



The Cost Of Capital for the National Broadband Network

A report for Optus

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Executive Summary

Optus has asked the Competition Economists Group (CEG) to estimate the weighted average cost of capital (WACC) that should be used to estimate the level of costs and regulated prices for wholesale access to the fibre to the node (FTTN) network. We have also been asked to provide a critique of Telstra's public statements on this matter.

We use the capital asset pricing model (CAPM) to estimate the FTTN nominal post tax vanilla WACC and arrive at an estimate of 10.47%.¹ Our estimate is consistent with the cost of capital estimated for the current ULLS service that the FTTN would be replacing. This is materially lower than Telstra's claimed nominal post tax cost of capital which is reported to be either 'north of 18 percent' or between 18 to 19 percent.²

These two estimates are not directly comparable. CEG's estimate of the WACC is the *expected* return required by investors in the FTTN. That is, it is the probability weighted average return that investors must expect to receive before making an investment in the FTTN. By contrast, from Telstra's public statements the 18 to 19 percent figure is not what Telstra needs to *expect* to receive but rather what Telstra hopes to achieve in the absence of adverse events for the FTTN – such as the potential costs of stranding due to the development of new technologies such as 'Super 3G'.

In other words, Telstra appears to be arguing that any regulatory cost modelling should adopt a required return on investment that is above the truly required return on investment in order to take account of the downside risks to future demand posed by new technologies.

As we demonstrate in section 2.2, proper application of finance theory requires that such issues be dealt with by factoring them into accurate forecasts of cash-flows - not by adjusting the discount rate applied to those cash-flows. For example, if Telstra's best estimate is that there is a 10% probability that FTTN sales in 5 years time will be decimated by a new technology then this should be factored into probability weighted demand forecast. This will have the effect of lowering the *expected* present value of future revenues and will then justify a higher price path for the FTTN. It is not consistent with sound finance theory and is at best inexact and non-transparent to attempt to deal with this issue by instead:

¹ This is based on a cost of equity of 11.08%, an assumed debt gearing (debt to asset ratio) of 40% and an assumed cost of debt of 9.55%. This debt premium is based on an assumed AA debt rating and prevailing yields on AA instruments on 20 June 2008. The cost of equity is based on an assumed CAPM asset beta of 0.45 (equity beta of 0.75 at 40% gearing), a risk-free rate of 6.59% and a market risk premium of 6%.

² <http://www.australianit.news.com.au/story/0,24897,23425146-5013641,00.html>



- overestimating future demand (by underestimating the probable impact of new technologies on future sales); and
- overestimating the WACC by an offsetting amount.

As we demonstrate in section 2.2, it is always, as a matter of mathematics, possible to correct for an error in the forecast cash-flows by imposing an opposite error in the discount rate used. However, the only way to accurately estimate the required adjustment to the discount rate is to first estimate the error in the cash-flows. In which case, it will be more accurate and transparent to simply fix the error at its source. Adjusting the WACC does not avoid the need to accurately model cash-flows, it simply makes the underlying cash-flow assumptions less transparent.

It is possible to ‘back-solve’ from Telstra’s claimed cost of capital an implied probability of stranding of the FTTN. That is, it is possible to attempt to make transparent Telstra’s assumptions regarding the risk of stranding. This can be done by comparing the CEG and Telstra estimates of the WACC and asking what probable costs of stranding are implied by the difference. The results of this comparison are summarised in the below table below.

Telstra’s Implied Probability of Stranding

% of future cash-flows stranded	Year at which stranding occurs		
	T=0	T=5	T=9
100%	45.0%	69.2%	99.7%
50%	60.1%	92.3%	Impossible
25%	90.1%	Impossible	Impossible

Source: CEG analysis described in section 4 below

From the perspective of the FTTN owner, the worst possible asset stranding event would be one where the asset becomes worthless immediately after its construction. That is, not only is the entire value of the asset wiped out but it is wiped out so early in the asset’s life that the owner had no ability to recover any of its investment. This scenario is even less favourable if we assume that there is zero upside to the prospect of avoiding stranding, ie, if we assume that Telstra had no prospect of earning more than its proposed cost of capital in the event that it wasn’t stranded.

This is clearly the worst imaginable stranding event and, therefore, should have the lowest possible probability required to justify Telstra’s proposed return. Nonetheless, the probability of such an event must still be 45%.

It is important to be clear what this means. We are proposing two possible states of the world. The first is that there is “no stranding” and Telstra earns its proposed WACC. The second is that there is “stranding” and Telstra earns nothing (has zero net cash-



flows from day one). In order to justify Telstra's proposed WACC there must be a 45% probability stranding of this type. That is, in order to justify Telstra earning twice the CAPM rate in the absence of stranding there must be 45% probability that the asset will be worthless on the first day that it is available for use.

If we adopt more realistic scenarios then the implied probability of stranding increases. For example, if we continue to assume that 100% of the unrecovered value of the asset will be stranded but restrict the stranding event to only occur five years after the asset begins its useful life, the probability of stranding rises to 69.2%. That is, the cost of capital proposed by Telstra implies a 69.1% probability that the asset will be worth nothing in 5 years. If we assume that the magnitude of the stranding event at 5 years will only result in 75% of the future cash-flows being lost then the implied probability of stranding rises to 92.3%.

The reason that the required probability of stranding approaches 100% at 9 years (the last column in the above table) is that after 9.1 years of receiving Telstra's proposed return Telstra would have fully recovered the cost of the FTTN – this is despite assuming that the intention is that the FTTN is depreciated over 30 years. Beyond that date there is no risk of stranding that can justify Telstra's proposed returns because Telstra would already have recovered its entire investment before that date. (We note that these high probabilities of standing are not sensitive to the assumptions used.)

If these very high probabilities of stranding are accurate it raises the obvious question of whether it is efficient to invest in the FTTN in the first place.

We are advised by Optus that they do not believe that the above estimates of the probability of stranding are credible. In their view, stranding of the FTTN is highly unlikely because even if wireless technologies fell in cost and increased in speed they would still need to make use of the FTTN for backhaul (ie, wireless technologies would need to make use of the FTTN fibre to carry data to a point close enough to customers to allow wireless connection at fast speeds). That is, wireless technologies would potentially make obsolete the remaining copper connecting the FTTN to the household, but not the FTTN itself.

Moreover, even if a wireless technology was able to be constructed to bypass the entire FTTN and could be built at a lower cost than the depreciated value of the FTTN it is unlikely that such a network would be built if the FTTN was already in place. This is because, once in place, the FTTN's marginal cost is effectively close to zero. A new entrant will only rationally enter the market if they believe that they can make a profit competing against an incumbent with zero marginal costs. That is, there is a substantial first mover advantage to building a ubiquitous FTTN that would provide protection against any threats from future stranding.

In our view it will likely be inefficient and inequitable for customers to pay Telstra its proposed WACC. One way to avoid paying Telstra its claimed premium is to select



another tenderer. However, it may be that Telstra is viewed by the Government as the preferred tenderer on other grounds.

If the Government and Telstra could not agree on fair compensation for the risk of stranding then the best course for the Government would be to simply indemnify Telstra for the risk. The Government could provide Telstra with an assurance that in the event that the investment (appropriately identified and quarantined from Telstra's other assets) 'failed' the Government would compensate Telstra and take over the asset. We provide a technical description of how such a mechanism would work at section 5.

Based on advice from Optus and our own analysis, this assurance would likely come at little cost to the Commonwealth because of the low risk of stranding of the nations monopoly fixed line network. If the Government took a different view and wanted to pass off this risk to others it could do so. Probably the cleanest way of doing so would be to provide a commitment by the Government to impose a levy on the industry to fund any costs incurred by the Government. This approach would be to all intents and purposes the same as Telstra's proposed (implicit) levy on the industry embedded in its inflated WACC estimate. The primary difference would be that the Government's levy would:

- only come into existence if the FTTN actually did fail; and
- would only recover the actual costs of failure (rather than Telstra's inflated estimate of the 'probable' costs).



1. Introduction

1. Optus has asked the Competition Economists Group (CEG) to advise on the appropriate weighted average cost of capital (WACC) required to compensate investors in an Australian fibre to the node (FTTN) asset. Optus also asked CEG to provide an appraisal of Telstra's public claims that it would require an 18% to 19% after tax return for any such investment.

2. The remainder of this report is structured as follows:
 - Section 2 explains the use of the capital asset pricing model (CAPM) to determine *expected* returns required by investors. We also explain how this differs from the concept of 'hurdle' rates of return that Telstra has been quoting;
 - Section 3 provides our best estimate of the CAPM expected rate of return required by investors. We also separately examine the need to factor in costs associated with future potential technological obsolescence;
 - Section 4 provides an appraisal of the reasonableness of Telstra's public proposed return on capital. In doing so we establish the probability of technological obsolescence implied by Telstra's WACC; and
 - Section 5 examines mechanisms by which the FTTN owner could be protected against uncertainty in future levels of demand.



2. CAPM rates of return vs hurdle rates of return

2.1. CAPM determines the *expected* return required by investors

3. The building block of modern finance theory is the capital asset pricing model (CAPM). The primary insight of the CAPM is that uncertainty in the returns of an asset do not necessarily imply that the asset is 'high risk' and requires a high rate of return. Rather, it is the contribution of an asset to the overall uncertainty of the investor's portfolio that determines its risk.
4. An asset may have highly variable returns but still make little or no contribution to the variability of the investor's portfolio. For an investment to be risky it must have returns that are correlated with returns on other assets or with the state of the economy more generally. Variations in returns that are purely random (ie, uncorrelated with events in the wider economy) can be diversified away by holding a large portfolio of assets. If assets have uncorrelated returns then holding a large number of those assets will result in a very low risk (low variability of returns) portfolio – even if every asset in that portfolio has highly uncertain returns.
5. This can be illustrated by comparing the risk associated with holding a portfolio of one \$1,000 bet on a toss of a coin versus a portfolio with 1,000 \$1 bets on different coin tosses. In the first scenario the investor's portfolio is highly uncertain with a future value of either \$0 or \$2,000 depending on the result of a single coin toss. With the second portfolio, the investor can be guaranteed a future value very close to \$1,000 (ie, with very little uncertainty).
6. By holding a portfolio that has exposure to a large number of coin tosses, the large portfolio has 'diversified' away (eliminated) almost all of the uncertainty about the future value of their portfolio. Uncertainty that can be eliminated by holding a large diversified portfolio is described as 'diversifiable risk' in the CAPM. The existence of diversifiable risk does not attract higher *expected* or *mean* returns in financial markets precisely because it can be diversified away.
7. However, in our example the elimination of risk is only possible because the results of each coin toss are uncorrelated with each other (ie, heads on one coin toss does not make it more likely that the other coin tosses will be heads).³ If the returns on assets are correlated with each other then, even with a diversified portfolio, there

³ If the coin were not completely uniform such that it was more likely to land one way than the other (but the investor didn't know which way before placing the 1,000 \$1 bets) then the gambler would be unable to fully diversify risk no matter how many bets were made.



will be uncertainty about the return on that portfolio. This form of risk is referred to as 'undiversifiable' or 'systematic' risk and is captured in the 'beta' parameter of the CAPM. It is only systematic risk that attracts a return in the CAPM.

8. The CAPM in its simplest form is described as:

$$R_e = R_f + \beta_e \cdot (R_m - R_f); \text{ where:}$$

R_f = the risk free rate of return — commonly based on long-term government bond rates;

$(R_m - R_f)$ = the market risk premium (MRP) — the expected return of the market as a whole less the risk free rate; and

β_e = the covariance of the return on equity under consideration with the return on the market as a whole relative to the variance of the return on the market.

9. β_e in the CAPM is the measure of 'relative risk'. If β_e equals one then the relevant equity has the same risk as the underlying market and, therefore, requires the same expected premium above the risk free rate. If β_e is less than one then the firm has less risk than the average firm in the market (and vice versa if β_e is greater than 1.0). The mathematical formula for β_e is provided below:

$$\beta_e = \frac{\text{Cov}(R_e, R_m)}{\text{Var}(R_m)} = \frac{E[(R_e - \bar{R}_e)(R_m - \bar{R}_m)]}{E[(R_m - \bar{R}_m)^2]}$$

R_e = the return on the relevant equity

\bar{R}_e = the expected return on the relevant equity

R_m = the return on the market

\bar{R}_m = the expected return on the market

10. It can be seen from this equation that if conditional on the deviation of the return on the market from its expectation, the average deviation of the return on the asset from its expectation is of the same magnitude and sign as that of the market then $\beta_e = 1$.

11. It is worth noting that the description above describes the simplest CAPM model and that other more sophisticated CAPM models have been developed. In this



paper we use the term ‘CAPM’ to refer to the general literature on theoretical determinants of asset pricing – all of which have the simple version of the CAPM model described above at its heart.

2.2. Distinction between CAPM return and ‘hurdle’ rates of return

12. Any discussion surrounding the correct regulated return for the FTTN has the potential to be confusing unless there is clarity about what the regulated return is actually compensating for. The most common source of confusion when discussing the cost of capital involves a failure to distinguish between the *expected* or *mean* required returns and the return required in the event that the project is ‘a success’.
13. Consider an asset that has a CAPM risk-adjusted *expected* return of 8% pa., ie an asset whose owners would require an 8% pa return given the risk. However, imagine that the investment has a 10% probability of ‘failure’ in one year’s time – where the effect of failure is that the asset becomes worthless and the entire value of the investment is lost. This might be the case, for example, if the asset was dependent on the success of some sort of R&D project. Investors will naturally ask “what return do we require if the project succeeds in order to have a pre-investment expectation of receiving our required 8% return”? The answer to this question is that the expected return must be 20% in the 90% of cases where the R&D is successful in order for the expected return to be 8%. Mathematically:

$$\text{Expected return} = 8\% = 0.1 \times (-100\%) + 0.9 \times X\%$$

$$\Rightarrow X = 20\%$$

14. Investors require an expected return of 8%. However, given the 10% probability of catastrophic failure where the entire asset becomes worthless, this is the same as saying that investors require a 20% return in the 90% of all other possible states of the world.
15. It may be that a business considering investing in the above asset might state that they require a 20% ‘hurdle’ rate of return before making such an investment. However, this must not be confused with the 8% required *expected* or *mean* return from investing in such a project – which is the true return of importance to investors. In other words, the most likely return may need to pass a ‘hurdle’ of 20% but this is only because this hurdle also results in the more relevant *expected* return satisfying the requirements of investors.
16. It would be a serious mistake of finance theory and practice to use the 20% ‘hurdle’ rate of return to discount the expected cash-flows from the project. To see why,



imagine that the project in the above example requires \$100m up front and that it will either pay off nothing (10% probability) or \$120m (90% probability). Thus, the expected cash-flows are negative \$100m up front and then \$108 in one year's time ($\$108 = 0.9 * \$120 + 0.1 * \$0$). The present value of these cash flows is exactly equal to zero when the correct discount rate is used.

$$PV \text{ of cash flows} = -\$100 + \frac{\$108}{1 + 8\%} = \$0$$

17. However, if the expected cash-flows are discounted at the 20% hurdle rate of return then it appears (incorrectly) that the present value of cash-flows is negative.

$$PV \text{ of cash flows} = -\$100 + \frac{\$108}{1 + 20\%} = -\$10$$

18. Only if the cash-flows being discounted are inflated above the truly expected cash flows will discounting using the 20% hurdle rate be accurate.
19. This example demonstrates that an error in the cash flows *can* be cancelled out by an offsetting error in the discount rate used. However, one can only determine the discount rate that will offset the error in the cash-flows if one first identifies the error in the cash-flows. In which case, the error is best fixed at its source, ie, by correcting the cash-flows. It is to invite error to fail to properly understand expected cash flows and then attempt to correct for this failure by changing the discount rate.
20. Framing a discussion in terms of 'hurdle' rates of return is inexact and obscures the true nature of expected returns and the distribution of those returns. From the perspective of a diversified investor the important return is the 'expected' or 'mean' return.

2.3. Why hurdle rates of return must not be used to set regulated prices?

21. As we discuss later, Telstra's public statement that it requires an 18% to 19% (midpoint 18.5%) is best interpreted as a 'hurdle' rate of return that is in excess of the truly actuarially expected return that Telstra requires. Telstra has discussed this 'hurdle' rate of return in the context of regulating the maximum prices on the FTTN.
22. In the next two subsections we describe why, irrespective of whether regulation sets maximum prices or sets maximum revenues, this discount rate should not be used in determining either.



2.3.1. Where the regulatory regime sets maximum prices

23. In order not to embody an expectations of monopoly profits, regulated prices must be set such that the discounted value of expected cash-flows is equal to zero. That is, the discounted value of expected revenues (at regulated prices) must be equal to the discounted value of expected expenditures. As a matter of finance theory, this discounting **must** be undertaken using the expected return investors require from the investment (for shorthand ‘the CAPM return’). This is the rate at which investors will rationally discount the future cash-flows for a project.

24. Mathematically, the following must hold true when discounting at the true CAPM cost of capital:

$$\text{Discounted value of expected revenues} = \text{Discounted value of expected expenditures} \quad (1)$$

(Regulated Price x Forecast Sales)

25. Now take the simplest case where there is only one price and regulation sets a single value for that price at the time of the initial investment and that price does not change over time. In this case, the regulated price that ensures the above equation holds true can be found by simply rearranging and solving for Price.

$$\text{Regulated Price} = \frac{\text{Discounted value of expected expenditures}}{\text{Discounted value of forecast sales}} \quad (2)$$

26. (2) Given that most sales are backloaded relative to expenditures (ie, sales only occur after expenditures on building the FTTN have been made) the effect of using a higher discount rate is to reduce the denominator of equation (2) more than the numerator and, therefore, increase the regulated price.

27. It follows that the only justification for using a discount rate above the CAPM rate is if expenditures have been under-estimated or if sales have been over-estimated – such that, at the correct discount rate, the regulated price will be underestimated. However, this is hardly a compelling justification for using a discount rate above the CAPM rate. Clearly, if there is an error in the forecast of expenditures/sales then the best solution to this is to correct the error directly.

28. This is especially true given that the appropriate increment to the correct discount rate can only be established if one first knows by how much expenditures/sales have been under/over estimated. Moreover, as we shall see later when we examine Telstra’s claim for an 18%-19% discount rate, small adjustments to the discount rate used in cost modelling can imply very large errors in the forecasts of expenditures/sales.



29. The above discussion is important because it appears from Telstra's public statements that it:
- will be proposing a price path that is not adjusted for any difference between forecast demand and actual demand;⁴
 - will be arguing that material downside risks to forecast demand exist (associated with development of challenger technologies to the FTTN such as 'Super 3G');⁵ and
 - that this justifies using a higher discount rate in regulatory cost modelling.⁶
30. However, this is a very indirect, and inexact, way of arguing for a higher rate of return. If Telstra believes that there is a material risk that technological advances will lead to 'Super 3G' winning substantial custom away from the FTTN then Telstra should simply include this factor in its probability weighted forecasts for sales. This is a much more direct, transparent and exact method for accounting for the potential impact of new technologies.

2.3.2. Where the regulatory regime sets maximum revenues

31. An alternative regulatory regime to the regime Telstra appears to be promoting is one that sets a path for maximum revenues instead of a path for maximum prices. Under this sort of regulatory regime prices are adjusted up or down depending on whether sales are lower/higher than expected. This means there is limited downside or upside risks to the FTTN owner as a result variations in demand.

⁴ Telstra CFO John Stanhope (in a presentation to the ABN conference, *Communications in the Digital Age* – submitted to the ASX on 29 April 2008) states:

"Let me table another thought – in a regime where prices are regulated, returns are not guaranteed. I want to expand on this as it is a point missed by many who think that high returns imply high prices for customers. With regulated pricing at a wholesale level, returns will only reach target if retail providers are successful in demonstrating the value of high speed broadband and moving consumers up the value chain to use faster speeds and more capacity. We as the investor will be bearing the risk here. ... Contrast this with the alternative view where returns, albeit at a lower level are guaranteed but prices may go up if demand does not meet expectations. You in Sydney will understand this. Every time I travel through the Lane Cove tunnel, it seems the toll has gone up again."

⁵ In the same speech (ibid) Mr Stanhope states:

*"And back to the matter at hand, a multibillion dollar fixed broadband investment is not without significant risk. Some industry observers claim that 4G wireless technologies will achieve speeds of gigabits per second. Japan's NTT DoCoMo is targeting 300Mbps "Super 3G" in 2009. ... While we do believe that FTTN has a long-term saleable future, there are always risks associated with such a long-term investment in a fast-evolving industry, and **the returns that any investor can get should reflect the risks that actual demand does not meet expectations.**"*
Emphasis added

⁶ See emphasis added to the above quote.



32. The only potential downside to the FTTN owner is if the new technology takes so much custom from the FTTN that there simply are not enough FTTN customers from which to recover the regulated revenue. If there is a material probability of this occurring then *expected revenues* will be less than *allowed revenues* set by the regulator. As a consequence, in order for expected revenues to be equal to expected expenditures (in a present value sense) it may be necessary to set the present value of allowed revenues above the present value of expected expenditures. Mathematically:

In order that equation (1) holds and:

$$\text{Discounted value of expected revenues} = \text{Discounted value of expected expenditures}$$

It may be necessary to set:

$$\text{Discounted value of allowed revenues} > \text{Discounted value of expected expenditures}$$

33. The amount by which the discounted value of allowed revenues must be set above the discounted value of expected expenditures will be equal to the expected value of any losses as a result of technological change making the FTTN obsolete (ie, resulting in the FTTN owner being unable to recover its costs no matter how high prices are set).
34. By setting allowed revenues above the discounted value of expected expenditures the regulator is effectively including in the FTTN owners costs not just their expected expenditures but also an estimate of the actuarially fair cost of self insuring against the prospect of new technologies making it impossible for the FTTN owner to recover their costs. The difference between the discounted value of allowed revenues and the discounted value of expected expenditures is, in effect, the cost of an insurance premium that the FTTN owner is writing to itself.
35. Of course, instead of explicitly and transparently estimating the probable cost of technological obsolescence it is possible to increase the discount rate above the true CAPM discount rate. However, this is an indirect and inexact way of attempting to account for such risks (assuming they actually exist). Moreover, as we shall see later when we examine Telstra's claim for an 18%-19% discount rate, small adjustments to the discount rate used in cost modelling can imply very large implied probabilities of obsolescence.



3. CEG's estimate of required returns

3.1. The CAPM required return expected by investors

36. The simple form the CAPM described in the previous section was first developed by Sharpe in (1964)⁷ and Lintner (1965)⁸ and is often described as the Sharpe CAPM or the Sharpe-Lintner CAPM in their honour. In this model the covariance of returns with the return on the market (β_e) is the only source of risk for investors. The result follows directly from the assumption in the Sharpe CAPM that investors only ever invest for a single period.
37. However, since the mid 1960s there have been a number of theoretical refinements to this model that show that, when investors invest over multiple periods, risk also depends on the covariance of realized returns with reinvestment opportunities in the economy and not just with realized return on the market at the end of a single period. Merton (1973)⁹ first relaxed the assumption that there was only a single period of analysis and the resulting model is variously described as the Merton CAPM, the 'inter-temporal CAPM' and the 'consumption CAPM'.
38. These theoretical developments are consistent with the empirical findings that the Sharpe CAPM tends to underestimate the cost of equity for firms with low β_e and tends to over-estimate the required returns for firms with high β_e . For a discussion of this finance literature see a recent CEG report to the ESCV.¹⁰ The key empirical finding of the literature is summarised in the figure below from Fama and French (2004)¹¹. The figure demonstrates graphically the empirical observation that low beta stock tend to earn more than predicted by the Sharpe CAPM (and *vice versa* for high beta stock).

⁷ Sharpe, William F., 1964, Capital Asset Prices: A Theory of Market Equilibrium Under Conditions of Risk, *Journal of Finance*, (19), pp. 425-442. 18 ,

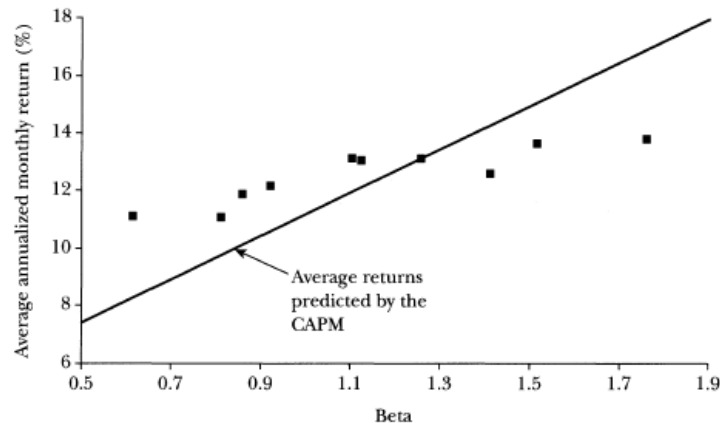
⁸ Lintner, John, 1965, The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets, *Review of Economics and Statistics*, (47), pp. 13-37.

⁹ Merton, Robert C., 1973, "An intertemporal asset pricing model," *Econometrica* 41, 867-887.

¹⁰ *Estimating Relative Risk in the Market for Funds*, CEG, October 2007. http://www.multinetgas.com.au/regulatoryissues/downloads/RegulatoryEnvironment/essentialServicesCommission/appendices/CECG_Estimating%20Relative%20Risk%20in%20the%20Market.pdf

¹¹ Fama, Eugene F. and Kenneth R. French, 2004, "The capital asset pricing model: Theory and evidence," *The Journal of Economic Perspectives* 18, pp. 25-46.

Figure 2
Average Annualized Monthly Return versus Beta for Value Weight Portfolios Formed on Prior Beta, 1928–2003



39. However, the relative ease with which historical covariance of returns with the market (β_e) can be measured and the difficulty in measuring covariance of returns with reinvestment opportunities (as per the Merton CAPM) has led to the continued reliance on the Sharpe CAPM by many practitioners and in Australian regulatory proceedings.
40. That said, the above empirical findings are not ignored but are factored into the choice of the range for β_e used in the Sharpe CAPM. For example, a common adjustment to observed betas is known as the Blume adjustment. The Blume adjustment sets the value of the equity beta equal to:

$$B_{\text{Blume}} = \beta_e * 0.67 + 1.0 * 0.33$$

41. This adjustment has the effect of setting the beta input used in the Sharpe CAPM closer to 1.0 than would simply result from adopting the observed β_e from stock market data. Such an adjustment is clearly consistent with the observation that the Sharpe CAPM tends to under/over estimate required returns when β_e is lower/higher than 1.0.



42. The CAPM expresses the rate of return as the post-tax¹² real return on equity. This can be converted into a real weighted average cost of capital (WACC) by estimating the cost of debt (R_d) for the business at a particular level of gearing (debt as a proportion of the total value (V) of the firm).

$$\text{WACC} = R_e * (E/V) + R_d * (D/V); \text{ where:}$$

E/V = the proportion of capital funded by equity;

D/V = the proportion of capital funded by debt.

43. The above formula for the WACC is commonly described as the post tax vanilla WACC. This formula of the WACC can be used to discount future net cash-flows in order to determine whether they are high enough to justify the initial investment. The definition of future cash-flows that must be used with the vanilla post tax WACC include *all* pre-personal tax cash-flows available to the firm's debt and equity holders after both the payment of corporate tax and any effective refund of that tax via franking credits. That is, this formula for the WACC assumes that the cost of corporations tax is being modelled separately and included in the cash-flows to be discounted.
44. There are other formulas for the WACC that are sometimes used that attempt to model the cost of tax within the WACC and not in the relevant cash-flows. This sometimes leads to confusion. For the purpose of this report all discussion of the WACC refers to the post tax vanilla WACC as described above.

3.2. Estimating the CAPM risks associated with the FTTN

45. It is important to keep in mind that the discussion in this section does not address expected cost of technological obsolescence because this is not a CAPM risk – ie, does not affect the *expected* return investors will demand. As discussed above, the expected cost of technological obsolescence must be captured in any cash-flow modelling by either: a) lowering forecast sales to reflect the probable loss of sales to new technologies; or b) including an estimate of the cost of self insuring against this risk in the businesses costs.

¹² Where the term 'post tax' describes the per-personal tax return available to investors after both the payment of corporate tax and any effective refund of that tax via franking credits.



46. In our view, the natural monopoly nature of the FTTN in combination with any sensible regulatory regime will give suggest an average to below average level of CAPM risk.
47. A meaningful analysis of the CAPM WACC for the FTTN cannot be performed without an understanding of the nature of the regulatory arrangements that will be applied to the FTTN. In what follows we assume that the regulatory arrangements will be similar to those applying to most other natural monopoly industries with large fixed costs and low variable costs. Specifically, we assume that maximum regulated prices will reflect efficiently incurred unit costs including a recovery of fixed costs. This means that maximum prices will be adjusted over time to reflect:
 - Changes in costs over time – such that if costs are higher than expected regulated maximum prices rise to reflect this; and
 - Changes in demand for services over time – such that if demand is higher than expected maximum regulated prices fall as fixed costs are able to be spread across a larger customer base.
48. These characteristics of a regulatory regime for natural monopolies are standard in Australia and internationally. They are also consistent with the regulatory regime being proposed by Optus in their regulatory submission and are consistent with the principles proposed by the G9 in its application of a special access undertaking to the ACCC.
49. The application of such a regulatory regime insulates the regulated business from many sources of CAPM risk that unregulated businesses are exposed to but also creates other sources of CAPM risk that those businesses are not exposed to.
50. For example, maximum regulated prices generally are only updated to reflect changes in costs and demand every few years. This makes administration easier and has the desirable property that it gives regulated businesses an incentive to reduce costs/increase sales in between regulatory reviews. However, it also has the effect of exposing the regulated business to any CAPM risks associated with variations in cash-flows in between regulatory reviews. This can potentially expose those businesses to higher CAPM risks than unregulated businesses who have the flexibility to update prices for changed economic conditions more frequently.
51. It is also the case that the business may be exposed to CAPM risks to the extent that the regulator systematically fails to update costs and demand forecasts accurately. In this context, a systematic regulatory error is one that covaries with conditions in the economy. An example of this may be that the regulator is relatively slow to update demand forecasts and, therefore, tends to underestimate



demand growth when it is increasing and *vice versa*. Another example might involve the regulator failing to recognise variations in the true market risk premium in the economy when resetting the cost of capital – such that the cost of capital tended to be underestimated in periods when the MRP was high and underestimated in periods when the MRP is low.

52. In our view, the CAPM risks faced by a monopolist are largely determined by the nature of the regulatory regime under which they operate – not by the nature of the service which is being provided. In particular, there is little reason to believe that Telstra's existing copper customer access network is subject to higher CAPM risks than gas and electricity customer access networks.
53. Consider what makes these assets natural monopolies requiring regulation in the first place. Telecommunications copper cable, electricity copper cable and gas pipelines are all natural monopolies for the same reason. Specifically, it is uneconomic to duplicate a cable/pipe running down a suburban street. Such duplication can occur but it is generally wasteful and it is more efficient to have only one infrastructure asset and require that owner to provide regulated access to companies wishing to supply retail telecommunications/electricity/gas services.
54. Consider also the nature of the cost structure for the FTTN, electricity and gas distribution networks. All three types of businesses have high fixed costs that are also 'sunk' (ie, once invested have little or no value in an alternative use). The marginal costs of using the infrastructure are generally very low (ie, extra usage involves only a relatively small increase in the costs of providing the infrastructure assets).
55. The one area where the businesses may materially differ is in the variability of demand they face. However, even here the nature of regulation will tend to dampen any such effects on the path of long term revenue. For example, imagine that demand is lower than expected, such that prices do not provide adequate revenues to cover fixed costs. So long as regulated prices rise in this scenario (and *vice versa* where demand is higher than expected) the impact of demand variability on cash-flow variability will be mitigated.

3.2.1. Australian regulatory precedent

56. Given these facts we consider that the best estimate of a range for the FTTN CAPM WACC can be derived by having regard to regulatory precedent in telecommunications and energy regulation.
57. There have been a large number of decisions made in these sectors by a large number of Australian regulators. In each of the decisions the regulator has had



regard to empirical and theoretical evidence put before them by access providers and access seekers. The decisions are then taken after sifting through that evidence and in the knowledge that their decisions can be subject to legal appeal. If one accepts the regulators' decisions as reflecting an unbiased estimate based on the evidence before them then these decisions can be used to establish a reasonable range for the CAPM WACC appropriate for the FTTN.

58. Australian regulatory precedent has established a fairly narrow band of estimates for the equity beta and MRP used to set the CAPM cost of capital. These are summarised in Table 1 and Table 2 below.

Table 1: Equity Beta used by Australian Regulators in Relevant Decisions (gearing at 60%)

Industry	Regulator/Year	Equity Beta
Telecommunications		
Telstra ULLS	ACCC,	1.25
Electricity Distribution		
NSW Distributors (3 businesses)	IPART, 2004	0.78 to 1.11
ActewAGL	ICRC, 2004	0.90
Aurora (Tas)	OTTER, 2003	0.95
Queensland Distributors (2 businesses)**	QCA, 2005	0.90
Victorian Distributors (5 businesses)	ESC, 2005	1.00
ETSA Utilities	ESCOSA 2004	0.8 (0.9 on appeal)
Electricity Transmission		
Draft Statement of Regulatory Principles [‡]	ACCC, 2004	1.0
National Electricity Rules	AEMC, 2006	1.0
Gas Distribution		
ActewAGL	ICRC, 2004	0.9 to 1.09
Victorian Distributors (3 businesses)	Vic. ESC, 2003	1.00
Victorian Distributors (3 businesses)	Vic. ESC, 2008	0.70
Envestra/Allgas	QCA, 2006	1.1
Envestra	ESCOSA, 2006	0.8 to 1.0
AGLGN	IPART, 2005	0.8 to 1.1
Gas Transmission		
ACCC, (5 businesses)	ACCC/various	1.0-1.14
Average		0.97

59. From Table 1 above it can be seen that the general consensus amongst regulators is that the equity beta for natural monopoly businesses should be around 1.0. The main exception to this is the ACCC's decision for Telstra where it set the equity beta equal to 0.83 at an assumed debt gearing level of 40%. However, for the purpose of comparison this is reported as an equity beta of 1.25 in the above table



(where an equity beta of 1.25 at 60% gearing is equivalent to an equity beta of 0.83 at 40%).

60. There is little reason to believe that Telstra's existing copper customer access network is subject to higher CAPM risks than gas and electricity customer access networks. As described above, these assets have similar cost characteristics that give rise to the need for regulation and, once imposed, the nature of which gives rise to similar CAPM risks.
61. On this basis, we believe that the appropriate range for the FTTN CAPM beta (assuming 60% gearing) is between a value of 1.00 consistent with the equity betas of gas and electricity customer access networks and a value of 1.25. The upper end of this range is defined by the ACCC's beta for Telstra's ULLS assets. It is essentially these assets that are being upgraded by the FTTN build (from copper to fibre).
62. However, in our view the ACCC has never properly justified the adoption of a higher CAPM beta for the ULLS infrastructure than for the gas and electricity infrastructure – infrastructure that often shares the same trenches. It may be that the ACCC has implicitly included some stranding risk from technological innovation or the operation of the TSLRIC cost modelling approach they have employed. We deal with these types of risks explicitly in the following sections so do not include any such compensation in our estimate of the CAPM beta.
63. In our view, a value for beta of around 1.1 (at 60% gearing) is a reasonable point estimate of the CAPM beta for the providers of access to regulated monopoly infrastructure such as the FTTN. This translates to an asset beta of around 0.45 which compares with the ACCC's assumed ULLS asset beta of 0.50.



Table 2: MRP used by Australian Regulators in Relevant Decisions

Industry	Regulator/Year	MRP
Telecommunications		
Telstra ULLS	ACCC/2006	6.0
Electricity Distribution		
NSW Distributors (3 businesses)	IPART, 2004	5.0 to 6.0
ActewAGL	ICRC, 2004	6.0
Aurora (Tas)	OTTER, 2003	6.0
Queensland Distributors (2 businesses)**	QCA, 2005	6.0
Victorian Distributors (5 businesses)	ESC, 2005	6.0
ETSA Utilities	ESCOSA 2004	6.0
Electricity Transmission		
Draft Statement of Regulatory Principles [‡]	ACCC, 2004	6.0
National Electricity Rules	AEMC, 2006	6.0
Gas Distribution		
ActewAGL	ICRC, 2004	6.0
Victorian Distributors (3 businesses)	Vic. ESC, 2003	6.0
Victorian Distributors (3 businesses)	Vic. ESC, 2008	6.0
Envestra/Allgas	QCA, 2006	6.0
Envestra	ESCOSA, 2006	6.0
AGLGN	IPART, 2005	6.0
Gas Transmission		
ACCC, (5 businesses)	ACCC/various	6.0

64. Table 2 demonstrates a strong consensus amongst Australian regulators for an MRP of 6%. We adopt this value in our estimates.
65. In order to estimate the WACC we must also estimate the risk free rate and the cost of debt. The standard regulatory approach is to estimate the risk free rate as yield on 10 year Commonwealth Government Securities (CGS). The cost of debt is then estimated by assigning a credit rating to the regulated activity and then estimating the yield on similarly rated bonds with a maturity of 10 years. The ACCC has historically assumed an A rating for a 40% geared ULLS service. Other regulators have historically assumed a BBB+ rating for 60% geared energy businesses. On 20 June 2008 CBASpectrum was reporting:
- Yields on 10 year CGS at 6.593%;
 - Yields on 10 year A rated debt at 9.555%
 - Yields on 10 year BBB+ rated debt at 9.964%



3.2.2. CEG WACC estimate

66. Our best estimate of the cost of capital for the FTTN is summarised below.

Table 3: CEG WACC estimate – parameter values

Parameter	Value
Nominal risk free rate (10 year CGS)	6.59%
Asset beta	0.45
Gearing	40.00%
Equity beta	0.75
MRP	6.00%
Nominal cost of equity	11.08%
Nominal cost of debt	9.55%
Nominal post tax vanilla WACC	10.47%
Expected long term annual inflation	2.50%
Real post tax vanilla WACC	7.77%

3.3. Probability of technological obsolescence

67. As described above, the probability of technological obsolescence due to technological change is not relevant to determining investors required returns.¹³ However, it is relevant to determining the prices necessary to ensure that investors actually expect to receive their required return.

68. CEG is not expert in forecasting the likely technological innovation that might lead to technological obsolescence for the FTTN. However, we have asked Optus to advise us on its opinion of such obsolescence. Their advice is that the risk of obsolescence is very small. The basis of this conclusion is that:

- no alternative fixed network would ever be built once the FTTN is built. This reflects the fact that alternative fixed networks will only ever be able to provide better quality services if they involve fibre to the home/premises (FTTH) and the FTTN will always have the lowest incremental cost of building a FTTH network; and

¹³ Unless the probability of technological obsolescence is somehow correlated with returns available on other assets.



- while wireless networks can offer higher quality on one dimension (mobility) they will never be able to provide comparable quality on the dimension of speed unless there are a large number of 'base stations' transmitting to small areas. However, in order to realistically achieve this any wireless technology would have to rely on the FTTN fibre for backhaul of data. Essentially, the wireless solution might make the copper between the node and the premises obsolete but it would need to rely on the fibre at the node to carry data to/from its base station.

69. Optus also advises that wireless services will always offer lower speeds than fixed solutions and this difference in quality will be greater the further the wireless link to the customer. While technological innovation may make wireless services faster over time the same is true for fixed solutions and the relativities can be expected to remain constant. Optus advises that a 3G base station (node) today offers up to a maximum of 15Mbps and that is for a user located very close to the 3G base station as the wireless performance drops with increasing distance from the base station. However, each base station covers up to many thousands of users. 3G services are used for mobile applications and where they are being used for fixed replacement the effective performance being achieved is closer to the low speed broadband solutions (ie, 256 or 512 kbps equivalents) rather than the over 12 Mbps required of the FTTN.
70. In addition to these technical claims, the FTTN would have a strong protection from new technologies merely by virtue of its first mover advantage. This is true even if new technologies would provide equivalent services with much lower upfront network build costs.
71. The reason is that, once built, the FTTN would have close to zero marginal costs of serving customers. A potential new entrant would know this and would know that the FTTN could profitably undercut them at any price in excess of the FTTN's marginal costs (ie, zero) to keep a customer. A new entrant will only enter if it believes that it can recover its upfront network build costs despite facing competition from an incumbent with close to zero marginal costs. This provides a first mover advantage to the FTTN that offers substantial protection from entry - even if the potential new entrant has much lower construction costs than the FTTN did.



4. Assessment of Telstra's claims

4.1. Telstra's public claims

72. Telstra has publicly declared that its required nominal rate of return is 'north of 18%'.¹⁴ More recently Telstra has been reported as arguing for an 18-19 percent post tax return on capital (midpoint 18.5%).

"At the weekend, Burgess at last outlined his FTTN price. A post-tax return on capital of 18-19 per cent to get back near the pre-tax returns of 27 per cent or so Telstra enjoyed before Trujillo started throwing shareholders' cash around to the tune of \$11 billion. Telstra is asking the Government to help it retain its near-monopoly profits."¹⁵

73. From this statement it is unclear whether this is a real or nominal required return. For the purpose of this section we assume that this is a nominal return and that the implied midpoint real return is 15.61% (based on a 2.5% long term inflation rate and application of the 'Fisher equation').¹⁶
74. Consistent with the above quote, we also assume that this return is the weighted average return on *capital* required not just the return on *equity*. We note that it is not meaningful to report a required return on equity without simultaneously reporting the associated level of debt gearing associated with that return (as the required return on equity rises with the amount of debt gearing).¹⁷

4.2. The implied probability of stranding

75. A 15.61% real required return on capital is more than double CEG's estimate of the CAPM cost of capital of 7.77%. This represents a 7.84% increment on top of the real CAPM WACC estimated by CEG. From this fact we can make a number of

¹⁴ Telstra head of public policy, Phil Burgess, is quoted in the Weekend Australian on 24 March 2008 (*Telstra Wants Network Return North of 18pc* by Jennifer Hewett) as stating "We need a return north of 18 per cent because that is our average return on other investments," he said. "You don't earn a low rate of return on a high-risk project."
<http://www.australianit.news.com.au/story/0,24897,23422057-5013041,00.html>

¹⁵ From the Australian 25th of March "Price of Loving Telstra" by Michael Sainsbury
<http://www.australianit.news.com.au/story/0,24897,23425146-5013641,00.html>

¹⁶ The Fisher equation states that the one plus real return is equal to one plus the nominal return divided by one plus the inflation rate.

¹⁷ Even if Telstra has been misquoted, or is being deliberately vague, the implications of the analysis below would not be materially different if the above figures were interpreted as required equity returns assuming reasonable levels of debt gearing.



observations about the implied probability of failure inherent in Telstra’s claimed rate of return. Specifically, if the costs of the FTTN are to be recovered over 30 years (in line with annuity depreciation) Table 4 describes the probabilities of asset stranding implied by Telstra’s WACC under different assumptions about what asset stranding means.

Table 4: Telstra’s Implied Probability of Stranding

% of future cash-flows lost due to stranding	Year at which stranding occurs		
	T=0	T=5	T=9
100%	45.0%	69.2%	99.7%
75%	60.1%	92.3%	Impossible
50%	90.1%	Impossible	Impossible

Source: CEG analysis described in section 4.3 below

76. From the perspective of the FTTN owner, the worst possible asset stranding event would be one where the asset becomes worthless immediately after its construction. That is, not only is the entire value of the asset wiped out but it is wiped out so early in the asset’s life that the owner has had no ability to recover any of its investment prior to it being wiped out. This prospect is made even worse if we assume that there is no capacity for Telstra to earn above its proposed WACC in the event that the asset is not stranded.
77. This is clearly the worst imaginable stranding event and, therefore, should have the lowest possible probability required to justify Telstra’s proposed return. Nonetheless, the probability of such an event must still be 45%.
78. It is important to be clear what this means. We are proposing two possible states of the world. The first is that there is “no stranding” and Telstra earns its proposed WACC. The second is that there is “stranding” and Telstra earns nothing (has zero net cash-flows from day one). In order to justify Telstra’s proposed WACC there must be a 45% probability of stranding of this type. That is, in order to justify Telstra earning twice the CAPM rate in the absence of stranding there must be a 45% probability that the asset will be worthless on the first day that it is available for use.
79. If we reduce the potential cost of stranding the associated probability of stranding must rise. For example, if we continue to assume that 100% of the value of the asset will be stranded but restrict the stranding event to only occur five years after the asset begins its useful life the probability of stranding rises to 69.2%. In this scenario Telstra receives five years of net cash-flow at its proposed WACC prior to net cash-flows falling to zero.



80. If we assume that the magnitude of the stranding event at 5 years will only result in 75% of the asset value being lost, then the implied probability of stranding rises to 92.3%. That is, if the worst possible stranding event is that the FTTN earns five years of proposed cash-flows before these cash-flows fall by 75% then there must be an 92.3% probability that stranding actually occurs.
81. If the worst possible stranding event is that the FTTN owner loses only 50% of cash-flows after five years then there is no probability of this stranding that can justify Telstra’s proposed WACC. That is, it is “impossible” to justify Telstra’s proposed WACC if this is the worst stranding event that Telstra is subject to.
82. It is worth noting that the estimates in Table 4 are dependent on, but not particularly sensitive to, our estimate of the true WACC for the FTTN. If instead of assuming the true real WACC is 7.77% we assume that it is 10% (ie, more than a quarter as high again as our best estimate) then the following implied probabilities of stranding would apply.

Table 5: Telstra’s Implied Probability of Stranding – CEG real WACC equals 10%

% of future cash-flows lost due to stranding	Year at which stranding occurs		
	T=0	T=5	T=9
100%	32.9%	55.1%	84.6%
75%	43.9%	73.4%	Impossible
50%	65.8%	Impossible	Impossible

Source: CEG analysis described in section 4.3 below

83. It is worth noting that in order to achieve a real WACC of 10% the implied asset (equity) beta must be 0.83 (1.38) and the cost of equity would have to be 12.08% in real terms. Even if we adopt such an estimate of the underlying real WACC, Telstra’s proposed WACC still implies very high probabilities of catastrophic stranding of the FTTN within a short period of time (as evidenced in Table 3 above).
84. The above probabilities are based on two possible states of the world where stranding either occurs in the nominated year or it never occurs. So, the 45% figure in Table 4 is the probability that 100% stranding occurs on day one of the FTTN’s life given that, if it does not occur then, it will never occur. Alternatively, this 45% figure can be thought of as representing the cumulative (present) value of all potential future stranding events of a similar nature.
85. We have also explicitly calculated the ‘annual’ probabilities of stranding associated with each type of stranding event and these are reported in the table below. That



is, we have assumed that stranding could happen in any year beyond year “T” and report below the implied annual probability of stranding and the associated cumulative probability of stranding over different periods.

Table 6: Telstra’s Implied Annualised Probability of Stranding*

% of future cash-flows lost due to stranding	T = 0			T = 5			T = 9		
	Cumulative risk of stranding within N years of date T								
	N=1	N=5	N=10	N=1	N=5	N=10	N=1	N=5	N=10
100%	6.8%	29.6%	50.5%	17.0%	60.5%	84.4%	96.6%	100%	100%
75%	11.4%	45.5%	70.3%	50.8%	97.1%	99.9%	–	–	–
50%	42.6%	93.8%	99.6%	–	–	–	–	–	–
25%	–	–	–	–	–	–	–	–	–

* Assuming that the probability of stranding is a constant in each year after some initial period of T years

86. The first probability reported in this table (6.8%) states that, if catastrophic (100% loss) stranding can happen in the first year of the FTTN’s life and can happen in every year thereafter, the probability of it actually happening in any given year is 6.8%. This is associated with a cumulative probability after five years of 29.6% and a cumulative probability after 10 years of 50.5%. That is, there must be a better than 50% probability that the FTTN will be worthless within 10 years to justify Telstra’s proposed cost of capital.
87. If we restrict the magnitude of stranding to be a 75% loss in cash-flows and restrict the time that this could occur to five years after the FTTN has been in operation then the annual probability must be 50.8% and there must be a virtual certainty (97.1% probability) that this would happen within 5 years of that date (ie, within 10 years of the FTTN being built). The empty cells in the above table represent scenarios where it would be impossible for any probability of stranding to justify Telstra’s proposed cost of capital.
88. Based on the advice we have received from Optus and based on the first mover advantage an FTTN owner would have, Telstra’s proposed compensation for asset stranding within its WACC does not appear credible. Moreover, if it was credible it would call into serious question whether investing in the FTTN is an economically rational public policy.
89. In our view it would be inefficient and inequitable for customers to pay Telstra its proposed WACC if this would mean that Telstra would be being compensated for self-insurance against technological obsolescence at a rate that exceeds the fair value of any such insurance premium.

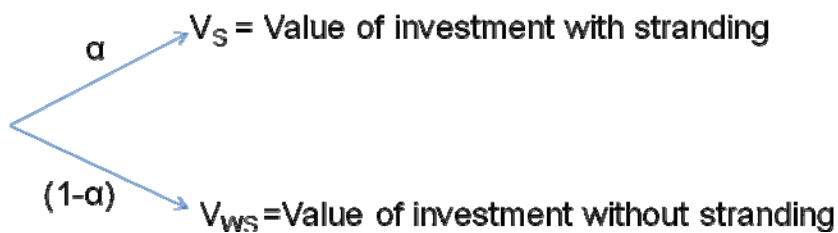
90. One way to avoid paying Telstra an inflated premium is to select another tenderer. However, it may be that Telstra is viewed by the Government as the preferred tenderer on other grounds. If so, it would be in customers best interest if:

- the Government only allowed Telstra to charge prices that reflected the true CAPM WACC and recognized the true probability of technological obsolescence when determining the expected future revenues given that price;
- and if the Government and Telstra could not agree on the true probability of technological obsolescence, then the Government should only allow Telstra to charge prices that reflect the true CAPM WACC and should calculate expected revenues ignoring the possibility of technological obsolescence, but the Government should then indemnify Telstra for the risks of technological obsolescence; and
- the Government made telecommunications customers bear the cost of any such indemnity if and when it occurred (or, alternatively, telecommunications customers paid private insurers to take over the indemnity otherwise provided by the Government to Telstra)

91. We discuss how this could be done in section 5 below.

4.3. Calculation of the implied probability of stranding

92. The calculations sitting behind [Table 4] are set out below and rely on simple binomial probability logic. We assume two potential states of the world: one in which 'stranding' occurs with a probability of " α " and one in which 'no stranding' occurs with a probability of $(1-\alpha)$. This is represented graphically below.



93. The expected value of the investment resulting from this binomial probability distribution can be expressed as:

$$\text{Expected value of investment} = \alpha \times V_S + (1 - \alpha) \times V_{WS}$$



If we set the expected value of the investment equal to the cost of building the FTTN (call this “I”) then we can solve for α as follows.

$$\alpha = \frac{1 - V_{WS}}{V_S - V_{WS}} \quad (3)$$

94. Having established equation (3), all that remains to do is to establish the value of the investment to Telstra with and without stranding (noting that Telstra benefits from an inflated cost of capital in the absence of stranding so the value of the investment will exceed I in that event). In the simplest case let us assume that, in the absence of stranding, the FTTN would have an infinite life and Telstra would continue to earn its proposed cost of capital forever. In this case it follows that:

$$V_{WS} = I \times \frac{\text{Telstra's proposed real WACC (15.61\%)}}{\text{The unbiased CAPM WACC (CEG estimates at 7.77\%)}}$$
$$V_{WS} = I \times 2.01$$

95. Similarly, if we assume that asset stranding involves the asset being worthless on the first day of its life then clearly:

$$V_S = 0$$

96. Substituting these values into equation 3 we get:

$$\alpha = \frac{1 - V_{WS}}{V_S - V_{WS}} = \frac{1 - 2.01}{-2.01} = 50.25\%$$

97. This has a perfectly intuitive explanation. Telstra’s proposed WACC is double our estimate of the true WACC. If, in the absence of stranding, Telstra were to receive double the true WACC it would be as if Telstra was being paid twice for its initial investment. In order to justify this there must be a 50% chance that it will receive nothing on its original investment. Only then will the probable benefits of receiving double the true WACC be offset by the probable costs of asset stranding.
98. The equations for V_S and V_{WS} can be made more general than in the above simple example. For example, we may wish to assume that:
- The FTTN has a finite life of “N” years rather than a perpetual life and that regulated prices over time are intended to allow the FTTN owner to recover its



initial capital investment in line with an N year annuity at their proposed WACC¹⁸;

- That stranding can only realistically occur a minimum of “Z” years after the FTTN has been built; and
- That stranding can only create a maximum loss of “Q” percent of the future cash-flows the FTTN would have enjoyed absent the possibility of stranding—where Q is less than 100%.

99. These are the assumptions that underlie the probabilities reported in Table 4 above. With the above definitions it is possible to define V_s and V_{ws} as:

$$V_{ws} = \frac{\text{N year annuity recovering I using Telstra's WACC}}{\text{N year annuity recovering I using the true WACC}}$$

where

$$\text{N year annuity recovering I using WACC} = \frac{I \times WACC}{1 - \left(\frac{1}{1+WACC}\right)^N}$$

and

$$V_s = RV + (1 - Q) \times (V_{ws} - RV)$$

where RV is the amount of its initial investment that Telstra would already have recovered after Z years and is given by:

$$RV = \frac{\text{N year annuity on I using Telstra's WACC}}{\text{True cost of capital}} \times \left(1 - \frac{1}{(1 + \text{True cost of capital})^Z}\right)$$

100. These equations are sufficient to replicate the probabilities reported in Table 4 above. The equation for URV simply needs to be substituted into the equation for V_s and then the equations for V_s and V_w need to be substituted into equation (3).

¹⁸ A constant payment made each year for N years will have a present value equal to “1” if it is equal to $\frac{WACC}{1 - \frac{1}{(1+WACC)^N}}$



All of these equations are directly proportional to the initial investment (I) and so this term cancels out in the application of equation 3.



5. Choices faced by the Government

101. Telstra's proposed WACC is based on a very pessimistic assessment of the expected future stranding of the FTTN. If the Government wishes to award Telstra the FTTN contract but does not share Telstra's pessimistic views then the Government would be better off indemnifying Telstra against future stranding and setting a materially lower WACC and therefore lower prices for consumers.
102. The Government could then choose to retain or pass on the risks for which it has indemnified Telstra. The obvious group of people to pass this risk onto would be customers – which is exactly what Telstra is attempting to do with its proposed WACC. Alternatively, the Government could pass the risk onto private sector insurers. We discuss how each of these options could be done below.

5.1. How the FTTN owner could be indemnified

103. Measured on a particular date in the future, the FTTN owner will have avoided making an economic loss provided that:

$$\begin{array}{l} \text{The remaining value of} \\ \text{the FTTN on that date} \end{array} = \begin{array}{l} \text{Compounded value* of} \\ \text{past expenditure} \end{array} \text{ less } \begin{array}{l} \text{Compounded value* of} \\ \text{past revenues} \end{array}$$

*Where all values are compounded through time to the relevant date at the CAPM WACC.

104. So long as the FTTN owner knows that, on a date in the future they can sell (or otherwise value) the FTTN assets according to this formula then downside risk associated with technological obsolescence will have been eliminated. This could be achieved by the Government (or a consortium selected in a competitive tender by the Government) providing a 'put option' to the FTTN owner prior to construction. But if the put option's exercise price were set equal to 100% of the remaining value of the FTTN on the particular date and if profits could be higher or lower than initially expected for reasons other than technological obsolescence, then this put option will have insured not only against technology-related stranding but also against non-technology related diminutions in profits.
105. Note that the event that triggers exercise of the put option is not the occurrence of a negative technology shock *per se*, but a calculation by the FTTN owner that the future revenues less expenses are worth less than the remaining value of the FTTN. The FTTN owner would be able to enjoy the up-side of non-technology related variations in revenues while being insured against both the corresponding downside and any technology-related downside. Granting the FTTN owner a put



option with an exercise price equal to the remaining value of the FTTN on a given date will mean that the FTTN owner is more than compensated for stranding risk so long as there is any possibility of up-side non-technology related variation in profits. Thus the FTTN owner could be made whole by granting them a put option that states that in, Z years time, the FTTN owner has the option to sell at a price equal to:

$$\text{Put option exercise value} = X\% \text{ of } \left(\text{Compounded value}^* \text{ of past expenditure} \text{ less } \text{Compounded value}^* \text{ of past revenues} \right)$$

*Where all values are compounded through time to the relevant date using the CAPM WACC.

106. The higher the likelihood of up-side variation in profits the smaller the percentage X of the remaining value of the FTTN on that date that need be offered as the exercise of the put option designed to make the FTTN owner whole.¹⁹
107. If the FTTN owner does exercise the put option on date Z then they must deliver ownership of the FTTN asset to the Government/consortium. (If X=100% then the FTTN owner has zero risk of making a loss on the FTTN.)²⁰ The Government/consortium can then sell FTTN services and earn a return from the asset so purchased.
108. Assuming the put option is exercised, the maximum prices charged by the new FTTN owner could be regulated by the ACCC – with a regulatory asset base (RAB) set equal to the amount paid for the asset to be used in a well understood regulatory regime (which may be under Part XIC or some other regime).
109. With X=100%, if the put is exercised, the FTTN owner will have earned the WACC. If the put is not exercised, the FTTN will have earned more than the WACC. This creates an asymmetry in favour of the FTTN owner. In order to eliminate this asymmetry some value of X less than 100% can be appropriate.

5.2. How the risk could be auctioned to investors

110. Instead of issuing the put option itself, the Government could purchase it from private entities. To do so it would have to hold an auction process to determine the market's best estimate of the expected cost of issuing the put option. Participants in such an auction are likely to be reinsurers, telecoms businesses and investment

¹⁹ Assuming that regulated prices are set based on the CAPM WACC that ignores the existence of the put option.

²⁰ .It is also worth noting that such a put option would guarantee a minimum future asset value. It would reduce the variation in the asset value and, therefore, would likely have an effect on the CAPM WACC.



banks or consortiums thereof. In effect, the government would be buying a market-tested insurance premium.

5.3. How the cost of the risk could be funded

111. There are a number of options available to the Government to fund the insurance premium that would allow the Government to purchase a put option equivalent to the put option granted to FTTN owner. Or, equivalently, if the Government retains the risk there are a number of options available to fund the expected cost of that risk. These include:

- Imposing a levy on the FTTN revenues (economically equivalent to adding an increment to the FTTN owner's CAPM WACC). Thus the FTTN customers would fund the insurance premium in an expected sense;²¹ and
- Imposing a levy on the telecommunications industry generally (eg, through an increment to the current USO levy – which would ultimately be passed through to customers of the telecommunications industry, and not just to customers of the FTTN itself).

112. It is important to remember that, under the model where the FTTN owner receives an increment to the WACC, telecommunications customers will have to pay for the insurance premium anyway. A government levy based on the market tested cost of this insurance premium is economically identical but has the advantage of the value of the premium being set transparently in the market.

113. Note also that a USO style levy could be attractive in that it could be set on an *ex post* basis. That is, the Government could issue the put option and simultaneously announce that if, but only if, the FTTN owner exercises the option in Z years time the Government will use an industry levy to fund any net cost²² it incurs. This has the advantage that the Government can indemnify the FTTN owner but can still:

- not have taken on any risk;
- not have to fund an insurance premium; and

²¹ Note that such a tax can only fund the insurance premium in an expected sense. That is, the expected revenues from the tax could equal the cost of the insurance premium but this could not be guaranteed as tax revenue would depend on demand.

²² Noting that, the net cost will be less than the amount the Government paid for the asset assuming that the FTTN assets purchased has positive value.



- only impose any cost on the industry if stranding actually occurs.

5.4. Benefits of vertical separation highlighted

114. The option described above only works if the FTTN is a vertically separated entity such that ownership of the business can be transferred upon exercise of the put option. Variants of this option are possible where ownership is not transferred upon exercise of the put option.²³ However, these can be more complicated.
115. In any event, under all options there is a requirement for clear and unambiguous accounting of past revenues and expenditures in delivering FTTN services. Even under operational separation, maintenance of these accounts may be difficult. For example, a vertically integrated Telstra may explicitly charge itself low FTTN prices but recover high revenues upstream. This would tend to underestimate true revenues that flowed from its ownership of the FTTN.

5.5. Impact on incentives

116. A potential criticism of an approach that removes the risk of economic loss from the FTTN owner is that it will blunt incentives to avoid these losses. In theory this is a valid concern, however, we would make the following observations:
- It is only in the circumstance that the put option is likely to be exercised that that the FTTN owner will have reduced incentive to perform; and
 - If the value of X is set below 100%, as we would recommend it should be, the FTTN owner still has a strong incentive to perform even if the option appears certain to be exercised. For example, if X=50% then the FTTN owner will still have to bear the first 50% of any economic losses that occur.

²³ For example, the FTTN owner could be given the option of writing down their asset value at a future date with: a) the Government agreeing to pay the FTTN owner some portion of the write-down; and b) the FTTN owner agreeing that regulated prices would be set according to the new written down value. In this scenario, the Government only pays for the difference between the written down value of the asset and the remaining value of the FTTN on that date as defined in section 4.. While this payment will be less than under the put option (assuming the written down value is above zero) the Government will not get any right to revenues from the FTTN beyond that date.