Northern Gas Ltd	0.39	n/a	67%	26%*
TransCanada	-0.16	n/a	60%	26%*
Proxy Group – UK				
Anglian Water	0.01	n/a	52%	30%*
International Energy Group Ltd	0.18	n/a	8%	30%*
Kelda Group	0.01	n/a	42%	30%*
Lattice Group plc	-0.13	n/a	51%	30%*
National Grid Group	0.53	n/a	33%	30%*
Pennon Group	-0.19	n/a	42%	30%*
Scottish and Southern Energy	0.07	n/a	17%	30%*
Scottish Power	0.28	n/a	35%	30%*
Severn Trent	-0.19	n/a	46%	30%*
United Utilities	0.06	n/a	40%	30%*
Viridian Group	0.17	n/a	29%	30%*

* The average statutory tax rate over the period has been used in the absence of company specific information on marginal and average tax rates.

Table B.2

ASSET BETAS AND RE-LEVERED EQUITY BETAS (60 PER CENT DEBT-TO-ASSETS)

Company	Asset Betas				Equity Betas (60% Debt-to-Assets)			
	Levering – Tax Term Excluded		Levering – Tax Term Included		Levering – Tax Term Excluded		Levering – Tax Term Included	
	Debt Beta = 0	Debt Beta = 0.15	Debt Beta = 0	Debt Beta = 0.15	Debt Beta = 0	Debt Beta = 0.15	Debt Beta = 0	Debt Beta = 0.15
Proxy Group – Australia								
AGL	0.31	0.36	0.33	0.37	0.77	0.68	0.75	0.66
Australian Pipeline Trust	0.42	0.50	0.46	0.53	1.04	1.03	1.04	1.02
Envestra	0.16	0.27	0.18	0.29	0.40	0.46	0.42	0.47

Company	Asset Betas				Equity Betas (60% Debt-to-Assets)			
	Levering – Tax Term Excluded		Levering – Tax Term Included		Levering – Tax Term Excluded		Levering – Tax Term Included	
	Debt Beta = 0	Debt Beta = 0.15	Debt Beta = 0	Debt Beta = 0.15	Debt Beta = 0	Debt Beta = 0.15	Debt Beta = 0	Debt Beta = 0.15
United Energy	0.21	0.28	0.23	0.29	0.52	0.47	0.52	0.47
Proxy Group – USA								
AGL Resources Inc	0.15	0.22	0.17	0.22	0.38	0.32	0.38	0.32
Atmos Energy Inc	-0.09	-0.03	-0.10	-0.03	-0.24	-0.30	-0.22	-0.26
Cascade Natural Gas Corp	-0.01	0.05	-0.01	0.03	-0.03	-0.11	-0.03	-0.12
Chesapeake Utilities Corp	-0.01	0.06	-0.01	0.04	-0.01	-0.09	-0.02	-0.10
Delta Natural Gas Co. Inc	0.00	0.08	-0.01	0.07	-0.01	-0.01	-0.01	-0.03
EnergySouth Inc	0.05	0.11	0.06	0.10	0.12	0.04	0.13	0.04
Laclede Group Inc	0.02	0.09	0.02	0.09	0.06	0.00	0.05	0.00
New Jersey Resources Corp	0.16	0.21	0.18	0.22	0.39	0.30	0.40	0.30
Ni Source Inc	0.06	0.15	0.08	0.14	0.16	0.14	0.18	0.14
Nicor Inc	0.04	0.08	0.04	0.07	0.09	-0.03	0.09	-0.03
Northern Borders Partners	0.02	0.10	0.03	0.09	0.06	0.03	0.07	0.02
Northwest Natural Gas Co. Inc	0.04	0.10	0.05	0.10	0.10	0.03	0.11	0.03
NUI Corp	0.12	0.21	0.15	0.22	0.31	0.29	0.35	0.31
Peoples Energy Corp	-0.01	0.05	-0.01	0.04	-0.02	-0.10	-0.02	-0.10
Piedmont Natural Gas Co. Inc	0.13	0.18	0.15	0.18	0.32	0.22	0.33	0.22
RGC Resources Inc	0.07	0.14	0.08	0.14	0.17	0.12	0.18	0.12
SEMCO Energy Inc	0.09	0.19	0.11	0.20	0.23	0.25	0.26	0.26
Sempra Energy	-0.02	0.04	-0.03	0.03	-0.06	-0.13	-0.06	-0.13
Southern Union	0.16	0.23	0.17	0.24	0.39	0.34	0.39	0.35
Southwest Gas Corp	0.23	0.32	0.26	0.34	0.59	0.57	0.60	0.58
WGL Holdings Inc	0.15	0.20	0.17	0.21	0.37	0.28	0.39	0.28
Other Companies – USA								
Duke Energy	-0.04	0.01	-0.05	-0.01	-0.10	-0.21	-0.10	-0.22
El Paso Corp	0.37	0.44	0.42	0.48	0.92	0.87	0.96	0.90
The Williams Companies Inc	0.36	0.44	0.37	0.44	0.91	0.86	0.85	0.82
Proxy Group – Canada								
BC Gas Inc	0.06	0.15	0.07	0.15	0.14	0.15	0.16	0.15
Enbridge Inc	-0.08	-0.01	-0.10	-0.03	-0.21	-0.24	-0.22	-0.26
Pacific Northern Gas Ltd	0.13	0.23	0.16	0.25	0.32	0.35	0.35	0.37
TransCanada	-0.06	0.03	-0.08	0.00	-0.16	-0.16	-0.17	-0.19
Proxy Group – UK								
Anglian Water	0.00	0.08	0.01	0.07	0.01	-0.02	0.01	-0.03

Company	Asset Betas				Equity Betas (60% Debt-to-Assets)			
	Levering – Tax Term Excluded		Levering – Tax Term Included		Levering – Tax Term Excluded		Levering – Tax Term Included	
	Debt Beta = 0	Debt Beta = 0.15	Debt Beta = 0	Debt Beta = 0.15	Debt Beta = 0	Debt Beta = 0.15	Debt Beta = 0	Debt Beta = 0.15
International Energy Group Ltd	0.17	0.18	0.17	0.18	0.41	0.22	0.39	0.21
Kelda Group	0.01	0.07	0.01	0.06	0.01	-0.05	0.02	-0.06
Lattice Group plc	-0.06	0.01	-0.08	-0.01	-0.16	-0.19	-0.17	-0.22
National Grid Group	0.35	0.40	0.39	0.43	0.89	0.79	0.90	0.79
Pennon Group	-0.11	-0.05	-0.13	-0.08	-0.28	-0.35	-0.29	-0.37
Scottish and Southern Energy	0.06	0.08	0.06	0.08	0.14	-0.02	0.14	-0.01
Scottish Power	0.18	0.24	0.20	0.24	0.46	0.36	0.46	0.37
Severn Trent	-0.10	-0.03	-0.12	-0.06	-0.26	-0.31	-0.27	-0.33
United Utilities	0.04	0.10	0.04	0.09	0.09	0.02	0.09	0.01
Viridian Group	0.12	0.16	0.13	0.17	0.30	0.19	0.30	0.19
Average – All Observations[126]	**0.09**	**0.16**	**0.10**	**0.15**	**0.22**	**0.16**	**0.23**	**0.16**
Average – Negative Betas Excluded	**0.14**	**0.21**	**0.16**	**0.22**	**0.36**	**0.30**	**0.36**	**0.30**
Minimum	**-0.11**	**-0.05**	**-0.13**	**-0.08**	**-0.28**	**-0.35**	**-0.29**	**-0.37**
Maximum	**0.42**	**0.50**	**0.46**	**0.53**	**1.04**	**1.03**	**1.04**	**1.02**

[126] These sample statistics use all of the beta observation, including the diversified US pipeline businesses.