Calculation of straight line depreciation – review of the AER's approximate calculation

CitiPower, Powercor and
Jemena Electricity Networks

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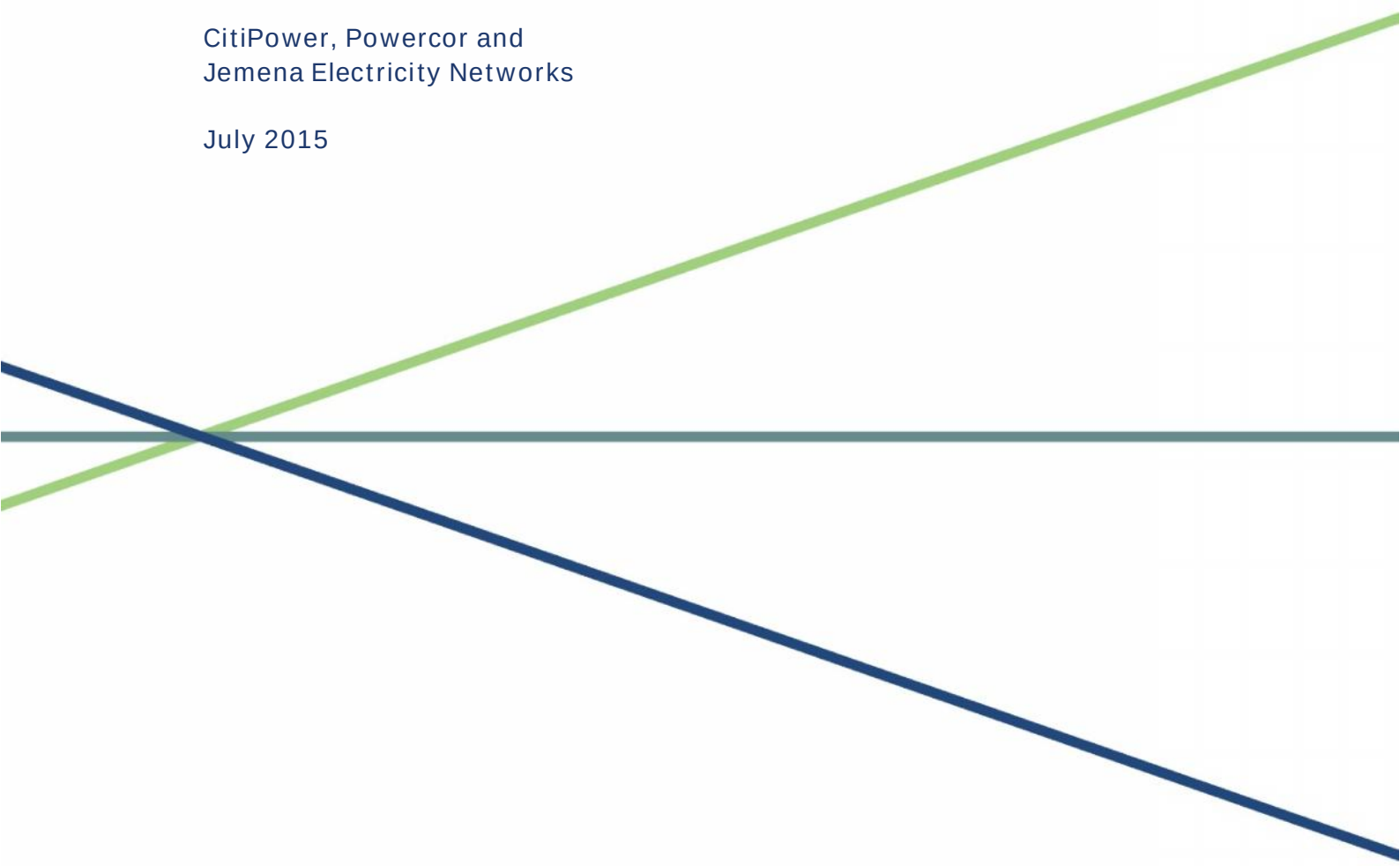

INCENTA
ECONOMIC CONSULTING

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1. Introduction and summary

1.1 Introduction

1.1.1 Scope of the report

1. I have been engaged by CitiPower, Powercor and Jemena Electricity Networks to review certain calculations the AER has performed in its preliminary decision for SA Power Networks[1] when calculating regulatory depreciation (the AER disagreed with the calculations performed by SA Power Networks and performed its own alternative calculation of regulatory depreciation). The specific matter that I have been asked to investigate is the calculation the AER has made in relation to the remaining life of each of the groups of assets that were in existence at the commencement of the new regulatory period, and whether there is a more suitable method for calculating depreciation under the National Electricity Rules.

2. In undertaking this task, I have been asked to assume the following:

   a. that the regulatory depreciation will be calculated using the "straight line" method, with the regulatory asset base escalated for inflation (measured using the Consumer Price Index, CPI), and

   b. the standard and remaining lives as determined by the AER for the 2010-15 regulatory period.

1.1.2 Authorship

3. This report has been prepared by Jeffrey John Balchin. I am the Managing Director of Incenta Economic Consulting, a firm that specialises in advising in relation to economic regulation issues in the infrastructure sector. I have 20 years of experience in relation to economic regulation and pricing issues across the electricity, gas, ports, airports and water sectors in Australia and New Zealand, having advised governments, regulators and major corporations on issues including the development of regulatory frameworks, regulatory price reviews and with respect to the negotiation of charges for unregulated infrastructure services. My full curriculum vitae is attached to this report as Appendix A.

4. I have read, understood and complied with the Guidelines for Expert Witnesses in Proceedings in the Federal Court of Australia, which are appended to this report as Appendix B.

[1] AER, 2015, Preliminary Decision: SA Power Networks Determination 2015/16 to 2019/20, April.

1.2 Summary of key conclusions

1.2.1 Background – reason there is an issue

5. The AER uses the Post Tax Revenue Model (PTRM) to derive allowed revenues and ultimately price controls.[2] This model applies a simplified method to calculate regulatory depreciation for assets in existence at the commencement of the new regulatory period. The model requires all past expenditures to be grouped into a small number of classes (or groups), and with the straight line method of depreciation then applied to these groups. The formula for calculating the regulatory depreciation allowance in respect of a particular group of assets for the first year of the regulatory period is as follows:[3]

$$Depreciation = \frac{Starting\ asset\ value\ (group)}{Starting\ remaining\ life\ (group)}$$

6. The calculation is then repeated over the years, but with the asset value being reduced each year to remove depreciation in the previous year, and with the remaining life reduced by "1" each year.

7. The difficult – and contentious – issue is how the remaining life of the group of assets is calculated, and the veracity of simply reducing this value by "1" each year.

1.2.2 AER method for deriving the remaining life of the groups

8. The AER has calculated the "remaining life" for the group of assets as at the start of the new regulatory period by taking the weighted average of the relevant remaining lives. The weights employed in this calculation were the written down asset values of the relevant assets. The groups of assets for the next regulatory period will comprise a grouping of:

   a. The groups of assets that were established at the commencement at the previous regulatory period, and

   b. The individual assets that have been created since that time.[4]

9. The remaining lives used for these assets were as follows:

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2 The relevant model for distribution is contained in: AER (2015), Final decision: Amendment – electricity transmission and distribution network service providers post-tax revenue models (version 3), January, Appendix B.

3 The formula here assumes that both the asset value and depreciation amount are specified in constant price (i.e., real or inflation-adjusted) terms. The PTRM in fact converts asset values into constant price terms and applies the calculation described here, and so this aspect of the issue is uncontentious.

4 To be precise, the information collected by the AER comprises the annual expenditure on assets within each of a number of different classes (with all assets in each class having the same economic life), and so is already grouped to this level. However, as explained further below, given the AER's simplifying assumption that all capital expenditure occurs at the same point in each year, grouping to this level does not create any error.

a. *The groups of assets that were established at the commencement at the previous regulatory period* – the remaining life established last time, less 5 years, and

b. *Capital expenditure since that time* – the remaining life of the individual assets given their initial economic lives and year of construction.

1.2.3 Assessment of the AER method

Objective

10. I take it as accepted that the most accurate application of the straight line depreciation method is one where individual assets were depreciated over their own depreciable lives, and note that the AER has made comments to this effect.[5] I also understand that this is consistent with the application of the method in financial accounting, and is the method that would be expected to be desirable when used to set cost-based charges (being expected to smooth prices).

11. I therefore compare the AER's approximate calculation of straight line depreciation to the result that would be derived if the straight line method was applied to assets individually.

Assessment

12. I have assessed whether the AER's method for deriving the remaining life for a group of assets is mathematically correct, against the objective defined above. I find that the AER's method contains a mathematical error. The correct approach to deriving the remaining life of a group of assets for a base year is to:

a. first calculate the weighted average depreciation rate for the individual assets (using asset values as the weighting variable), and then set the remaining life equal to the reciprocal of this, or alternatively

b. set the remaining life for the group equal to the weighted average of the remaining lives of the individual assets, but using the depreciation associated with each asset in the base year as the weighting variable.

13. Thus, the error in the AER's method can be expressed as:[6]

a. deriving the remaining life of the group directly (i.e., as the asset-value weighted average of each asset's remaining life) rather than indirectly by first calculating the weighted average depreciation rate, or

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5 AER, 2015, Preliminary Decision: SA Power Networks Determination 2015/16 to 2019/20, April, Attachment 5, pp.5-12, 5-13.

6 I find, however, that it is appropriate to simply reduce the remaining life of the group of assets by "1" each year as the AER proposes, although this is subject to the caveat discussed in the text that an error will exist after the time that individual assets would have been fully depreciated if the straight line method had been applied to assets individually.

b. using the incorrect weighting variable (i.e., using the asset value as the weighting variable, rather than the depreciation amount in the base year).

14. I find that the AER's method (subject to the caveat below) will overstate the remaining life for the group of assets, and so produce a depreciation allowance that is lower than the amount that would be derived by applying the method to assets individually. It is evident from the AER's preliminary decision in relation to SA Power Networks that the error in the AER's method can be very material.[7]

15. However, the depreciation allowance calculated using the method described in paragraph 13 will remain correct only while all of the assets within the group would have had a positive remaining value if the straight line method was applied to assets individually. Thus, an error will be created after the time that individual assets would have been fully depreciated, and from that time the depreciation allowance calculated would exceed the amount that would be derived from applying the method to assets individually.[8]

16. Correcting for this error in the context of grouping assets in the manner described above is not straightforward. The adjustment required to the formula that I have derived requires substantial information to be collected about the pattern of past expenditures and even then is complex, and the inherent flaw in the AER method means that it is not a suitable base from which to commence. Given the potential for a material error to be created, a preferred route in my view would be to alter how the depreciation allowance in respect of past capital expenditure is reflected in the PTRM so that additional information is factored into the calculation. I discuss possible options next.

1.2.4 Alternatives to using an approximate calculation

17. In the text, I discuss three possible options for increasing the amount of information that is factored into the calculation of the depreciation allowance, which are to:

a. Continue to group assets within an asset class, but construct a separate set of groups for the capital expenditure undertaken within each regulatory period

i. The effect of this would be to reduce and possibly nullify the error caused as a consequence of grouping assets[9]

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7 The method that SA Power Networks applied is very similar to what I derive as the correct approach in this report. The AER's preliminary decision led to materially different asset lives for some asset classes, and amounted to a difference in the revenue requirement of $320 million for the forthcoming regulatory period (AER, 2015, Preliminary Decision: SA Power Networks Determination 2015/16 to 2019/20, April, Attachment 5, Table 5.3 and p.5-14).

8 I observe in the text that this outcome is consistent with the result the AER produced in Figure 5.1 of the Preliminary Decision (AER, 2015, Preliminary Decision: SA Power Networks Determination 2015/16 to 2019/20, April, Attachment 5, p.5-16). As suggested in the text, the same effect also causes the error from applying the AER's method to reduce (as the new error offsets the original error) and eventually reverse, which is also consistent with the figure to which reference was just referred made.

9 If the standard lives of assets were rounded to the nearest five years and regulatory periods continued to be of a five year term, then the error in the depreciation allowance would be concentrated within a

b. Continue to group annual expenditure within an asset class,[10] but depreciate each of these values individually

   i. The effect of this is that the method of calculating depreciation for forecast capital expenditure would simply be extended into the future (after replacing forecast values with actual values)

c. Relay upon the businesses' business systems to keep track of the depreciation associated with assets that have already been created

   i. The effect of this is that the PTRM would take the (future) depreciation associated with past capital expenditures as an input. The calculation of depreciation in relation to forecast capital expenditure could be retained within the PTRM to ensure that flexibility in relation to price determinations is not lost.

18. Any of these options would be an improvement to the current method of deriving regulatory depreciation, and all would be straightforward to implement. My preference would be the second option as it would retain the PTRM as a self-contained model, not involve any compromise to the calculation of depreciation and not require any additional information to that already reported to the AER. I observe that even if a firm wanted to define 50 different asset classes, then this would still be straightforward to implement as a single worksheet in an Excel spreadsheet.[11]

single regulatory period (i.e., depreciation would be too high at the start of the period and too low at the end). The smoothing of revenues would imply that no effect on tariffs would be created.

[10] The AER's standard approach commences the depreciation of assets from the year after the expenditure has occurred. Thus, there is no loss of information from grouping all expenditure of a particular asset class that is undertaken within a particular year.

[11] The standard approach for applying the straight line depreciation method is to set out the calculation in a matrix format for each asset class, with the capital expenditure forming the vertical axis and the annual depreciation calculated in respect of each annual capital expenditure amount forming the rows. The matrix once constructed is then copied for each asset class. If provision were to be made for 50 asset classes and the next 100 years within the model, then the calculation would require 5,000 rows and 100 columns (this is a small fraction of the 1,048,576 rows and 16,384 columns available within an Excel spreadsheet. Creating the necessary calculations is also very simple because the calculation is identical across assets and can simply been extended to the requisite number of assets.

2. Assessment of the AER approximate calculations

2.1 How the AER calculates depreciation for past capital expenditure

2.1.1 Structure of the Post Tax Revenue Model

19. The AER applies the Post Tax Revenue Model (PTRM) to derive allowed revenues for regulated firms, of which the allowance for regulatory depreciation is a component. The allowed revenues are used, in combination with other inputs, to generate the price controls that are specified as part of a regulatory determination.

20. The PTRM contains a simplified calculation of the regulatory depreciation that is attributable to assets that are in place prior to the new regulatory period (that is, the depreciation in respect of actual, past capital expenditure).[12] The depreciation calculation in the PTRM is structured on the assumption that all existing assets will be aggregated into a small number of classes (or groups),[13] and then the straight line depreciation method is applied as if each of these groups were a single asset. One common factor for each of the groups is that the depreciable life for new assets are identical. The regulatory depreciation allowance that is calculated for each of these groups for the first year of the new regulatory period depends upon two inputs:

    a. The starting regulatory value for the each of the groups of assets, which is the aggregate of the written down value of each of the assets (for regulatory purposes) within each group as at the start of the new regulatory period. This input is uncontentious, and

    b. The remaining life that is attributed to each of the groups of assets. The derivation of this input is one focus of this report.

21. The deprecation allowance for the first year of the new regulatory period for the group of assets is calculated as:[14]

$$Depreciation = \frac{Starting\ asset\ value\ (group)}{Starting\ remaining\ life\ (group)}$$

22. The calculation is then repeated over the remaining years of the new regulatory period, but with the asset value being reduced each year to remove depreciation in the previous year, and with the remaining life attributable to each group being reduced by "1" each year.

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12 Actual capital expenditure for the year prior to the commencement of a new regulatory period is typically unknown at the time that the new price controls are determined. This slight complication is ignored for simplicity in this report.

13 The number of such groups varies substantially across the regulated businesses, although for no apparent reason.

14 The formula here assumes that both the asset value and depreciation amount are specified in constant price (i.e., real or inflation-adjusted) terms. The PTRM in fact converts asset values into constant price terms and applies the calculation described here, and so this aspect of the issue is uncontentious.

23. I take it as common ground that applying the straight line depreciation method to groups of assets, rather than to individual assets, involves an approximation to the application of the straight line method and the resulting potential for error. A second focus of this report is whether such an approximation is justified is addressed in section 3 of this report.

2.1.2 AER method for deriving the remaining life of the groups

24. At the time of calculating the new price controls, two categories of assets that are relevant to this report exist:

    a. First, there are the groups of assets that were established at the commencement at the previous regulatory period.

    b. Secondly, there is the new expenditure associated with assets in each of the asset classes over the preceding regulatory period, separated into each of the years of the preceding period.

25. It is noted for completeness that the second category implies that individual assets within a class are grouped together with other assets in that class that were created during the same year. However, as discussed further in section 3, grouping assets in this manner generates little potential for error, and so is ignored in the discussion below.

26. The AER has proposed in the preliminary decision for SA Power Networks[15] that the "remaining life" for each of the groups of assets as at the start of the new regulatory period would be calculated by:

    a. taking the weighted average of the relevant remaining lives, with the weights employed in this calculation being the written down asset values of the relevant assets as at the end of the current regulatory period, and

    b. calculating the remaining lives for each of the groups of assets as:

        i. for the groups of assets that were established at the commencement at the previous regulatory period – the remaining life established at the commencement of the last regulatory period, minus 5, and

        ii. for the capital expenditure undertaken since that time – the remaining life of the individual assets, which in turn is a function of their year of construction and the depreciable life for the relevant asset class.

27. The AER described its method (which it labelled as the "weighted average remaining life", or WARL, method) in its own words as follows:[16]

This approach involves rolling forward from the approved remaining lives of existing assets at the start of the regulatory control period to the end of the regulatory control period. The remaining asset lives at the end of the regulatory control period for new assets acquired

[15] AER, 2015, Preliminary Decision: SA Power Networks Determination 2015/16 to 2019/20, April.

[16] AER, 2015, Preliminary Decision: SA Power Networks Determination 2015/16 to 2019/20, April, Attachment 5, p.5-12.

during the regulatory control period are also determined. The remaining lives of the existing assets and new assets at the end of the regulatory control period are then weighted based on their asset values, to come up with an average remaining life for the entire class. The remaining asset lives at the end of this period become the remaining asset lives at the start of the next regulatory control period.

28. It is noted that the AER's method involves a repeated grouping of assets at successive price reviews. Thus, while the depreciation on forecast capital expenditure is calculated on the basis of individual assets, the individual assets actually installed will be aggregated into the small number of groups at the next price review.

2.2 Objective when assessing the AER's calculations

29. I take it as given for this report that, when assessing the accuracy of approximations for the application of the straight line depreciation method, the appropriate comparison point is to the application of the method to assets individually. This would appear to be consistent with the AER's views, as reflected in the following comment:[17]

The remaining asset lives calculated by both the WARL and average depreciation approaches are not perfect compared with the approach of tracking assets individually. Some information is lost when assets are combined into a single asset class, and when new assets are added to that asset class. For this reason, we focus on the materiality of calculation distortions relative to the 'true' remaining asset lives (that is, remaining asset lives if assets were not aggregated into asset classes and they were not recalculated at each reset). [footnote omitted]

30. Applying the straight line depreciation to individual assets is consistent with my understanding of the standard practice in financial accounting,[18] where it is my understanding that information is typically captured and retained in businesses' information systems at this disaggregated level (with the information at the level of individual assets being referred to as the asset register).

31. In addition, I note that a desirable outcome for regulatory purposes of depreciating assets individually is that as replacement capital expenditure takes place and so enters the regulatory asset base, the asset being replaced is fully depreciated and so no longer reflected in the regulatory asset base.[19] The matching of expenditure being included in the regulatory asset base with assets becoming fully depreciated would be expected to smooth out cost-based prices over time. Indeed, under idealised circumstances, this matching under straight line depreciation would generate a time path for the capital

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17 AER, 2015, Preliminary Decision: SA Power Networks Determination 2015/16 to 2019/20, April, Attachment 5, pp.5-12, 5-13.

18 Whilst this is beyond my area of expertise, I note that the guidance from the relevant accounting standard (AASB 116) regarding the recognition, carrying amounts, depreciation and impairment of property plant and equipment is framed as applying to individual assets, with the exception to this being that "[i]t may be appropriate to aggregate individually insignificant items, such as moulds, tools and dies, and to apply the criteria to the aggregate value" (AASB 116, principle 7).

19 In reality, this process would only be expected to occur on average, across a portfolio of assets because the service lives of assets individual assets would be expected to vary around the expected life.

component in prices that follows the growth in capital input prices.[20] For this matching to occur, depreciation needs to reflect the circumstances of the individual assets.

32. Accordingly, in my assessment of the AER's method of deriving the regulatory depreciation allowance, I have focussed on how the AER's method compares with a calculation performed at the level of individual assets. I refer to this measure in the text as the "accuracy" of the AER's calculation; however, I observe for completeness that I am only assessing the accuracy with which the straight line depreciation method is being applied and am not assessing the appropriateness of the choice of that method, nor the appropriateness of the inputs applied (most notably the choice of economic lives for individual assets).

2.3 Results of mathematical analysis

2.3.1 Tasks undertaken

33. I have first assessed whether the AER's method for deriving the remaining lives for the groups of assets is accurate by analysing the issue mathematically, the full workings for which is set out in Appendix A. The questions that I have sought to answer are as follows:

a. First, in the context of the AER's calculation of regulatory depreciation in the PTRM, which method for deriving the remaining lives for a group of assets will result in the most accurate calculation of straight line for a base year (I refer to this as the "accurate" remaining life).

b. Secondly, whether, once the remaining life for a base year is calculated, it is correct to reduce the remaining life by "1" each year when calculating regulatory depreciation (and the circumstances in which this will no longer be correct).

c. Thirdly, to assess how the AER's calculation of the remaining life (and thereby the regulatory depreciation allowance) compares to the accurate result that I have derived.

2.3.2 Method for deriving the remaining life for a group

34. In relation to the first of these tasks, I have established that the method for deriving the remaining life for a group of assets that results in the most accurate calculation of depreciation is to follow a two-step procedure, which is to:[21]

a. First calculate the weighted average depreciating rate for the assets in the group, where the depreciation rate for an asset is the reciprocal of its remaining life and the

[20] This outcome results under the following assumptions: (i) for each type of asset, the business has a portfolio of assets of different vintages with an equal spread across all vintages (implying, amongst other things, that the business is older than the service life of the oldest assets), (ii) either no growth or no economies of scale from serving new growth, and (iii) a constant required return on equity (inclusive of tax).

[21] This is established in section A.2.

regulatory values of the assets (i.e., written down values) are used as the weighting variable, and

b. Secondly, to set the remaining life for the group of assets equal to the reciprocal of the weighted average depreciation rate for the group, as calculated above.

35. This calculation differs to the AER method in that a weighted average depreciation rate for the group is first calculated (and, from this, a remaining life), whereas the AER method involves calculating a weighted average remaining life for the group directly. These calculations deliver different results, and in my view the AER's method contains a mathematical error, which I return to below.

36. As an alternative, I also show that the accurate remaining life for a group for a particular year can also be calculated directly, but it requires the depreciation for the year in question (rather than the regulatory values of the assets) to be used as the weighting variable.[22] Thus, an alternative means of expressing the source of the error in the AER calculation is that it has employed the incorrect weighting variable when deriving the weighted average remaining life for the groups of assets.

2.3.3 Projecting the remaining life for the group of assets into future years

37. Subject to the caveat below, I find that the AER is correct to assume that the remaining life for the group of assets will reduce by "1" each year, provided that the starting life for the group of assets is accurately established at the outset.

38. The caveat to this is that the projection of the remaining life of the group of assets into future years will only remain accurate until the point where individual assets within the group would have been fully depreciated. After that time, the remaining life calculated using the method described above will understate the accurate remaining life of the group (and so overstate the accurate depreciation allowance). I observe, however, that it is complex to adjust the calculation of depreciation when undertaken for groups of assets for the prospect that individual assets would have been fully depreciated, without first calculating the depreciation that would have been derived of the method had been applied to assets individually.

2.3.4 Comparison with the AER's method

39. I have also compared the remaining lives for groups of assets calculated according to my method with the remaining lives that are calculated according to the AER's method. As discussed above, the difference between the methods can be expressed as either that:

a. the AER calculates a weighted average remaining life directly (using asset values as weights), whereas it should have first calculated the weighted average depreciation rate for each group, and then set the remaining life for each group equal to the reciprocal of this, or

[22] This is established in section A.5.

b. the AER's weighted average remaining life calculation incorrectly uses asset values as weights, whereas depreciation amounts in the base year should have been used.

40. I find that,[23] with the exception of a special case, the AER method will result in a greater remaining life than the accurate value, and so will understate the depreciation that would result from applying the straight line method to individual assets. The special case is where all assets in the class have the same remaining life, in which the two methods deliver an identical result.

2.3.5 Limitations to the use of an approximate depreciation calculation

41. As I have commented upon above, my derivation of the formulae for establishing the accurate remaining lives for the groups and for projecting this over time rest on the assumption that none of the assets in the groups would have been fully depreciated if the straight line method had been applied to assets individually. A consequence of this simplification is that, after the time when individual assets would have commenced being full depreciated under an individual-asset calculation, the method that I have set out will understate the accurate remaining life for the group (and so overstate depreciation).

42. I have also concluded that the AER method will overstate the accurate remaining life of the group. However, this conclusion too is dependent upon the assumption that individual assets would not have been fully depreciated. The upward bias in the AER formula would reduce as individual assets commence being fully depreciated assets, and past some point the bias would be expected to reverse (and the AER method would then overstate the required depreciation) as the new error works in the opposite direction to the original error.

43. Indeed, these outcomes are quite consistent with the AER's own simulations that it presented in the Figure 5.1 of its preliminary decision for SA Power Networks, which showed that:

a. In relation to the remaining lives proposed by SA Power Networks the figure suggests that its method produced a very similar outcome for the first 10 years to what would be produced if depreciation was calculated for assets individually; however, from year 11 onwards its method overstated depreciation. The figure shows, however, that the problem with the SA Power Networks approximation is that it did not follow the substantial step-down in the individual-asset depreciation that would be calculated from year 11 onwards. This step-down clearly is the result of the existing assets at the start of the 2015-20 period becoming fully depreciated under an individual-asset depreciation calculation.

b. In contrast, the AER method resulted in a materially lower depreciation allowance for the first 10 years than the correct value, and then produces a higher depreciation allowance from year 11 onwards.[24] The consequence of this is – which is shown in the

[23] This is established in section A.4.

[24] This conclusion is reached by comparing the slope of the RAB function under the AER method to the slope under the individual asset calculation. The AER function is initially flatter; however, it becomes steeper after the kink in the individual asset RAB function after year 10.

figure – is that the AER method results in the RAB value exceeding the correct value for the first 23 years, and then being lower than the correct value from that point onwards.

44. In my view, it is apparent that both approaches for generating an approximate calculation of straight line depreciation contain potential errors. Indeed, the AER's calculations suggest that in the case of SA Power Networks and the next regulatory period, the error could be very material.[25] It is not easy, however, to correct the formula derived in this report to address the effect of individual assets becoming fully depreciated for the remaining life for the group. Similarly, correcting the AER's formula would imply using the formula that I have derived in this report to correct its inherent flaw, and so it offers no easier prospect for deriving an accurate approximation.

45. Accordingly, a more appropriate course of action would be to change the structure of the PTRM to collect more information from previous periods and to use this in the calculation of regulatory depreciation. I set out my views on possible options in the next section.

[25] The method that SA Power Networks applied is very similar to what I derive as the correct approach in this report. The AER's preliminary decision led to materially different asset lives for some asset classes, and amounted to a difference in the revenue requirement of $320 million for the forthcoming regulatory period (AER, 2015, Preliminary Decision: SA Power Networks Determination 2015/16 to 2019/20, April, Attachment 5, Table 5.3 and p.5-14).

3. Improvements on the approximate depreciation calculations

46. In the previous section I concluded that an approximate calculation of straight line depreciation brings with it the prospect of error. While I concluded that the AER's method contains an inherent flaw, the formula that I derive will also produce an incorrect result after the time when individual assets within the group would have been fully depreciated if depreciation was applied on an individual asset basis.

47. Given this, a more appropriate course of action, in my view, would be to use more information about historical capital expenditure when calculating the regulatory depreciation allowances.

48. I note at the outset that under the method that the AER derives regulated prices, there is no loss of information caused by aggregating together expenditure on individual assets that is undertaken in a particular year and that corresponds to a particular class (with one characteristic being the same depreciable life). I say this because the AER's method involves commencing depreciation from the next year after the relevant asset has entered into service.[26] Accordingly, all assets within a class created in a particular year must have the same depreciable life (and so depreciate at the same time).

49. I can think of three broad methods for employing more information in the calculation of regulatory depreciation, which are as follows.

    a. *Group assets created within a particular regulatory period* – the first option would be to continue to group past expenditures, but to only group expenditures that were undertaken during a given regulatory period (that is, do not add past period capital expenditure to an existing group, instead create a new group). Thus, if there were six expenditure classes, then six new groups would be created at the end of each regulatory period. The formulae that I have set out in this report for deriving the remaining lives of each group would be applied. This option could be applied with very little structural change to the existing PTRM.

        i. This approximate calculation of depreciation would continue to generate the wrong depreciation allowance after assets within the group would have been fully depreciated.

        ii. However, the error would be contained to a five-year period (representing the spread of the remaining asset lives). In addition, if the current practice of rounding standard lives to the nearest five years were to continue, then all of error would be concentrated within a given regulatory period, and consequently have no effect on prices.[27]

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26 The AER assumes that the expenditure occurs on average at the midpoint of the year and capitalises half a year of return into the starting value of the RAB. The veracity of that timing assumption is not relevant to the matters considered in this report.

27 That is, depreciation would be too high for the first part of the period and too low for the second part; however, the effect of smoothing revenue in present value terms over the period means that the price would not unaffected by this error.

b. *Continue the treatment in relation to forecast capital expenditure* – that is, continue the current practice of grouping together the annual capital expenditure of a particular expenditure class,[28] and continue to calculate depreciation for these separate groups into the into future regulatory periods (that is, after replacing the forecast of capital expenditure with the actual amount).[29]

c. *Provide for depreciation on past expenditure to be an input in the PTRM* – and instead rely upon the regulated business's own business systems to keep track of the calculation of depreciation in relation to assets installed in previous regulatory periods. The PTRM could still calculate the depreciation in relation to forecast capital expenditure, and so provide the AER with the means to adjust depreciation for changes to forecasts of capital expenditure.

50. All of these options are feasible – and indeed none would be particularly difficult to implement – and all would be an improvement on the current practice of grouping past expenditures and undertaking an approximate calculation of depreciation.[30] Of the options, my preference would be the second because it would leave the PTRM self-contained, not require any additional information to that already reported to the AER, not lead to any relevant information being sacrificed and remain straightforward to implement. This practice is also consistent with how the Economic Regulatory Authority of Western Australia has calculated depreciation in its past decisions.

51. The one exception to the conclusion above would be if the AER was to change how it recognised the timing of expenditure, and to seek to commence depreciation from when an asset had actually entered into service during a particular year.[31] In this case, calculations at the level of individual assets would be required, and it would be sensible then to rely upon the businesses' business systems for this purpose.[32]

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28 I am assuming that one characteristic of each class is that all assets within the class that are created within a particular year have the same economic life.

29 I understand that other distributors separate their assets into a larger number of classes, for example with AusGrid using 20 asset classes and SA Power Networks using 17. However, keeping track of depreciation on annual expenditures across 50 asset classes would remain a very simple task in Excel given that the structure of calculations across the asset classes is identical.

30 All of these options would also work equally well with the use of a forecast depreciation, which (as I understand it is proposed to be implemented) would require a step change in depreciation at the start of the next regulatory period to accommodate any difference between forecast and actual depreciation.

31 This is the practice of the Commerce Commission in New Zealand, and as a consequence it relies upon the businesses' accounting systems to keep track of depreciation on existing assets.

32 In my experience, regulated businesses would normally capture the quarter in which an asset was created, and sometimes the month.

4. Declaration

52. I have has made all of the inquiries that I believe to be desirable and appropriate in the preparation of this report and no matters of significance that I regard as relevant have, to my knowledge, been withheld.

Jeffrey John Balchin
13 July 2015

A. Demonstration of the mathematical results in relation to depreciation

A.1 Definitions

53. The variables used in this appendix are defined as follows:

a. V_t^i = regulatory value (written down) of asset *i* at the start of year *t*

b. RL_t^i = remaining life of asset *i* at the start of year *t*

c. R_t^i = rate of depreciation for asset *i* in year *t*

d. D_t^i = depreciation of asset *i* in year *t*

54. Straight line depreciation is assumed. All variables are also assumed to be specified in constant price terms (that is, in terms of the general price level prevailing at a common point in time).

55. It follows from the definitions and assumptions set out in the above paragraphs that:[33]

a. $D_t^i = \frac{V_t^i}{RL_t^i} = V_t^i \cdot R_t^i$, and

b. $R_t^i = {}^1/_{RL_t^i}$

c. $RL_{t+1}^i = RL_t^i - 1$,[34] and

d. $V_{t+1}^i = V_t^i - D_t^i = V_t^i(1 - R_t^i) = V_t^i\left(1 - {}^1/_{RL_t^i}\right)$

A.2 Proposition 1 – derivation of the "accurate" remaining life for a group

56. It is assumed that a group of assets will be created (spanning assets $i = 1$ to I). The objective is to derive a remaining life value for the group of assets for year *t* (denoted RL_t^*) such that, when this life is to the aggregate value of assets in a class, generates the same depreciation value as the sum of the depreciation values that are calculated for each asset individually. That is:

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33 These definitions – and the associated formulae – all assume that the asset in question has at least 1 year of service life remaining. In practice, depreciation is the lesser of the value provided by the relevant formulae and the written down value of the asset at the start of the year in question, so that the written down value of the asset cannot be less than zero. The implications of assets becoming fully depreciated for the formulae that I derive are addressed separately below.

34 A corollary of this is that the depreciation rate for any asset will increase as the remaining life of the asset reduces.

$$\frac{1}{RL_t^*}\sum_{i=1}^{I} V_t^i = \sum_{i=1}^{I} \frac{V_t^i}{RL_t^i}$$

57. Starting with the right hand side, if we substitute the depreciation rates for the individual assets, then this becomes:

$$\sum_{i=1}^{I} \frac{V_t^i}{RL_t^i} = \sum_{i=1}^{I} V_t^i \cdot R_t^i$$
$$= \sum_{i=1}^{I} V_t^i \cdot R_t^i \cdot \left(\frac{\sum_{i=1}^{I} V_t^i}{\sum_{i=1}^{I} V_t^i}\right)$$
$$= \frac{\sum_{i=1}^{I} V_t^i \cdot R_t^i}{\sum_{i=1}^{I} V_t^i} \cdot \sum_{i=1}^{I} V_t^i = R_t^* \cdot V_t^*$$

58. The result immediately above implies that the accurate depreciation value for year *t* for the group of *I* assets can be obtained by applying the weighted average depreciation rate for year t (denoted R_t^*) to the aggregate (written down) value of the assets at the start of year *t* (denoted V_t^*), with the individual asset values used as the weights to calculate the depreciation rate. It follows from this that the accurate depreciation value for year *t* will be calculated if a remaining life for the group of assets is used that is calculated as the reciprocal of the weighted average depreciation rate set out above, that is:

$$RL_t^* = 1 \Big/ \frac{\sum_{i=1}^{I} V_t^i \cdot R_t^i}{\sum_{i=1}^{I} V_t^i} = \frac{\sum_{i=1}^{I} V_t^i}{\sum_{i=1}^{I} V_t^i \cdot R_t^i} = \frac{\sum_{i=1}^{I} V_t^i}{\sum_{i=1}^{I} V_t^i \Big/ RL_t^i}$$

59. The formula above says that the accurate remaining life for the group of assets is derived as a two-step calculation, namely to:

a. First derive the weighted average depreciation rate, and

b. Secondly, set the remaining life for the group of assets equal to the reciprocal of this depreciation rate.

60. The AER's approach, in contrast, was to calculate the remaining life for the group of assets by calculating the weighted average of the individual assets' remaining lives directly. Apart from the special case where all assets have the same remaining life, this will result in a different value for the remaining life than when using the formula above, and so will not generate an accurate value for depreciation for the year in question, and so is mathematically incorrect. The direction of the error is addressed in section A.4 below.

A.3 Proposition 2 – does the (accurate) remaining life reduce by "1" each year?

61. The AER's approximate calculation of depreciation assumes that the remaining life of each group of assets will reduce by "1" each year. The purpose of this section is to assess whether this is a correct assumption, assuming that the remaining life is established accurately at the outset.

62. It was shown above that the accurate remaining life for the group of *I* assets is given by:

$$RL_t^* = \frac{\sum_{i=1}^{I} V_t^i}{\sum_{i=1}^{I} V_t^i / RL_t^i}$$

63. It also follows that:

$$RL_{t+1}^* = \frac{\sum_{i=1}^{I} V_{t+1}^i}{\sum_{i=1}^{I} V_{t+1}^i / RL_{t+1}^i}$$

64. However, it is also the case that:

a. $RL_{t+1}^i = RL_t^i - 1$, and

b. $V_{t+1}^i = V_t^i \left(1 - 1/RL_t^i\right)$

65. Substituting these expressions into the formula above yields:

$$RL_{t+1}^* = \frac{\sum_{i=1}^{I} V_t^i \cdot \left(1 - \frac{1}{RL_t^i}\right)}{\sum_{i=1}^{I} V_t^i \cdot \left(1 - \frac{1}{RL_t^i}\right) \cdot \left(\frac{1}{RL_t^i - 1}\right)}$$

66. Manipulation of this expression yields:

$$RL_{t+1}^* = \frac{\sum_{i=1}^{I} V_t^i}{\sum_{i=1}^{I} V_t^i / RL_t^i} - 1 = RL_t^* - 1$$

67. It follows that, subject to the caveat below, the "accurate" remaining life for the group of assets will reduce by "1" each year.

68. The caveat to this is that the expression above assumes that the remaining life for each individual asset in the group is at least 1 year (meaning to that no asset has become fully

depreciated, or indeed there is a negative written down value).[35] It is reasonably straightforward to show that the simple expression above will overstate the decline in the "accurate" remaining life of the group after the time that individual assets in the group would have become fully depreciated.

A.4 Proposition 3 – relationship between the AER weighted average life and the accurate average life

69. Recall from above that the accurate remaining life for the group of assets is given by the following:

$$RL_t^* = \frac{\sum_{i=1}^{I} V_t^i}{\sum_{i=1}^{I} V_t^i / RL_t^i}$$

70. This compares to the formula that the AER applied, which is as follows:

$$RL_t^{AER} = \frac{\sum_{i=1}^{I} RL_t^i \cdot V_t^i}{\sum_{i=1}^{I} V_t^i}$$

71. The AER formula for calculating remaining life will calculate a different value to the correct formula, except where the remaining life of the assets is identical. In all other cases, the error in using the AER formula will be positive. The error is demonstrated by setting out the formula for the difference between the two methods:

$$RL_t^{Error} = RL_t^{AER} - RL_t^* = \frac{\sum_{i=1}^{I} RL_t^i \cdot V_t^i}{\sum_{i=1}^{I} V_t^i} - \frac{\sum_{i=1}^{I} V_t^i}{\sum_{i=1}^{I} V_t^i / RL_t^i}$$

72. In order to simplify the demonstration, it is assumed below that there are only two assets that are to be grouped. This does not affect the generality of the results because a group of *n* assets can be thought of as a group that comprises *(n-1)* sequential groupings of assets.[36] In the two asset case, the error in the AER's remaining life will be given by:

$$RL_t^{Error} = \frac{V_t^1 \cdot RL_t^1 + V_t^2 \cdot RL_t^2}{V_t^1 + V_t^2} - \frac{V_t^1 + V_t^2}{\frac{V_t^1}{RL_t^1} + \frac{V_t^2}{RL_t^2}}$$

73. If this expression is expanded and simplified, it reduces to the following:

35 The condition that the remaining life be at least 1 year means the same thing as the asset not being fully depreciated (or attracting a negative value) if the standard lives for individual assets are specified in terms of whole years.

36 That is, with two assets grouped, and then that group combined with the third asset, and so forth.

$$RL_t^{Error} = \frac{(RL_t^1 - RL_t^2)^2}{RL_t^1\left(\frac{V_t^1 + V_t^2}{V_t^1}\right) + RL_t^2\left(\frac{V_t^1 + V_t^2}{V_t^2}\right)}$$

74. The bottom line of this expression is strictly positive, provided that the written down values of each of the assets remain greater than zero (otherwise it is undefined). Subject to this condition, the top line of the expression means that:

    a. If the remaining life of the assets are identical, then the AER formula will give the correct result, and

    b. In all other cases, the error in using the AER formula will be positive – that is, the AER formula will overstate the accurate remaining life of the group of assets, and so understate the regulatory depreciation that would result from applying the straight line method to assets individually.

75. Again, it is noted that this conclusion rests on the assumption that no asset in the group would have been fully depreciated if depreciation was applied on an individual asset basis.

A.5 Proposition 4 – alternatively, the correct weights for calculating the remaining life of a group of assets is the annual depreciation values (rather than the written down value)

76. I have defined the "accurate" remaining life for a group of assets as the life that results in the depreciation calculated for a group of assets to equate to the aggregate of the depreciation values that would be calculated for each asset individually. Thus, the objective is to find RL_t^* such that:

$$\frac{\sum_{i=1}^{I} V_t^i}{RL_t^*} = \sum_{i=1}^{I} D_t^i$$
$$\Rightarrow RL_t^* = \frac{\sum_{i=1}^{I} V_t^i}{\sum_{i=1}^{I} D_t^i}$$

77. Noting that:

$$V_t^i = D_t^i \cdot RL_t^i$$

78. Substituting this into the previous expression yields:

$$RL_t^* = \frac{\sum_{i=1}^{I} D_t^i \cdot RL_t^i}{\sum_{i=1}^{I} D_t^i}$$

79. This expression implies that an alternative method of calculating the "correct" remaining life for the group for year *t* is to calculate the weighted average of the individual asset remaining lives, using the calculated depreciation for each asset for year *t* as the weights.

80. It can be further observed that the only circumstance where using depreciation as the weighting variable will result in the same (weighted average) remaining life that is derived when using asset values as the weighting variable (i.e., the AER's method) is where (for all *i*):

$$\frac{D_t^i}{\sum_{i=1}^{I} D_t^i} = \frac{V_t^i}{\sum_{i=1}^{I} V_t^i}$$

81. Again, noting that:

$$V_t^i = D_t^i \cdot RL_t^i$$

82. The condition above can be re-expressed as:

$$\left(\sum_{i=1}^{I} D_t^i . RL_t^i\right) = \left(\sum_{i=1}^{I} D_t^i\right) \cdot RL_t^i$$

83. This condition will only be met if the remaining lives are the same for every asset. Thus, this second method of calculating the remaining life leads to the same result reached previously, namely that the AER method will only produce the accurate remaining life for a group of assets in the special case where each asset has the same remaining life.

B. Curriculum vitae

Jeff Balchin

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Jeff is the Managing Director of Incenta Economic Consulting. Jeff has 20 years of experience in relation to economic regulation issues across the electricity, gas, ports, airports, rail, water and telecommunications sectors in Australia and New Zealand. He has advised governments, regulators and major corporations on issues including the development of regulatory frameworks, regulatory price reviews and issues around the introduction and measurement of competition (including franchise bidding). His particular specialities have been on the application of finance principles to economic regulation, the design of incentive compatible regulation and efficient tariff structures and the drafting and economic interpretation of regulatory instruments.

In addition, Jeff has substantial experience with the application of economic and finance principles to pricing and investment appraisal and associated commercial disputes in unregulated infrastructure and non-infrastructure markets. He has also assisted with applying economic principles to transfer pricing.

Jeff has undertaken a number of expert witness assignments.

Past positions

Jeff previously was a Principal at PwC in its economics and policy team for almost 4 years, prior to that a director and partner at the Allen Consulting Group for over 13 years, and prior that he held a number of policy positions in the Commonwealth Government. In this latter role, he was on the secretariat of the Gas Reform Task Force (1995-1996), where he played a lead role in the development of the National Gas Code.

Relevant experience

A. Economic regulation of network / monopoly activities

Assistance to parties during price reviews/negotiations

- Regulatory valuation of telecommunications local loop assets (Client: Chorus, 2014) – prepared a report advising on the appropriate valuation of local loop assets for the purpose of deriving a TSLRIC price for unbundled local loop access.
- Design of incentives for operating expenditure efficiency (Client: ElectraNet, 2012-13) – provided expert advice on the detailed application of the incentive arrangements for operating expenditure, including the link between the incentive scheme and the forecasting method.
- Regulatory depreciation (Client: APA, 2012-13) – provided expert reports on the economic principles relevant to the depreciation method that is applied to set gas transmission charges.
- Regulatory cost of debt (Clients: Powerlink, ElectraNet and Victorian gas distributors 2011-2012) – provided a series of reports addressing how the benchmark cost of debt should be established pursuant to the National Electricity Rules and on the appropriate benchmark allowance for debt and equity raising costs.
- Real cost escalation (Client: Energex, 2009-10) – advised Energex on appropriate escalators to apply to forecasts of operating and capital expenditure over the regulatory period.

- Strategic advice, Victorian electricity distribution review and NSW gas distribution review (Client: Jemena Electricity Networks, 2009-2011) – retained as strategic adviser during the review and also provided advice on a range of technical regulatory economic issues, including on regulatory finance matters, service incentives, party contracts, allocation of costs between regulated and unregulated activities and forecasting of expenditure.
- Regulatory cost of debt (Client: Powercor Australia Limited, 2009-2010) – provided a series of reports addressing how the benchmark cost of debt should be established pursuant to the National Electricity Rules.
- Service incentive scheme (Client: Powercor Australia Limited, 2010) – assisted Powercor to quantify the financial effect that would have flowed if the former service performance incentive scheme had continued. Also prepared an expert report pointing to a material inconsistency in how the AER intended to close out the old scheme and the parameters for the new service performance incentive scheme, which was accepted by the AER.
- Input methodologies for NZ regulated businesses (Clients: Powerco NZ and Christchurch International Airport, 2009-2012) – advised in relation to the Commerce Commission's development of input methodologies, focussing asset valuation, the regulatory cost of capital, the use of productivity trends in regulation and the design of incentive-compatible regulation. Also assisted in briefing counsel in subsequent reviews.
- Commercial negotiation of landing charges (Client: Virgin Blue, 2009-2012) – economic advice to Virgin Blue during its commercial negotiation of landing charges to a number of major and secondary airports.
- Equity Betas for Regulated Electricity Transmission Activities (Client: Grid Australia, APIA, ENA, 2008) – Prepared a report presenting empirical evidence on the equity betas for regulated Australian electricity transmission and distribution businesses for the AER's five yearly review of WACC parameters for these industries. The report demonstrated the implications of a number of different estimation techniques and the reliability of the resulting estimates. Also prepared a joint paper with the law firm, Gilbert+Tobin, providing an economic and legal interpretation of the relevant (unique) statutory guidance for the review.
- Economic Principles for the Setting of Airside Charges (Client: Christchurch International Airport Limited, 2008-2013) – Provided advice on a range of economic issues relating to its resetting of charges for airside services, including the valuation of assets and treatment of revaluations, certain inputs to the cost of capital (beta and the debt margin) and the efficiency of prices over time and the implications for the depreciation of assets and measured accounting profit.
- Treatment of Inflation and Depreciation when Setting Landing Charges (Client: Virgin Blue, 2007 2008) – Provided advice on Adelaide Airport's proposed approach for setting landing charges for Adelaide Airport, where a key issue was how it proposed to deal with inflation and the implications for the path of prices over time. The advice also addressed the different formulae that are available for deriving an annual revenue requirement and the requirements for the different formulae to be applied consistently.
- Application of the Grid Investment Test to the Auckland 400kV Upgrade (Client: Electricity Commission of New Zealand, 2006) - As part of a team, undertook a review of the Commission's process for reviewing Transpower's proposed Auckland 400kV upgrade project and undertook a peer review of the Commission's application of the Grid Investment Test.

- Appropriate Treatment of Taxation when Measuring Regulatory Profit (Client: Powerco New Zealand, 2005 2006) - Prepared a series of statements on how taxation should be treated when measuring realised and projected regulatory profit.
- Application of Directlink for Regulated Status (Client: Directlink, 2003-2004) – Prepared advice on the economic efficiency of the conversion of an unregulated (entrepreneurial) interconnector to a regulated interconnector and how the asset should be valued for pricing purposes.
- Principles for the 'Stranding' of Assets by Regulators (Client: the Independent Pricing and Regulatory Tribunal, NSW, 2005) - Prepared a report discussing the relevant economic principles for a regulator in deciding whether to 'strand' assets for regulatory purposes (that is, to deny any further return on assets that are partially or unutilised).
- Principles for Determining Regulatory Depreciation Allowances (Client: the Independent Pricing and Regulatory Tribunal, NSW, 2003) - Prepared a report discussing the relevant economic and other principles for determining depreciation for the purpose of price regulation, and its application to electricity distribution. An important issue addressed was the distinction between accounting and regulatory (economic) objectives for depreciation.
- Methodology for Updating the Regulatory Value of Electricity Transmission Assets (Client: the Australian Competition and Consumer Commission, 2003) - Prepared a report assessing the relative merits of two options for updating the regulatory value of electricity transmission assets at a price review - which are to reset the value at the estimated 'depreciated optimised replacement cost' value, or to take the previous regulatory value and deduct depreciation and add the capital expenditure undertaken during the intervening period (the 'rolling-forward' method). This paper was commissioned as part of the ACCC's review of its Draft Statement of Regulatory Principles for electricity transmission regulation.
- Application of Murraylink for Regulated Status (Client: Murraylink Transmission Company, 2003) – Prepared advice on the economic efficiency of the conversion of an unregulated (entrepreneurial) interconnector to a regulated interconnector and how the asset should be valued for pricing purposes.
- Proxy Beta for Regulated Gas Transmission Activities (Client: the Australian Competition and Consumer Commission, 2002) - Prepared a report presenting the available empirical evidence on the 'beta' (which is a measure of risk) of regulated gas transmission activities. This evidence included beta estimates for listed firms in Australia, as well as those from the United States, Canada and the United Kingdom. The report also included a discussion of empirical issues associated with estimating betas, and issues to be considered when using such estimates as an input into setting regulated charges.
- Treatment of Working Capital when setting Regulated Charges (Client: the Australian Competition and Consumer Commission, 2002) - Prepared a report assessing whether it would be appropriate to include an explicit (additional) allowance in the benchmark revenue requirement in respect of working capital when setting regulated charges.
- Pricing Principles for the South West Pipeline (Client: Esso Australia, 2001) - As part of a team, prepared a report describing the pricing principles that should apply to the South West Pipeline (this gas transmission pipeline was a new asset, linking the existing system to a new storage facility and additional gas producers).
- Likely Regulatory Outcome for the Price for Using a Port (Client: MIM, 2000) - Provided advice on the outcome that could be expected were the dispute over the price for the use of a major port to be resolved by an economic regulator. The main issue of contention was the valuation of the port

assets (for regulatory purposes) given that the installed infrastructure was excess to requirements, and the mine had a short remaining life.

- Relevance of 'Asymmetric Events' in the Setting of Regulated Charges (Client: TransGrid, 1999) - In conjunction with William M Mercer, prepared a report (which was submitted to the Australian Competition and Consumer Commission) discussing the relevance of downside (asymmetric) events when setting regulated charges, and quantifying the expected cost of those events.

Major roles for regulators

- Aurizon Network price review (Client: Queensland Competition Authority, 2013-14) – advised the QCA on the appropriate rate of return (discount rate) for the Aurizon Network business, which included an assessment of the relative risk of Aurizon Network compared to other infrastructure sectors, advice on the appropriate benchmark gearing level and on the benchmark debt interest rate.
- Victorian Gas Distribution Price Review (Client: the Essential Services Commission, Vic, 2006 2008) - Provided advice to the Essential Service Commission in relation to its review of gas distribution access arrangements on the treatment of outsourcing arrangements, finance issues, incentive design and other economic issues.
- Envestra Gas Distribution Price Review (Client: the Essential Services Commission, SA, 2006) - Provided advice on several finance related issues (including 'return on assets' issues and the financial effect of Envestra's invoicing policy), and the treatment of major outsourcing contracts when setting regulated charges.
- DBCT price review (Client: QCA, Qld, 2004-2006) – advice on a number of finance related issues, including the calculation of IDC for a DORC valuation, cost of debt and equity beta.
- Victorian Electricity Distribution Price Review (Client: the Essential Services Commission, Vic, 2003 2005) - Provided advice to the Essential Service Commission on a range is economic issues related to current review of electricity distribution charges, including issues related to finance, forecasting of expenditure and the design of incentive arrangements for productive efficiency and service delivery. Was a member of the Steering Committee advising on strategic regulatory issues.
- Victorian Water Price Review (Client: the Essential Services Commission, Vic, 2003 2005) - Provided advice to the Essential Services Commission on the issues associated with extending economic regulation to the various elements of the Victorian water sector. Was a member of the Steering Committee advising on strategic regulatory issues, and also provided advice on specific issues, most notably the determination of the initial regulatory values for the water businesses and the role of developer charges.
- ETSA Electricity Distribution Price Review (Client: the Essential Services Commission, SA, 2002 2005) - Provided advice on the 'return on assets' issues associated with the review of ETSA's regulated distribution charges, including the preparation of consultation papers. The issues covered include the valuation of assets for regulatory purposes and cost of capital issues. Also engaged as a quality assurance adviser on other consultation papers produced as part of the price review.
- Victorian Gas Distribution Price Review (Client: the Essential Services Commission, Vic, 2001 2002) - Economic adviser to the Essential Services Commission during its assessment of the price caps and other terms and conditions of access for the three Victorian gas distributors. Was responsible for all issues associated with capital financing (including analysis of the cost of capital and assessment of risk generally, and asset valuation), and supervised the financial modelling and derivation of regulated charges. Also advised on a number of other issues, including the design of

incentive arrangements, the form of regulation for extensions to unreticulated townships, and the principles for determining charges for new customers connecting to the system.

- ETSA Electricity Distribution Price Review (Client: the South Australian Independent Industry Regulator, 2000 2001) - As part of a team, prepared a series of reports proposing a framework for the review. The particular focus was on the design of incentives to encourage cost reduction and service improvement, and how such incentives can assist the regulator to meet its statutory obligations. Currently retained to provide commentary on the consultation papers being produced by the regulator, including strategic or detailed advice as appropriate.
- Dampier to Bunbury Natural Gas Pipeline Access Arrangement Review (Client: the Independent Gas Pipelines Access Regulator, WA, 2000 2002) - Provided economic advice to the Office of the Independent Regulator during its continuing assessment of the regulated charges and other terms and conditions of access for the gas pipeline, including a review of all parts of the draft decision, with particular focus on the sections addressing the cost of capital (and assessment of risk generally), asset valuation and financial modelling. Represented the Office on these matters at a public forum, and provided strategic advice to the Independent Regulator on the draft decision.
- Goldfield Gas Pipeline Access Arrangement Review (Client: the Independent Gas Pipelines Access Regulator, WA, 2000 2004) - Provided economic advice to the Office of the Independent Regulator during its continuing assessment of the regulated charges and other terms and conditions of access for the gas pipeline, including a review of all parts of the draft decision, with particular focus on the sections addressing the cost of capital (and assessment of risk generally), asset valuation and financial modelling. Represented the Office on these matters at a public forum, and provided strategic advice to the Independent Regulator on the draft decision.
- Victorian Electricity Distribution Price Review (Client: the Office of the Regulator General, Vic, 1999 2000) - Economic adviser to the Office of the Regulator General during its review of the price caps for the five Victorian electricity distributors. Had responsibility for all issues associated with capital financing, including analysis of the cost of capital (and assessment of risk generally) and asset valuation, and supervised the financial modelling and derivation of regulated charges. Also advised on a range of other issues, including the design of incentive regulation for cost reduction and service improvement, and the principles for determining charges for new customers connecting to the system.
- Victorian Ports Corporation and Channels Authority Price Review (Client: the Office of the Regulator General, Vic, 2000) - Advised on the finance related issues (cost of capital and the assessment of risk generally, and asset valuation), financial modelling (and the derivation of regulated charges), and on the form of control set over prices. Principal author of the sections of the draft and final decision documents addressing the finance related and price control issues.
- AlintaGas Gas Distribution Access Arrangement Review (Client: the Independent Gas Pipelines Access Regulator, WA, 1999 2000) - Provided economic advice to the Office of the Independent Regulator during its assessment of the regulated charges and other terms and conditions of access for the gas pipeline. This advice included providing a report assessing the cost of capital associated with the regulated activities, overall review of all parts of the draft and final decisions, with particular focus on the sections addressing the cost of capital (and assessment of risk generally), asset valuation and financial modelling. Also provided strategic advice to the Independent Regulator on the draft and final decisions.
- Parmelia Gas Pipeline Access Arrangement Review (Client: the Independent Gas Pipelines Access Regulator, WA, 1999 2000) - Provided economic advice to the Office of the Independent Regulator during its assessment of the regulated charges and other terms and conditions of access for the gas pipeline, including a review of all parts of the draft and final decisions, with particular

focus on the sections addressing the cost of capital (and assessment of risk generally), asset valuation and financial modelling. Also provided strategic advice to the Independent Regulator on the draft and final decisions.

- Victorian Gas Distribution Price Review (Client: the Office of the Regulator General, Vic, 1998) - Economic adviser to the Office of the Regulator General during its assessment of the price caps and other terms and conditions of access for the three Victorian gas distributors. Major issues addressed included the valuation of assets for regulatory purposes, cost of capital financing and financial modelling. Principal author of the draft and final decision documents.

Development/Review of Regulatory Frameworks

- Review of the Australian energy economic regulation (Client: Energy Networks Association, 2010-2012) – assisting the owners of energy infrastructure to engage in the current wide-ranging review of the regime for economic regulation of energy infrastructure. Advice has focussed in particular on the setting of the regulatory WACC and on the regime of financial incentives for capital expenditure efficiency, and included strategic and analytical advice, preparation of expert reports and assistance with ENA submissions.
- Review of the Australian electricity transmission framework (Client: Grid Australia, 2010-2013) – assisting the owners of electricity transmission assets to participate in the wide-ranging review of the framework for electricity transmission in the national electricity market, covering such matters as planning arrangements, the form of regulation for non-core services and generator capacity rights and charging. Has included analytical advice on policy choices, facilitation of industry positions and articulation of positions in submissions.
- Implications of greenhouse policy for the electricity and gas regulatory frameworks (Client: the Australian Energy Market Commission, 2008-2009) – Provided advice to the AEMC in its review of whether changes to the electricity and gas regulatory frameworks is warranted in light of the proposed introduction of a carbon permit trading scheme and an expanded renewables obligation. Issues addressed include the framework for electricity connections, the efficiency of the management of congestion and locational signals (including transmission pricing) for generators and the appropriate specification of a cost benefit test for transmission upgrades in light of the two policy initiatives.
- Economic incentives under the energy network regulatory regimes for demand side participation (Client: Australian Energy market Commission, 2006) – Provided advice to the AEMC on the incentives provided by the network regulatory regime for demand side participation, including the effect of the form of price control (price cap vs. revenue cap), the cost-efficiency arrangements, the treatment of losses and the regime for setting reliability standards.
- Implications of greenhouse policy for the electricity and gas regulatory frameworks (Client: the Australian Energy Market Commission, 2008) - Provided advice to the AEMC in its review of whether changes to the electricity and gas regulatory frameworks is warranted in light of the proposed introduction of a carbon permit trading scheme and an expanded renewables obligation. Issues addressed include the framework for electricity connections, the efficiency of the management of congestion and locational signals for generators and the appropriate specification of a cost benefit test for transmission upgrades in light of the two policy initiatives.
- Application of a 'total factor productivity' form of regulation (Client: the Victorian Department of Primary Industries, 2008) - Assisted the Department to develop a proposed amendment to the regulatory regime for electricity regulation to permit (but not mandate) a total factor productivity approach to setting price caps – that is, to reset prices to cost at the start of the new regulatory

period and to use total factor productivity as an input to set the rate of change in prices over the period.

- Expert Panel on Energy Access Pricing (Client: Ministerial Council on Energy, 2005 2006) - Assisted the Expert Panel in its review of the appropriate scope for commonality of access pricing regulation across the electricity and gas, transmission and distribution sectors. The report recommended best practice approaches to the appropriate forms of regulation, the principles to guide the development of detailed regulatory rules and regulatory assessments, the procedures for the conduct of regulatory reviews and information gathering powers.
- Productivity Commission Review of Airport Pricing (Client: Virgin Blue, 2006) - Prepared two reports for Virgin Blue for submission to the Commission's review, addressing the economic interpretation of the review principles, asset valuation, required rates of return for airports and the efficiency effects of airport charges and presented the findings to a public forum.
- AEMC Review of the Rules for Setting Transmission Prices (Client: Transmission Network Owners, 2005 2006) - Advised a coalition comprising all of the major electricity transmission network owners during the new Australian Energy Market Commission's review of the rules under which transmission prices are determined. Prepared advice on a number of issues and assisted the owners to draft their submissions to the AEMC's various papers.
- Advice on Energy Policy Reform Issues (Client: Victorian Department of Infrastructure/Primary Industries, 2003 ongoing) - advice to the Department regarding on issues relating to the transition to national energy market arrangements, cross ownership rules for the energy sector, the reform of the cost benefit test for electricity transmission investments and the scope for lighted handed regulation in gas transmission.
- Productivity Commission Review of the National Gas Code (Client: BHPBilliton, 2003 2004) - Produced two submissions to the review, with the important issues including the appropriate form of regulation for the monopoly gas transmission assets (including the role of incentive regulation), the requirement for ring fencing arrangements, and the presentation of evidence on the impact of regulation on the industry since the introduction of the Code.
- Development of the National Third Party Access Code for Natural Gas Pipeline Systems Code (Client: commenced while a Commonwealth Public Servant, after 1996 the Commonwealth Government, 1994-1997) - Was involved in the development of the new legal framework for the economic regulation of gas transmission and distribution systems, with advice spanning the overall form of regulation to apply to the infrastructure and the appropriate pricing principles (including the valuation of assets for regulatory purposes and the use of incentive regulation), ring fencing arrangements between monopoly and potentially contestable activities, and whether upstream infrastructure should be included within the regime.

Licencing / Franchise Bidding

- Competitive Tender for Gas Distribution and Retail in Tasmania (Client: the Office of the Tasmanian Energy Regulator, 2001 2002) - Economic adviser to the Office during its oversight of the use of a competitive tender process to select a gas distributor/retailer for Tasmania, and simultaneously to set the regulated charges for an initial period.
- Issuing of a Licence for Powercor Australia to Distribute Electricity in the Docklands (Client: the Office of the Regulator General, Vic, 1999) - Economic adviser to the Office during its assessment of whether a second distribution licence should be awarded for electricity distribution in the Docklands area (a distribution licence for the area was already held by CitiPower, and at that time, no area in the state had multiple licensees). The main issue concerned the scope for using

'competition for the market' to discipline the price and service offerings for an activity that would be a monopoly once the assets were installed.

Assessments of the degree and prospects for competition / need for regulation

- Transmission connection assets (Client: Grid Australia, 2012) – prepared an assessment of the degree of competition in the provision of transmission connection assets, which included advice on the market within which the service is provided and an assessment of the degree of rivalry (including the prospects for entry) in that market.
- South East network (Client: Kimberley Clarke, 2011) – advised whether the gas pipeline from which it is supplied would pass the threshold for regulation.
- Pilbara rail access (Client: BHP Billiton) – assisted in the preparation of expert evidence on whether the Pilbara rail infrastructure passed the test for declaration of essential infrastructure, with specific focus on the analysis of whether there would be a promotion of competition in other markets from the granting of access.
- Need for regulation of gas transmission pipelines (Client: SA Government) – advised as to whether the Moomba to Adelaide pipeline was likely to pass the threshold required for regulation under the Gas Code, focussing upon an assessment of the degree of competition for its services.

B. Pricing in non-infrastructure markets

Assessment of competition in energy retail markets

- Assessment of retail competition in Victoria and South Australia (Client: Australian Energy Market Commission) – assisted the Commission to quantity and interpret information on margins for retailers and to draw inferences about the level of competition. Also provided a peer review of the Commission's overall assessment of the level of competition, including the Commission's overall analytical framework and the other indicators it considered.

Default/transitional regulated prices for retail functions

- ACT transitional tariff review (Client: ICRC, ACT, 2010) – advised the regulator on an appropriate method to derive a benchmark wholesale electricity purchase cost for an electricity retailer, including the relationship between the wholesale cost and hedging strategy.
- South Australian default gas retail price review (Client: the Essential Services Commission, SA, (2007-2008) – derived estimates of the benchmark operating costs for a gas retailer and the margin that should be allowed. This latter exercise included a bottom-up estimate of the financing costs incurred by a gas retail business.
- South Australian default electricity retail price review (Client: the Essential Services Commission, SA, 2007) - estimated the wholesale electricity purchase cost for the default electricity retail supplier in South Australia. The project involved the development of a model for deriving an optimal portfolio of hedging contracts for a prudent and efficient retailer, and the estimate of the expected cost incurred with that portfolio.
- South Australian default gas retail price review (Client: the Essential Services Commission, SA, 2005) - As part of a team, advised the regulator on the cost of purchasing gas transmission services for a prudent and efficient SA gas retailer, where the transmission options included the use of the Moomba Adelaide Pipeline and SEAGas Pipeline, connecting a number of gas production sources.

Market Design

- Options for the Development of the Australian Gas Wholesale Market (Client: the Ministerial Committee on Energy, 2005) - As part of a team, assessed the relative merits of various options for enhancing the operation of the Australian gas wholesale markets, including by further dissemination of information (through the creation of bulletin boards) and the management of retailer imbalances and creation of price transparency (by creating short term trading markets for gas).
- Review of the Victorian Gas Market (Client: the Australian Gas Users Group, 2000 2001) - As part of a team, reviewed the merits (or otherwise) of the Victorian gas market. The main issues of contention included the costs associated with operating a centralised market compared to the potential benefits, and the potential long term cost associated with having a non-commercial system operator.
- Development of the Market and System Operation Rules for the Victorian Gas Market (Client: Gas and Fuel Corporation, 1960) - Assisted with the design of the 'market rules' for the Victorian gas market. The objective of the market rules was to create a spot market for trading in gas during a particular day, and to use that market to facilitate the efficient operation of the system.

Transfer pricing

- Application of a netback calculation for infrastructure under the Minerals Resource Rent Tax (Client: BHPB, 2011-13) – advised on how the arms-length price for the use of downstream infrastructure should be determined, including the valuation of assets, weighted average cost of capital and on the implications for the price of incentive compatible contracts.

Pricing strategy

- Pricing for telephone directory services (Sensis, 2012) – as part of a team, advised on how margins could be maximised for the telephone directory business in the context of falling print advertising and a very competitive digital market, informed by the application of econometric techniques.
- Effectiveness of promotional strategies (Target, 2011-12) – as part of a team, applied econometric techniques to assess the effectiveness of Target's promotional strategies, with tools developed for management to improve profitability.
- Optimal pricing (Client: Coles, 2011-12) – applied econometric techniques to assist Coles to set relativities of prices within "like" products and developed a method to test the effectiveness of promotional strategies.

C. Regulatory due diligence and other finance work

- Sale of the Sydney Desalination Plant (Client: a consortium of investors, 2011-12) – Prepared a regulatory due diligence report for potential acquirer of the asset, including a review of the financial modelling of future pricing decisions.
- Sale of the Abbot Point Coal Terminal port (Client: a consortium of investors / debt providers, 2010-11) – Prepared a regulatory due diligence report for potential acquirer of the asset, including a review of the financial modelling of future pricing decisions.
- Private Port Development (Client: Major Australian Bank, 2008) - Prepared a report on the relative merits of different governance and financing arrangements for a proposed major port development that would serve multiple port users.

- Sale of Allgas gas distribution network (Client: confidential, 2006) – Prepared a regulatory due diligence report for potential acquirer of the asset.
- Review of Capital Structure (Client: major Victorian water entity, 2003) - Prepared a report (for the Board) advising on the optimal capital structure for a particular Victorian water entity, taking account of the likely impact of cost based regulation.

D. Expert Witness Roles

- Abbot Point Coal Terminal Pricing Arbitration (Client: Adani, 2013) – Prepared a number of expert reports for the arbitration on economic issues arising from the application of the cost-based formula in the pricing agreement, including the economic meaning of key terms, the valuation of assets (and specifically the role and calculation of interest during construction), the quantification of transaction costs of raising finance and the calculation of the required rate of return (most notably, the benchmark cost of debt finance).
- New Zealand Input Methodologies (Clients: Powerco and Christchurch International Airport Limited, 2009-2012) – Prepared expert report for both clients on a range of economic issues, including the valuation of assets, weighted average cost of capital, cost allocation, the regulatory treatment of taxation and interpretation of the new purpose statement in the Commerce Act. Appeared as an expert before the Commerce Commission in the key conferences held during the review. Also assisted the clients in their subsequent merit reviews of the Commission's decision.
- Victorian gas market dispute resolution panel (Client: VENCorp, 2008) – Prepared a report and was cross examined in relation to the operation of the Victorian gas market in the presence of supply outages.
- Consultation on Major Airport Capital Expenditure Judicial Review (Client: Christchurch International Airport, 2008) - Prepared an affidavit for a judicial review on whether the airport consulted appropriately on its proposed terminal development. Addressed the rationale, from the point of view of economics, of separating the decision of 'what to build' from the question of 'how to price' in relation to new infrastructure.
- New Zealand Commerce Commission Draft Decision on Gas Distribution Charges (Client: Powerco, 2007 08) - Prepared an expert statement about the valuation of assets for regulatory purposes, with a focus on the treatment of revaluation gains, and a memorandum about the treatment of taxation for regulatory purposes and appeared before the Commerce Commission.
- Sydney Airport Domestic Landing Change Arbitration (Client: Virgin Blue, 2007) - Prepared two expert reports on the economic issues associated with the structure of landing charges (note: the evidence was filed, but the parties reached agreement before the case was heard).
- New Zealand Commerce Commission Gas Price Control Decision – Judicial Review to the High Court (Client: Powerco, 2006) - Provided four affidavits on the regulatory economic issues associated with the calculation of the allowance for taxation for a regulatory purpose, addressing in particular the need for consistency in assumptions across different regulatory calculations.
- Victorian Electricity Distribution Price Review – Appeal to the ESC Appeal Panel: Service Incentive Risk (Client: the Essential Services Commission, Vic, 2005 2006) - Prepared expert evidence on the workings of the ESC's service incentive scheme and the question of whether the scheme was likely to deliver a windfall gain or loss to the distributors (note: the evidence was filed, but the appellant withdrew this ground of appeal prior to the case being heard).
- Victorian Electricity Distribution Price Review – Appeal to the ESC Appeal Panel: Price Rebalancing (Client: the Essential Services Commission, Vic, 2005 2006) - Prepared expert

evidence on the workings of the ESC's tariff basket form of price control, with a particular focus on the ability of the electricity distributors to rebalance prices and the financial effect of the introduction of 'time of use' prices in this context (note: the evidence was filed, but the appellant withdrew this ground of appeal prior to the case being heard).

- New Zealand Commerce Commission Review of Information Provision and Asset Valuation (Client: Powerco New Zealand, 2005) - Appeared before the Commerce Commission for Powerco New Zealand on several matters related to the appropriate measurement of profit for regulatory purposes related to its electricity distribution business, most notably the treatment of taxation in the context of an incentive regulation regime.
- Duke Gas Pipeline (Qld) Access Arrangement Review – Appeal to the Australian Competition Tribunal (Client: the Australia Competition and Consumer Commission, 2002) - Prepared expert evidence on the question of whether concerns of economic efficiency are relevant to the non price terms and conditions of access (note: the evidence was not filed as the appellant withdrew its evidence prior to the case being heard).
- Victorian Electricity Distribution Price Review – Appeal to the ORG Appeal Panel: Rural Risk (Client: the Office of the Regulator General, Vic, 2000) - Provided expert evidence (written and oral) to the ORG Appeal Panel on the question of whether the distribution of electricity in the predominantly rural areas carried greater risk than the distribution of electricity in the predominantly urban areas.
- Victorian Electricity Distribution Price Review – Appeal to the ORG Appeal Panel: Inflation Risk (Client: the Office of the Regulator General, Vic, 2000) - Provided expert evidence (written and oral) to the ORG Appeal Panel on the implications of inflation risk for the cost of capital associated with the distribution activities.

Qualifications and memberships

- Bachelor Economics (First Class Honours) University of Adelaide
- CEDA National Prize for Economic Development

C. Guidelines for Expert Witnesses in Proceedings in the Federal Court of Australia

FEDERAL COURT OF AUSTRALIA
Practice Note CM 7
EXPERT WITNESSES IN PROCEEDINGS IN THE FEDERAL COURT OF AUSTRALIA

Practice Note CM 7 issued on 1 August 2011 is revoked with effect from midnight on 3 June 2013 and the following Practice Note is substituted.

Commencement

1. This Practice Note commences on 4 June 2013.

Introduction

2. Rule 23.12 of the Federal Court Rules 2011 requires a party to give a copy of the following guidelines to any witness they propose to retain for the purpose of preparing a report or giving evidence in a proceeding as to an opinion held by the witness that is wholly or substantially based on the specialised knowledge of the witness (see **Part 3.3 - Opinion** of the *Evidence Act 1995* (Cth)).

3. The guidelines are not intended to address all aspects of an expert witness's duties, but are intended to facilitate the admission of opinion evidence[1], and to assist experts to understand in general terms what the Court expects of them. Additionally, it is hoped that the guidelines will assist individual expert witnesses to avoid the criticism that is sometimes made (whether rightly or wrongly) that expert witnesses lack objectivity, or have coloured their evidence in favour of the party calling them.

Guidelines

1. General Duty to the Court[2]

1.1 An expert witness has an overriding duty to assist the Court on matters relevant to the expert's area of expertise.

1.2 An expert witness is not an advocate for a party even when giving testimony that is necessarily evaluative rather than inferential.

1.3 An expert witness's paramount duty is to the Court and not to the person retaining the expert.

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[1] As to the distinction between expert opinion evidence and expert assistance see *Evans Deakin Pty Ltd v Sebel Furniture Ltd* [2003] FCA 171 per Allsop J at [676].

[2] The "*Ikarian Reefer*" (1993) 20 FSR 563 at 565-566.

2. The Form of the Expert's Report[3]

2.1 An expert's written report must comply with Rule 23.13 and therefore must

(a) be signed by the expert who prepared the report; and

(b) contain an acknowledgement at the beginning of the report that the expert has read, understood and complied with the Practice Note; and

(c) contain particulars of the training, study or experience by which the expert has acquired specialised knowledge; and

(d) identify the questions that the expert was asked to address; and

(e) set out separately each of the factual findings or assumptions on which the expert's opinion is based; and

(f) set out separately from the factual findings or assumptions each of the expert's opinions; and

(g) set out the reasons for each of the expert's opinions; and

(ga) contain an acknowledgment that the expert's opinions are based wholly or substantially on the specialised knowledge mentioned in paragraph (c) above[4]; and

(h) comply with the Practice Note.

2.2 At the end of the report the expert should declare that "[the expert] has *made all the inquiries that* [the expert] *believes are desirable and appropriate and that no matters of significance that* [the expert] *regards as relevant have, to* [the expert's] *knowledge, been withheld from the Court*."

2.3 There should be included in or attached to the report the documents and other materials that the expert has been instructed to consider.

2.4 If, after exchange of reports or at any other stage, an expert witness changes the expert's opinion, having read another expert's report or for any other reason, the change should be communicated as soon as practicable (through the party's lawyers) to each party to whom the expert witness's report has been provided and, when appropriate, to the Court[5].

2.5 If an expert's opinion is not fully researched because the expert considers that insufficient data are available, or for any other reason, this must be stated with an indication that the opinion is no more than a provisional one. Where an expert witness who has prepared a report believes that it may be incomplete or inaccurate without some qualification, that qualification must be stated in the report.

2.6 The expert should make it clear if a particular question or issue falls outside the relevant field of expertise.

2.7 Where an expert's report refers to photographs, plans, calculations, analyses, measurements, survey reports or other extrinsic matter, these must be provided to the opposite party at the same time as the exchange of reports[6].

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[3] Rule 23.13.

[4] See also *Dasreef Pty Limited v Nawaf Hawchar* [2011] HCA 21.

[5] The *"Ikarian Reefer"* [1993] 20 FSR 563 at 565

[6] The *"Ikarian Reefer"* [1993] 20 FSR 563 at 565-566. See also Ormrod *"Scientific Evidence in Court"* [1968] Crim LR 240

3. Experts' Conference

3.1 If experts retained by the parties meet at the direction of the Court, it would be improper for an expert to be given, or to accept, instructions not to reach agreement. If, at a meeting directed by the Court, the experts cannot reach agreement about matters of expert opinion, they should specify their reasons for being unable to do so.

J L B ALLSOP
Chief Justice
4 June 2013