CEG: Escalation factors affecting expenditure forecasts (labour and materials)

Appendix 12

Tasmanian Networks Pty Ltd

Transend Networks Pty Ltd

COMPETITION ECONOMISTS GROUP

Escalation factors affecting expenditure forecasts

December 2013

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COMPETITION ECONOMISTS GROUP

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1 Introduction

1. CEG has been commissioned by Ausgrid, Endeavour Energy, Essential Energy, ActewAGL and Transend (collectively the NSPs) to estimate cost escalation factors in order to assist it in forecasting future operating and capital expenditure based on changes in unit costs. The NSPs have requested that cost escalation factors be developed for:

   - aluminium;
   - copper;
   - steel;
   - crude oil;
   - labour, including utilities industry , professional services and general labour; and
   - construction – both engineering and non-residential.

2. Escalation factors, properly derived, can be used to project forward the value of base objects into the future. An example of a base object may be the average wages of a full time employee in the electricity, gas, water and waste sectors (utilities industry) over the 2012-13 financial year.

3. Planning of future projects may be conducted on the basis that a certain number of such employees may be required over a period of time during the next regulatory period. Escalation factors for utilities industry wages can be used to determine the expected cost of the labour input to this project.

4. In this report, we review the foundations for the methodology that has been applied in the context of previous energy network determinations and re-estimate escalation factors based on the most recently available data.

5. The methodology that we have adopted in this report is to source predictions of future prices for these inputs, whether in the form of futures prices or expert forecasts, and to rely on these data to develop escalation factors. Where futures prices are available and are sufficiently liquid, we have used these in preference to forecasts on the basis that these represent the best forecast of prices by informed market participants.

6. This methodology and the use of input data applied in this report to estimate escalation factors is characterised by a high degree of transparency.

7. Issues of consistency in timing are important to the development of escalation factors, because their function is to project forward prices or costs from one period to another. We report escalation factors based on:

   - the forecast change in average prices between financial years (which we call 'financial year' escalators); and

- the forecast change in average prices between each calendar year (which we call 'calendar year' escalators).

8. Each business has estimated over a particular period the base price of the units that it seeks to escalate. This is important to escalation because each business' escalation factors must consistently commence escalation of prices from the correct base period.

9. The remainder of this report is set out as follows:

   - Section 2 sets out the basis of the methodology that is proposed by CEG to estimate cost escalation factors;
   - Section 3 describes our calculation of labour cost escalation factors; and
   - Section 4 describes our calculation of materials cost escalation factors.

2 Description of methodology

10. In order to escalate forward the NSPs' operating and capital expenditure it is necessary to obtain or develop forecasts of either:

    a. the price of goods and services directly purchased by the NSPs; or

    b. the price of inputs used in the production of goods and services directly purchased by the NSPs for the purpose of delivering their expenditure programs.

11. This task would best be achieved by examining forecasts of prices for all inputs purchased by the NSPs (i.e. category a) above). However, with the possible exception of labour costs, bespoke forecasts for individual items (e.g. transformers, copper cable, switch gear) are difficult to procure. For example, while there are forecasts for labour costs in the general utilities sector (i.e., for electricity, gas, water and wastewater) there are few, if any, forecasts of the cost of equipment purchased by the NSPs.

12. The lack of such forecasts for most goods and services purchased by the NSPs reflects the specialised and heterogeneous nature of these goods and services – such that there is insufficient demand for forecasts of these prices and no active trading in 'futures' for these goods and services. For example, there is no formal 'futures market' for transformers.

13. However, price forecasts for many of the inputs used in the production of equipment/services purchased by NSPs can be informed by raw material forecasts and/or futures. Specifically:

    a. futures prices and forecasts for aluminium, copper and crude oil can be used to inform forecasts for the value of these materials as components of NSPs' expenditures;

    b. forecasts of the price of steel, construction and labour can be used to project forward the value of these components of NSPs' expenditures; and

    c. forecasts of general cost movements (e.g. consumer price index or producer price index) can be used to derive changes in the cost of other inputs used by the NSPs or their suppliers that are not captured above (e.g. energy costs and equipment leases etc.).

14. This high-level approach has previously been proposed by CEG in its reports for electricity and gas businesses[1] and has been accepted by the AER in its previous determinations on this issue.[2]

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[1] These reports are for Electranet, NSW and Tasmanian electricity distribution and transmission businesses, Western Power and Jemena Gas Networks.

[2] An exception to this is the AER's recent decision to cease reliance on futures prices for crude oil for the purpose of estimating crude oil escalation factors. In its review the Victorian gas businesses, the AER

15. The necessary steps required to develop a forecast for the escalation of an expenditure program are as follows:

Step 1	break down the expenditure program into different cost categories for which there are cost forecasts (or for which cost forecasts can be derived);
Step 2	source/derive relevant cost forecasts; and
Step 3	calculate a weighted average escalation factor using weights derived in Step 1 and forecasts from Step 2.

16. In order to complete Step 2 where there are no futures or forecasts available for a particular good or service (e.g. transformers) it may be necessary to derive a forecast for that good or service from other forecasts. The methodology taken in deriving a forecast is similar to the above – the only difference being the starting point is not a breakdown of the costs of the overall expenditure programs but a breakdown of the costs of the equipment in question. It can be described as follows:

Step 2A	breakdown the cost of production for that good/service into component inputs parts for which there are forecasts available (e.g. steel, aluminium and labour);
Step 2B	source the relevant input cost forecasts; and
Step 2C	calculate a weighted average escalation factor using weights derived in step 2A and forecasts from step 2B.

17. The remainder of this section sets out a number of considerations that guide the approach set out above.

2.1 Preference for futures over forecasts

18. In coming to our estimates of the NSPs' future escalation factors we have had regard to various predictions of how prices may change in the future. These predictions have been obtained from two general sources: futures market prices and expert forecasts.

19. In CEG's opinion, the most reliable forecast for input prices is provided by prices determined in the futures market – provided that the relevant market is sufficiently liquid. That is, the most reliable predictor of prices on a particular date in the future is the price at which market participants are willing to commit to trading on that day. If there was a better estimate of future prices then investors could expect to profit by buying/selling futures until today's futures price reflected the best estimate of spot prices on the relevant future date.

20. Of course, futures prices will be very unlikely to exactly predict future spot prices given that all manner of unexpected events can occur. In fact, futures prices have

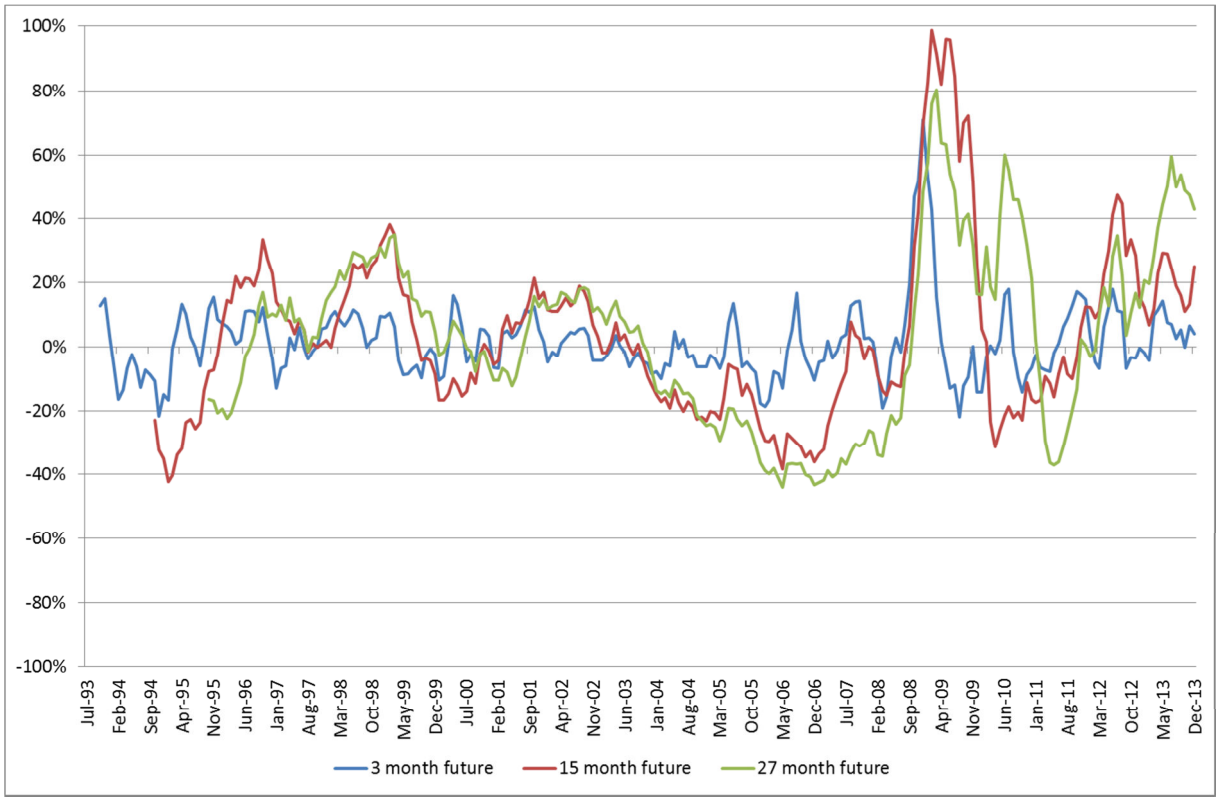
instead decided to base its escalation factors for crude oil on a forecast of constant real prices. We discuss this in greater detail at section 4.3 below.

spectacularly underestimated refined aluminium prices in the last few years (see Figure 1). They nonetheless provide the best estimate of future spot prices.

21. An important reason why futures markets are more reliable than professional forecasts is that in order to participate in a futures market (and help set the price in that market) participants are required to place funds at risk. This is a standard proposition in finance theory not just limited to futures markets for base metals and oil. The International Monetary Fund also makes the same point when it states:

> *While futures prices are not accurate predictors of future spot prices, they nevertheless reflect current beliefs of market participants about forthcoming price developments. Bowman and Husain (2004) find that futures-prices-based models produce more accurate forecasts than the models based on historical data or judgment, especially at long horizons.*[3]

Figure 1: Prices predicted by LME futures less actual prices – Aluminium



Source: CEG analysis, Bloomberg

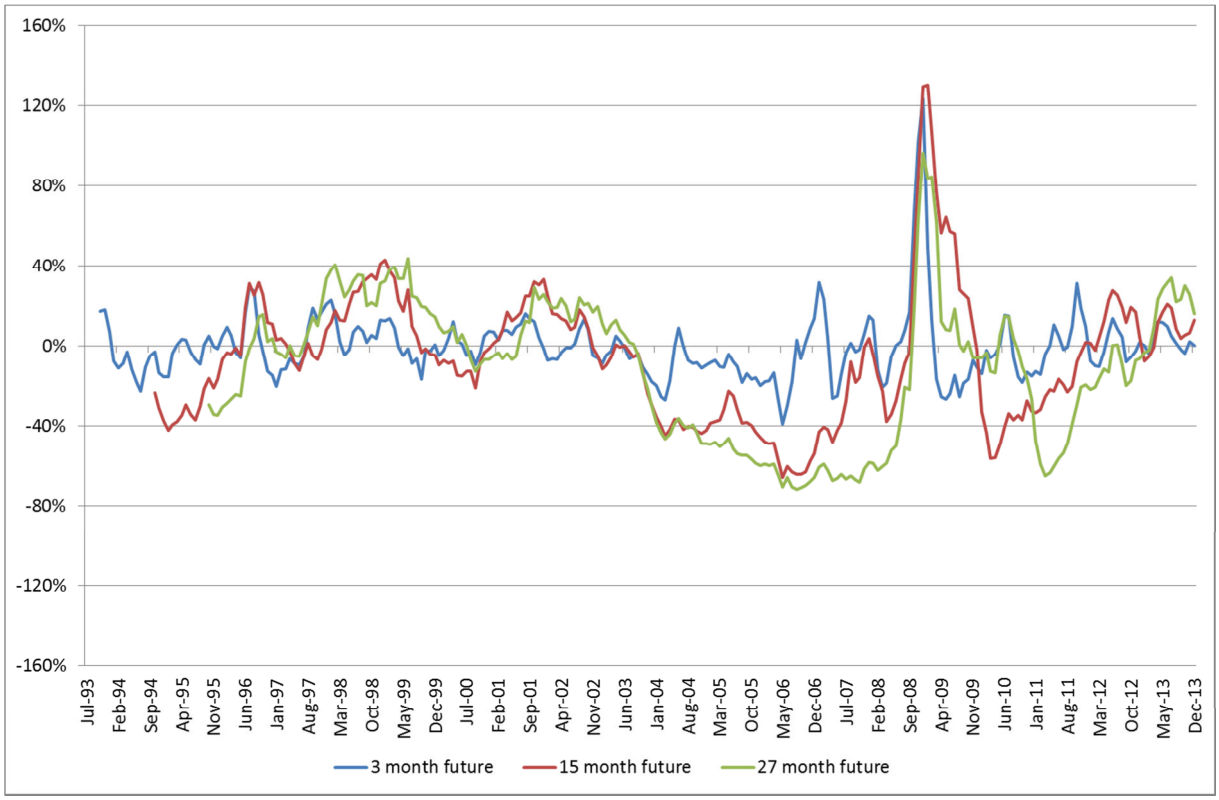
22. As presented in Figure 1, between 2002 and 2007, 15 and 27 month futures prices systematically underestimated spot prices (i.e. failed to anticipate the increase in spot prices and overestimated the rate at which they would subsequently fall).

3 IMF, *World Economic Outlook*, April 2007, p.8

Between 2008 and 2010 the opposite is true and futures prices systematically overestimated spot prices, sometimes significantly so.

23. In Figure 2 below, it is evident that futures prices of copper have at times underestimated spot prices, particularly at 15 and 27 months, and similarly to aluminium futures did not predict the global financial crisis and the temporary collapse in copper prices over that period.

Figure 2: Prices predicted by LME futures less actual prices – Copper



Source: CEG analysis, Bloomberg

24. We note that the AER has historically agreed with our preference of futures over forecasts and has implemented this for aluminium, copper and crude oil. However in its recent regulatory review of the Victorian gas businesses, the AER has materially changed its views in relation to the predictive value of futures prices for crude oil and no longer relies upon futures prices to estimate its crude oil escalation factors. We discuss the AER's considerations in greater detail at section 4.3 below.

2.2 Why firm specific hedging is not an alternative to escalation

25. In its expenditure forecast assessment guidelines issues paper the AER made the following statement in relation to cost escalation:[4]

> *We have also devoted considerable effort in recent determinations to examining the methods employed by NSPs to account for all of these factors, which have tended to be quite detailed and in some cases prone to material error. We also note that a material amount of time and money has been devoted in engaging expert consultants in developing frameworks for the recognition of input price escalators and also in the forecasting of input prices. The impact of price escalation on total allowances is typically in the range of 3% to 5%.*
>
> *We are interested in stakeholder views in the materiality and effectiveness of the assessment approach we have employed in the past,* ***particularly in light of the expenditure impact of these factors, the uncertainty inherent in some inputs and whether firms should be able to manage the impact of some cost factors e.g. through hedge contracts, productivity dividends in wage negotiations and in the timing of input purchases****. We are interested in views as to whether a standardised approach could be agreed upon between NSPs and other stakeholders, including the use of forecasts published independently of the regulatory process, as well as the joint engagement of experts to produce forecasts.*
>
> *Where factors are particularly uncertain and unmanageable, we would also be interested in exploring appropriate risk sharing mechanisms between NSPs and consumers e.g. potential pass through or price control adjustments, or whether the existing ex ante approach is adequate.* (emphasis added)

26. The highlighted element of this quote appears to suggest that instead of businesses cost allowances including an element for cost escalation (be it positive or negative) businesses could:

- hedge exposure to input price movements (so that they are no better/worse off as a result of price movements);
- negotiate with suppliers to only pay higher prices if the quality "productivity" of the good/service improves commensurately (such that fewer units need to be purchased to achieve the same result). The quote appears to only countenance this strategy in relation to labour purchases. However, there is no obvious

4 AER, *Expenditure forecast assessment guidelines for electricity distribution and transmission: Issues paper*, December 2012, p. 114

reason why productivity negotiations with suppliers should only be relevant to suppliers of labour;

- time purchases of inputs to periods when their prices are low and thereby avoid the costs of any price increases.

27. In our view, these are strategies that a business could, and, at least in the case of the second dot point, should undertake. However, there is no reason to believe that these would lead to zero price escalation. Indeed, the first and last strategies would actually lead to higher expected costs – at least relative to the cost escalation that would result following our methodology of using commodity futures prices.

28. To understand why hedging input price exposure will lead to higher costs relative to escalation based on commodity futures prices, consider a business with a requirement to buy copper wire over a five year regulatory period. The cost escalation methodology we use assumes that copper wire will increase in proportion with the traded futures prices for copper over the five years (weighted by the importance of copper as an input into the cost of producing copper wire).

29. If a business actually tried to hedge its exposure to future copper price movements it is precisely these futures prices that they would pay for the hedging. That is, when a firm hedges it locks in the futures prices, not the current prices. Consequently, they would be locking in the same cost escalation that is calculated using the methodology outlined previously. They would not be locking in zero price movements in copper – this is not possible unless by chance that the market is predicting zero price movements.

30. However, by actually trading in the futures market they would incur transaction costs, including in the form of the buy/sell spread, which are not included in our calculations (which are based on mid prices). Consequently, actually hedging would raise costs by more than we estimate using our methodology. Of course, actually hedging would also have the advantage of removing uncertainty from the business. However, it would not change the fact that the best forecast of the business's costs would still include the predicted movements in copper prices etc.

31. In the case of negotiating with suppliers for the best price, or offsetting productivity improvements for price increases, this is certainly a prudent practice for a business to undertake. However, it cannot be assumed that this practice will eliminate real cost increases in the price of inputs. Businesses must operate in a market with suppliers. If the market price is increasing then businesses have no option but to pay that market price for the inputs that they require. This may sometimes involve increases in prices that are not associated with any improvement in quality – as might be the case in a tight labour market where labour is in demand from other industries.

32. The same is true in relation to the timing of input purchases. It will generally not be possible to avoid price increases by buying the input when its price is low and storing it until its price is high and using it then. This is a role that is played by

commodities traders who do store physical stockpiles of commodities in an attempt to benefit from inter-temporal arbitrage (buy low and sell high) and in so doing smooth out the movements in market price. However, this is not a role that can be profitably undertaken by an electricity network business.

33. Storage of physical product is expensive (in time value of money costs and physical costs) and this cost is higher the more value added in the product (e.g., copper wire is higher value added than raw copper). The efficient practice is for inter-temporal arbitrage to occur at the level of raw copper and not copper wire. Businesses already benefit from the smoothing of raw copper prices (and this is reflected in copper futures) as a result of the actions of commodity traders. Any attempt by the NSPs to mimic the actions of commodity traders by attempting inter-temporal arbitrage of copper wire prices would be highly speculative and unlikely to significantly reduce costs, if at all.

2.3 Forecasting foreign exchange movements

34. An important determinant of future equipment prices is the future value of the Australian dollar. This is clearly true of imported equipment but is also true in relation to the purchase of domestically produced equipment that may nonetheless be sold on a world market and in relation to the input costs for domestic suppliers (e.g. the cost of copper and aluminium for Australian producers of electrical cable).

35. In the context of the NSPs' escalation factors, it is normally the case that commodities traded on international markets are priced in terms of United States dollars, and generally futures and forecasts of these commodities are also based in these terms. This means that we must establish a forecast of the value of the Australian dollar, in terms of the United States dollar, over the relevant horizon so that forecasts of commodity prices can be expressed in Australian dollar terms.

36. For the purpose of this report, we have sourced forward rates from Bloomberg until 2023. To ensure accuracy, we have averaged daily historical FX forward forecasts from one to 10 years into the future over the month to 21 November 2013.

2.4 Real versus nominal escalation

37. It is our understanding that the escalation factors that are to be applied to both operating and capital expenditure must escalate the real price of the underlying good or service as outlined in the terms of reference, and not the nominal price. However, it is not always possible to obtain forecasts of future price movements that are expressed in real terms.

38. For wage costs, we have relied on Independent Economics forecasts of nominal wage growth, deflated by Independent Economics' own forecast of Australian inflation. That is, where they are available, we have preferred forecasts of the real change in underlying input prices.

39. However, where we have relied on futures markets to derive forecasts of particular prices (e.g. aluminium), we have deflated these by an inflation forecast based on Reserve Bank of Australia (RBA) data for Australian dollar prices. This is because futures contracts tend to be written in nominal terms and it is not possible to 'see' the inflation expectations of the parties of that contract.[5] The derivation of this forecast is very simple and is explained in Box 1 below.

Box 1: Derivation of forecast CPI index based on RBA forecasts

The RBA issues a Statement on Monetary Policy four times a year, the most recent in November 2013. Since February 2007, the RBA has released as part of these statements its forecast of CPI changes over the next two to three years. An example of the most recent forecasts is shown below.

Table 6.1: Output Growth and Inflation Forecasts[a]
Per cent

	Year-ended					
	June 2013	Dec 2013	June 2014	Dec 2014	Jun 2015	Dec 2015
GDP growth	2.6	2¼	2½	2–3	2¼–3¼	2¾–4¼
Non-farm GDP growth	2.7	2¼	2½	2–3	2¼–3¼	2¾–4¼
CPI inflation[b]	2.4	2½	2¾	2–3	2–3	1½ –2½
Underlying inflation[b]	2½	2¼	2½	2–3	2–3	1¾ –2¾
	Year-average					
	2012/13	2013	2013/14	2014	2014/15	2015
GDP growth	2.6	2½	2½	2–3	2–3	2½ –3½

(a) Technical assumptions include A$ at US$0.95, TWI at 72 and Brent crude oil price at US$104 per barrel
(b) Based on current legislation for the price of carbon
Sources: ABS; RBA

In combination with the historical Australian Bureau of Statistics (ABS) series for CPI, the RBA forecasts naturally lend themselves to the creation of a forecast index, based on the following steps:

- obtain historical CPI from the ABS, currently available up to and including the September quarter, 2013;
- estimate the December 2013 and June 2014 forecast index numbers based on the actual index numbers for December 2012 and June 2013 and the change in CPI forecast by the RBA;
- estimate subsequent June and December forecast index numbers based on the forecast index numbers for the previous Junes and Decembers and the change in

5 For the purpose of calculating real escalation factors monthly nominal forecasts have been converted to annual real forecasts by way of first converting the nominal forecasts to real forecasts in each month (i.e. the monthly nominal forecast divided by the monthly inflation forecast). Annual real forecasts have then been calculated by averaging 12 months of monthly real forecasts.

CPI forecast by the RBA;

- beyond the horizon of the RBA forecasts, estimate June and December forecast index numbers based on the forecast index numbers for the previous June and December, increased by 2.50%; and
- forecast March and September quarter indices by interpolating between the relevant June and December quarters.

The use of 2.50% as a long-term forecast of inflation is selected as being the mid-point of the RBA's target range of 2 to 3 percent. We note that the entirety of this methodology is consistent with the approach utilised in the AER's modelling of escalation factors.

2.5 Timing of escalation factors

40. Issues of timing are critical to determining escalators that can consistently be applied for this purpose. An escalator provides an estimate for the increase in price for an input from one period to another. For consistency it is important that the escalation factors that are applied to the base planning objects are:

    i. derived in a way that is consistent with the base period in which these costs have been measured;

    ii. derived in a way that is consistent with their intended use in forecasting future costs in specific periods; and

    iii. avoid overlapping periods or 'gaps' such that escalation is either not properly accounted for or is double counted.

41. It is our understanding that escalation factors are used for the purpose of forecasting expenditure programs based on changes in unit costs, to form part of the NSPs revenue proposals for the 2014-15 to 2018-19 regulatory periods.

42. Each business has estimated over a particular period the base price of the units that it seeks to escalate. This is important to escalation because each business' escalation factors must consistently commence escalation of prices from the correct base period. The base periods applying to the objects to be escalated by the NSPs are presented in Table 1 below.

Table 1: NSP base periods

NSP	Base period
Ausgrid	December 2012
Endeavour Energy	2012-13 financial year
Essential Energy	2012-13 financial year
Transend – opex	2012-13 financial year
Transend – capex	June 2012
ActewAGL	2012-13 financial year

43. It is important that escalation factors do not either omit or double-count price changes over a particular period of time. Whilst all these criteria may seem trivial, it is our experience that achieving timing consistency is one of the most difficult and contentious issues in the development of escalation factors. For example, the calculations described in Appendix A show that it can be particularly challenging in the context of utilities labour costs.

2.6 Quarterly indexation using annual escalators

44. Some of the forecasts that we have regard to in deriving escalation factors, such as those provided by Independent Economics, express forecast changes as the change in average prices from one financial year to the next. These lend themselves naturally to use as financial year escalation factors, as described above.

45. However, sometimes forecasts expressed in this way cannot be so readily used. For example, the methodology used by the AER in its final determinations for the New South Wales and Tasmanian electricity businesses assumed that forecasts for utilities industry wages would only be applied after the expiry of each firm's enterprise bargaining agreement (EBA). In some cases, this transition was made at the start of the calendar year, which meant that the forecasts could not straightforwardly be applied to the data in order to project it forward.

46. In the context of these final determinations, the AER accepted the views of its consultant, Econtech, that its forecasts could be used to construct a quarterly index that could then be used to estimate forecasts or escalators based on alternative timing assumptions. Econtech proposed a four-part equation,[6] an example of which is:

$$Index\ Sept\ 08 = (2 * Index(07-08) + 7 * Index(08-09) - Index(09-10))/8$$

$$Index\ Dec\ 08 = (9 * Index(08-09) - Index(09-10))/8$$

$$Index\ Mar\ 09 = (-Index(07-08) + 9 * Index(08-09))/8$$

$$Index\ Jun\ 09 = (-Index(07-08) + 7 * Index(08-09) + 2 * Index(09-10))/8$$

6 Econtech, *Updated labour cost growth forecasts*, 25 March 2009, pp.23-4

47. The main rationale behind the choice of these formulae was that the quarterly index derived by their use was consistent with the annual forecasts from which they were estimated. We note that that this set of formulae is not the only method by which such an index could be constructed, but we regard it as reasonable for its purpose.

48. The AER used these formulae in its final determinations in respect of Econtech forecasts for utilities industry wages, general labour and construction. However, the formulae are not specific to use with Econtech forecasts, and in this report we apply them generally to any forecast expressed in this way. We also employ these formulae, translated by two quarters, to convert forecasts expressed in average calendar year terms into a quarterly index.

2.7 Precision and accuracy

49. There is always a high degree of uncertainty associated with predicting the future. Although we consider that we have obtained the best possible estimates of the NSPs' future costs at the present time, the actual magnitude of these costs at the time that they are incurred may well be considerably higher or lower than we have estimated in this report. This is a reflection of the fact that while futures prices and forecasts today may well be a very precise estimate of current expectations of the future, they are at best an imprecise estimate of future values.[7]

50. Although the spreadsheet modelling underlying the calculation of these escalation factors may, in some cases, predict quarterly or even monthly values of commodity prices in the future, we do not represent that it is possible to generate precise estimates for these values. Rather, this modelling approach is used because futures prices and forecasts often themselves make predictions for a particular quarter in the future, so we must adopt a similar structure to incorporate these predictions.

51. Finally, we note the distinction between precision and accuracy. Although there is considerable imprecision in predicting the future, this is not a reason to unecessarily estimate escalation factors that are artificially biased upward or downward, even if this bias is relatively small.

52. At Appendix A we describe why a transition between the NSPs' actual EBA wages data and forecasts of future wage growth must be carefully made to avoid bias in the escalation factors. We consider this to be an issue of accuracy, rather than precision, since it involves making efficient and consistent use of the data available to come to the best forecast escalation factors given the circumstances.

53. At Appendix B we provide a review of the forecasts we provided the NSPs in the context of revised proposals submitted to the AER in February 2009 compared to actual outcomes in the period since those escalation factors were published.

7 See, for example, Figure 1 above.

2.8 Presentation of escalation factors

54. Where we present escalation factors in this report, we do so in tables with separate rows for each NSP. For each NSP, the first escalation factor represents the escalation from that NSP's base period to the financial year or calendar year corresponding to that column. Each subsequent escalation factor to the right of the first represents a financial year on financial year (or calendar year on calendar year) change in costs.

55. The reason for the use of different rows for each NSP to report our results is that:

- NSPs have varying base periods which mean that the first escalation factor (and the year to which it is applied) may be different for each NSP; and
- NSPs have different actual wage increases which are utilised in estimating cost escalation factors for utility labour costs.

3 Forecasts of labour cost inputs

56. This section sets out the specific considerations that have been made regarding the derivation of labour cost escalators for the NSPs' expenditure programs. These considerations guide the data sources and methodology that have been selected in each case. The NSPs have requested that CEG develop escalation factors their labour input costs.

    The NSPs have commissioned forecasts from Independent Economics for the growth of average annual wages in different sectors in New South Wales, Tasmania and Australian Capital Territory. Labour forecasts have been sought for three different sectors: utilities, professional services and general.

57. We consider that, following the AER's approach in its final determinations for the New South Wales and Tasmanian electricity businesses and also the approach of the Australian Competition Tribunal in Energex,[8] it is reasonable to use actual measures of changes in staff costs where these are available in preference to the much broader measures that are available for the entire utilities industry. We have therefore used actual salary increases paid by the NSPs and committed future increases where these are available to estimate utilities industry labour escalation factors. Escalation factors beyond this horizon are based on the utility wage price index forecasts sourced from Independent Economics.

58. Transitioning from modelling wage increases as occurring once a year, based on actual data, to an index based on quarterly changes in wages can result in a biased estimate of wages escalation. That is, we are transitioning from an index that measures actual wage-setting processes, where the NSPs pay their employees wage increases four quarters of increase 'up front', to a stylised framework that assumes it can spread these increases out over a year. Under such a transition, even if the actual wage outcomes and the wages forecasts are perfectly consistent, escalation factors may be underestimated or overestimated. Appendix A contains a full discussion of the nature of this problem and the solutions that CEG has applied to resolve this bias.

59. The NSPs have also requested that CEG develop escalation factors for general and professional services labour costs. For general labour in the economy as a whole and professional services labour we have adopted escalators based on Independent Economics' forecasts of movements in the wage price index for these sectors.

60. In all cases, to ensure consistency with Independent Economics forecasts, we have estimated:

    - financial year escalation factors based on financial year on financial year growth forecasts obtained from Independent Economics; and

8 Application by Ergon Energy Corporation Limited (Labour Cost Escalators) (No 3) [2010] ACompT 11 (24 December 2010)

- calendar year escalation factors based on calendar year on calendar year growth forecasts obtained from Independent Economics.

61. The distinction is important. While we can use the technique introduced by Econtech and described at section 2.6 above to 'splice' financial year on financial year growth forecasts provided by Independent Economics into a quarterly index this involves a number of underlying assumptions. The resulting index would not necessarily be consistent with the calendar year escalation factors provided by Independent Economics (nor would the opposite transformation from calendar year forecasts to an index be consistent).

3.1 Utilities labour

62. Table 2 below presents financial and calendar year escalation factors based upon actual and committed EBA increases spliced with Independent Economics forecasts for utilities sector wage price index growth.

Table 2: Escalation factors for utilities sector labour, real

Financial year		**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**
Ausgrid		1.1%	0.2%	1.2%	1.6%	2.1%	2.1%	2.0%
Endeavour Energy		n.a.	0.2%	1.2%	1.6%	2.1%	2.1%	2.0%
Essential Energy		n.a.	0.2%	0.1%	1.2%	2.1%	2.1%	2.0%
Transend - opex		n.a.	0.2%	-0.3%	1.1%	2.0%	2.0%	2.0%
Transend - capex		0.8%	0.2%	-0.3%	1.1%	2.0%	2.0%	2.0%
ActewAGL		n.a.	2.4%	0.6%	1.6%	2.1%	2.1%	2.1%
Calendar year	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Ausgrid	n.a.	1.3%	0.2%	0.3%	1.9%	2.1%	2.0%	2.0%
Endeavour Energy	n.a.	0.2%	0.2%	0.3%	1.9%	2.1%	2.0%	2.0%
Essential Energy	n.a.	0.2%	0.2%	1.0%	1.9%	2.1%	2.0%	2.0%
Transend - opex	n.a.	0.3%	-0.2%	0.8%	1.8%	2.0%	2.0%	2.0%
Transend - capex	0.3%	0.8%	-0.2%	0.8%	1.8%	2.0%	2.0%	2.0%
ActewAGL	n.a.	1.3%	2.3%	1.2%	2.0%	2.1%	2.1%	2.1%

Source: CEG analysis, NSPs and Independent Economics data

3.2 General labour

63. Table 3 below presents financial and calendar year escalation factors based upon Independent Economics forecasts for general labour wage price index growth.

Table 3: Escalation factors for general labour, real

Financial year		2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Ausgrid		0.1%	1.1%	0.6%	1.1%	1.7%	1.8%	1.8%
Endeavour Energy		n.a.	1.1%	0.6%	1.1%	1.7%	1.8%	1.8%
Essential Energy		n.a.	1.1%	0.6%	1.1%	1.7%	1.8%	1.8%
Transend - opex		n.a.	1.0%	0.5%	1.0%	1.6%	1.7%	1.8%
Transend - capex		0.5%	1.0%	0.5%	1.0%	1.6%	1.7%	1.8%
ActewAGL		n.a.	1.1%	0.8%	1.3%	1.8%	1.9%	1.9%
Calendar year	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Ausgrid	n.a.	0.3%	0.9%	0.6%	1.5%	1.7%	1.8%	1.8%
Endeavour Energy	n.a.	0.3%	0.9%	0.6%	1.5%	1.7%	1.8%	1.8%
Essential Energy	n.a.	0.3%	0.9%	0.6%	1.5%	1.7%	1.8%	1.8%
Transend - opex	n.a.	0.4%	0.7%	0.6%	1.4%	1.7%	1.7%	1.7%
Transend - capex	0.1%	0.9%	0.7%	0.6%	1.4%	1.7%	1.7%	1.7%
ActewAGL	n.a.	0.4%	1.1%	0.8%	1.6%	1.9%	1.9%	1.9%

Source: CEG analysis and Independent Economics data

3.3 Professional services labour

64. Table 4 below presents financial and calendar year escalation factors based upon Independent Economics forecasts for professional services wage price index growth.

Table 4: Escalation factors for professional services, real

Financial year		2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Ausgrid		0.1%	1.0%	0.8%	1.3%	1.8%	1.9%	1.9%
Endeavour Energy		n.a.	1.0%	0.8%	1.3%	1.8%	1.9%	1.9%
Essential Energy		n.a.	1.0%	0.8%	1.3%	1.8%	1.9%	1.9%
Transend - opex		n.a.	0.8%	0.6%	1.2%	1.8%	1.8%	1.8%
Transend - capex		0.6%	0.8%	0.6%	1.2%	1.8%	1.8%	1.8%
ActewAGL		n.a.	0.8%	0.9%	1.4%	1.9%	1.9%	1.9%
Calendar year	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Ausgrid	n.a.	0.2%	1.1%	0.8%	1.6%	1.9%	1.9%	1.9%
Endeavour Energy	n.a.	0.2%	1.1%	0.8%	1.6%	1.9%	1.9%	1.9%
Essential Energy	n.a.	0.2%	1.1%	0.8%	1.6%	1.9%	1.9%	1.9%
Transend - opex	n.a.	0.2%	0.9%	0.7%	1.6%	1.9%	1.8%	1.8%
Transend - capex	0.1%	0.6%	0.9%	0.7%	1.6%	1.9%	1.8%	1.8%
ActewAGL	n.a.	0.2%	1.1%	0.9%	1.7%	2.0%	1.9%	1.9%

Source: CEG analysis and Independent Economics data

4 Forecasts of materials cost inputs

65. The following section sets out the specific considerations that have been made regarding the derivation of materials cost escalation for the NSPs' expenditure programs. These considerations guide the data sources and methodology that have been selected in each case.

4.1 Aluminium and copper

66. It is important to be clear when we talk about movements in 'the' price of aluminium and copper that we are really talking about movements in the price of the metal in question at a particular stage in its production process.

67. In the case of aluminium, we are referring to a refined metal to a particular specification. The prices used in this section are prices for aluminium traded on the London Metals Exchange (LME) that meet the specifications of that exchange. Specifically, prices are per tonne for 25 tonnes of aluminium with a minimum purity of 99.7 per cent.[9]

68. The prices quoted are not necessarily the prices paid for aluminium equipment by manufacturers. For example, producers of electrical cable purchase fabricated aluminium to be used in their manufacturing processes. This fabricated aluminium has gone through further stages of production than the refined aluminium that is traded on the LME. Its price can be expected to be influenced by refined aluminium prices but these prices cannot be expected to move together in a 'one-for-one' relationship.

69. The absence of a one-for-one relationship between the prices of refined aluminium traded on the LME and the price paid by manufacturers for fabricated materials as inputs to their production process does not mean that the use of the LME prices to estimate escalation factors is invalid. The correct application of Step 2, described in paragraph 16 above, the assignation of component weights to the escalation factors derived from the forecast LME prices, can ensure that these escalation factors are used in a way that is consistent with the underlying objects that they represent.

70. Similarly, the prices quoted for copper are prices traded on the London Metals Exchange that meet the specifications of this exchange. Again, although there is not necessarily a one-for-one relationship between these prices and the price paid for copper equipment by manufacturers, this is the correct application of Step 2, as explained above.

71. We have obtained LME prices for all of aluminium and copper futures, averaged over the majority of the month of November 2013.[10] The LME's longest dated

9 See London Metals Exchange website for more details of contract specifications.

10 Up to and including 20 November, a total of 13 business days.

future for these products is 27 months, allowing us to forecast prices out to and including February 2016 by interpolating between the future prices. However, available futures prices do not extend out any further than that.

72. To forecast prices beyond February 2016 , we have had regard to professional forecasts rather than assuming that aluminium and copper prices will remain constant in real terms from February 2016 onwards.

73. Consensus Economics surveys professional forecasters on a range of economic variables. They regularly perform surveys of forecasters' opinions on future commodity prices, the most recent of which was conducted in October 2013.[11] Consensus Economics provide quarterly forecasts out to September 2015 in nominal US dollar terms.

74. Consensus Economics also provides a 'long-term' forecast in nominal and real US dollar terms. Unlike with the shorter term forecasts, Consensus does not disclose how many or which institutions contributed to the forecasts nor does it give any information on the range of forecasts. Moreover, it is unclear what the definition of 'long-term' is – Consensus Economics only states that they represent:[12]

> *Long term 5-10 year average estimates (2019-2023) in nominal and real (inflation adjusted) 2013 dollar terms.*

75. For these reasons, we must treat the Consensus Economics long-term forecasts with some caution.

76. Consistent with the methodology employed previously by the AER[13], we have assumed that these long-term forecasts apply to a horizon of 7.5 years from the month in which they were made. That is, for forecasts made in October 2013, we assumed that long-term forecasts are for the month of April 2021.

77. Forecasts of the price of aluminium and copper between the end of the LME forecasts in February 2016 and the Consensus Economics forecast in April 2021 can be generated by interpolating between these price points. However, as described above, the escalation factors beyond April 2021 must be treated with caution due to their reliance on the Consensus Economics mean forecast.

78. We use the approach described above to produce a monthly series of aluminium and copper prices, which may then be averaged to estimate financial and calendar year escalators out to 2019/20 and 2019, respectively. These escalators are shown in Table 5 and Table 6 below.

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11 Consensus Economics, *Energy & Metals Consensus Forecasts,* October 2013.

12 Ibid, p. 5

13 See for example AER, *New South Wales distribution determination 2008-09 to 2012-13*, April 2009, Appendix L.

Table 5: Escalation factors for aluminium, real

Financial year		2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Ausgrid		-5.6%	-0.2%	4.2%	5.8%	5.0%	4.2%	3.6%
Endeavour Energy		n.a.	-0.2%	4.2%	5.8%	5.0%	4.2%	3.6%
Essential Energy		n.a.	-0.2%	4.2%	5.8%	5.0%	4.2%	3.6%
Transend - opex		n.a.	-0.2%	4.2%	5.8%	5.0%	4.2%	3.6%
Transend - capex		0.9%	-0.2%	4.2%	5.8%	5.0%	4.2%	3.6%
ActewAGL		n.a.	-0.2%	4.2%	5.8%	5.0%	4.2%	3.6%
Calendar year	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Ausgrid	n.a.	-5.6%	1.0%	5.9%	5.4%	4.5%	3.9%	3.3%
Endeavour Energy	n.a.	0.0%	1.0%	5.9%	5.4%	4.5%	3.9%	3.3%
Essential Energy	n.a.	0.0%	1.0%	5.9%	5.4%	4.5%	3.9%	3.3%
Transend - opex	n.a.	0.0%	1.0%	5.9%	5.4%	4.5%	3.9%	3.3%
Transend - capex	4.8%	-3.6%	1.0%	5.9%	5.4%	4.5%	3.9%	3.3%
ActewAGL	n.a.	0.0%	1.0%	5.9%	5.4%	4.5%	3.9%	3.3%

Source: CEG analysis, LME and Consensus Economics data.

Table 6: Escalation factors for copper, real

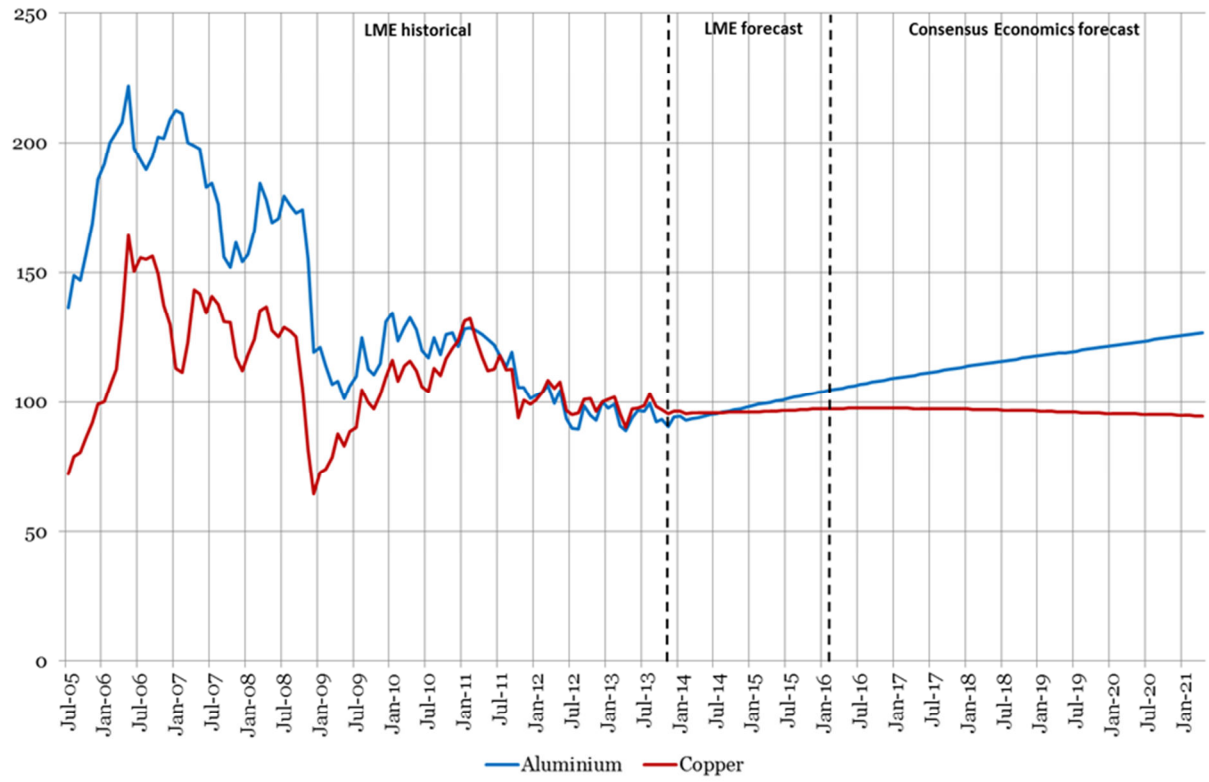
Financial year		2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Ausgrid		-2.3%	-0.8%	-0.9%	1.1%	0.3%	-0.3%	-0.7%
Endeavour Energy		n.a.	-0.8%	-0.9%	1.1%	0.3%	-0.3%	-0.7%
Essential Energy		n.a.	-0.8%	-0.9%	1.1%	0.3%	-0.3%	-0.7%
Transend - opex		n.a.	-0.8%	-0.9%	1.1%	0.3%	-0.3%	-0.7%
Transend - capex		1.2%	-0.8%	-0.9%	1.1%	0.3%	-0.3%	-0.7%
ActewAGL		n.a.	-0.8%	-0.9%	1.1%	0.3%	-0.3%	-0.7%
Calendar year	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Ausgrid	n.a.	-2.3%	-1.8%	0.8%	0.9%	-0.1%	-0.5%	-0.9%
Endeavour Energy	n.a.	-0.1%	-1.8%	0.8%	0.9%	-0.1%	-0.5%	-0.9%
Essential Energy	n.a.	-0.1%	-1.8%	0.8%	0.9%	-0.1%	-0.5%	-0.9%
Transend - opex	n.a.	-0.1%	-1.8%	0.8%	0.9%	-0.1%	-0.5%	-0.9%
Transend - capex	4.6%	-3.3%	-1.8%	0.8%	0.9%	-0.1%	-0.5%	-0.9%
ActewAGL	n.a.	-0.1%	-1.8%	0.8%	0.9%	-0.1%	-0.5%	-0.9%

Source: CEG analysis, LME and Consensus Economics data.

79.

80. Figure 3 below shows a series of indexed aluminium and copper prices, including history sourced from LME and forecasts implied by the escalation factors for aluminium and copper respectively.

Figure 3: Indexed real price levels for aluminium and copper



December 2012 = 100
Source: London Metals Exchange (Bloomberg) and Consensus Economics

4.2 Steel

81. A component of the NSPs' costs is associated with products using steel such as transformers and substations.

82. Again, it is important to draw a distinction between the steel products used by NSPs and the steel 'at the mill gate'. Just as is the case with aluminium, the steel used by the NSPs has been fabricated and, as such, embodies labour, capital and other inputs (e.g. energy). While there is not necessarily a one-for-one relationship, it is still relevant to consider what is expected to happen to 'mill gate' steel prices.

83. We rely on Consensus Economics forecasts for hot-rolled coil (HRC) for Asian steel prices[14]. These forecasts are in an identical format to those for aluminium and copper, with quarterly short term nominal forecasts and a long term real forecast. It is important to note that HRC is a more processed form of steel than billet, and commands a premium over the prices reported on the LME.

[14] Previous analysis conducted by CEG and accepted by the AER has relied on an average of forecasts for Hot Rolled Coil for European and US steel prices. However, Consensus Economics currently also publish forecasts specific to the Asian market, which are more relevant in this context.

84. We have relied on a historical series derived from Bloomberg (MEPS carbon steel products). Although this series is relatively close to the Consensus Economics forecast series, it is not identical. To ensure that this does not cause step changes to the escalation factors that are not caused by changes in underlying prices, we have used a percentage change approach for the forecasts – that is, we have moved the October 2013 price from the MEPS historical series forward in time by the percentage changes forecasted by Consensus Economics.[15]

85. The escalation factors derived on the basis of short term and long term Consensus Economics forecasts are shown in the table below.

Table 7: Escalation factors for steel, real

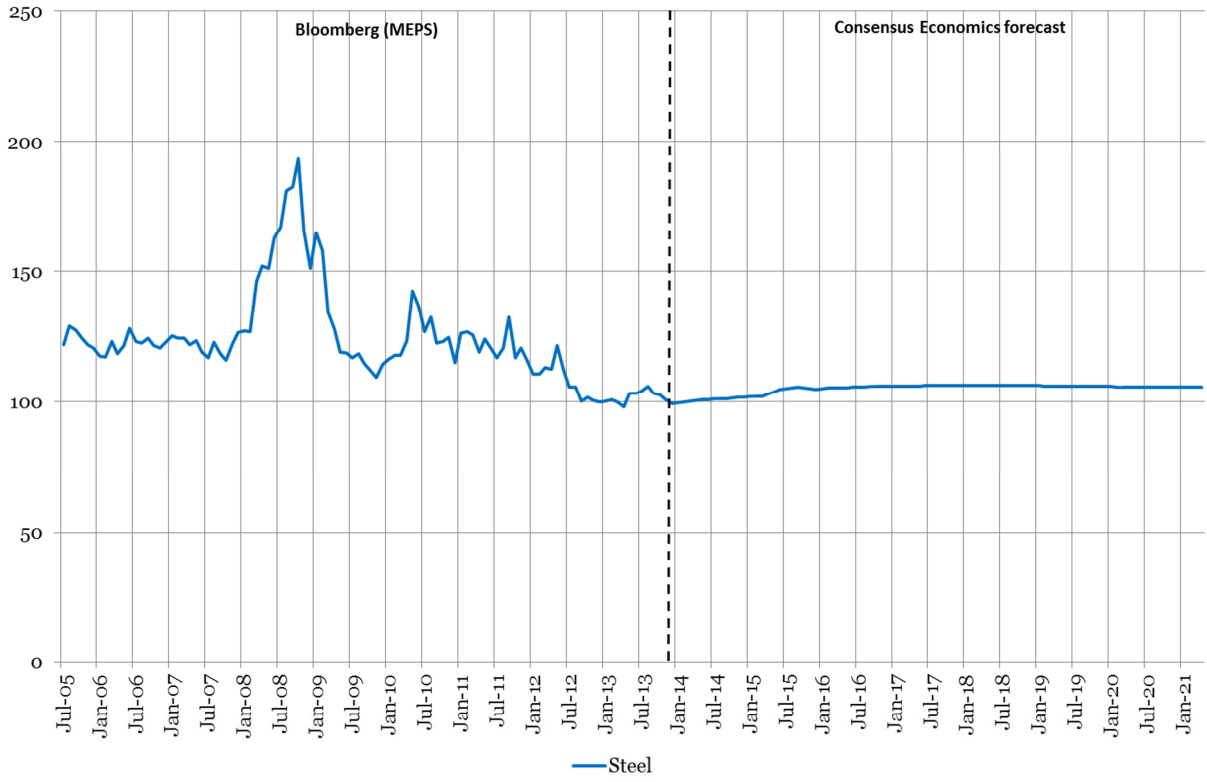
Financial year		2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Ausgrid		1.7%	-0.1%	0.6%	3.2%	0.6%	0.3%	-0.1%
Endeavour Energy		n.a.	-0.1%	0.6%	3.2%	0.6%	0.3%	-0.1%
Essential Energy		n.a.	-0.1%	0.6%	3.2%	0.6%	0.3%	-0.1%
Transend - opex		n.a.	-0.1%	0.6%	3.2%	0.6%	0.3%	-0.1%
Transend - capex		-9.5%	-0.1%	0.6%	3.2%	0.6%	0.3%	-0.1%
ActewAGL		n.a.	-0.1%	0.6%	3.2%	0.6%	0.3%	-0.1%
Calendar year	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Ausgrid	n.a.	1.9%	-1.0%	3.3%	1.5%	0.5%	0.1%	-0.3%
Endeavour Energy	n.a.	0.2%	-1.0%	3.3%	1.5%	0.5%	0.1%	-0.3%
Essential Energy	n.a.	0.2%	-1.0%	3.3%	1.5%	0.5%	0.1%	-0.3%
Transend - opex	n.a.	0.2%	-1.0%	3.3%	1.5%	0.5%	0.1%	-0.3%
Transend - capex	-3.9%	-5.6%	-1.0%	3.3%	1.5%	0.5%	0.1%	-0.3%
ActewAGL	n.a.	0.2%	-1.0%	3.3%	1.5%	0.5%	0.1%	-0.3%

Source: CEG analysis, Bloomberg and Consensus Economics data.

86. Figure 4 below shows a series of indexed steel prices, including history based on MEPS and forecasts implied by the escalation factors for steel.

[15] We have requested but not been able to obtain the precise historical data source utilised by Consensus Economics.

Figure 4: Indexed real price levels for steel



December 2012 = 100
Source: HRC Asia (Bloomberg) & Consensus Economics

4.3 Crude oil

87. Until recently, the AER applied a methodology based upon crude oil futures to estimate crude oil cost escalation factors. However in its recent regulatory review of the Victorian gas distribution businesses, the AER relied upon the results of an empirical study to raise concerns with the use of futures prices for the purpose of predicting future crude oil prices. The AER instead calculated crude oil escalation factors based on constant real Australian prices.

88. In this report, we have adopted the AER's revised precedent with modifications to reflect constant real United States prices. We note however that there appears to be no economic rationale for why this should be a superior forecast to the use of futures prices. This area merits further research.

89. In its report for the Victorian gas distribution businesses, SKM noted research conducted in a discussion paper by the United States Federal Reserve which concluded that:[16]

[16] Alquist, R., Kilian, L. And Vigfusson, J., *Forecasting the Price of Oil*, Board of Governors of the Federal Reserve System, International Finance Discussion Papers, Number 1022, July 2011, p. 69.

> *More commonly used methods of forecasting the nominal price of oil based on the price of oil futures or the spread of the oil futures price relative to the spot price cannot be recommended. There is no reliable evidence that oil futures prices significantly lower the MSPE relative to the no-change forecast at short horizons, and long-term futures prices often cited by policymakers are distinctly less accurate than the no-change forecast.*

90. In this paper, the "no-change" forecast refers to a constant real price of oil.

91. SKM subsequently recommended the use of Consensus Forecasts as an alternative to reliance upon futures prices. However, the AER rejected this, stating that:[17]

> *Consensus Economics and EIA forecasts were both included in the discussion paper's data set and it was found that, for horizons beyond several years, the nominal price of oil adjusted for expected inflation is the best forecast of nominal oil prices.*

92. On this basis, the AER stated that it preferred zero real escalation for crude oil, with historical data on crude oil prices being sourced from the US Department of Energy (DoE).[18]

93. We note that the AER appears to have made an error of logic in its preference for constant real escalation factors for crude oil. Even if the US Federal Reserve discussion paper convincingly showed that the best forecast for future crude oil prices was constant real prices, this does not justify the AER's position.

94. Specifically, the AER has not considered that all the analysis presented in the discussion paper is conducted in US dollars and refers to real prices in US dollar terms. A constant real price for crude oil in US dollar terms will not be equivalent to a constant real price in Australian dollar terms. This is because:

    - currently, the Australian dollar is expected to depreciate against the US dollar over the long term; and
    - there are difference in expected inflation between Australia and the United States.

95. If we accept literally the AER's support for the findings of the discussion paper, then the escalation factors implied by constant real prices in US dollars are shown in Table 8 below.

96. In developing the escalation factors in Table 8, we have sourced forecasts of United States inflation from the Congressional Budget Office (CBO). The CBO's most recent baseline economic forecasts includes a series of inflation history and

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17 AER, Access arrangement draft decision: SPI Networks (Gas) Pty Ltd, 2013–17, Part 3 Appendices, September 2012, p. 130

18 Consistent with the approach used by the AER, we have used monthly prices for West Texas Intermediate crude.

forecasts.[19] We have used history and forecasts relating to the consumer price index for all urban consumers.

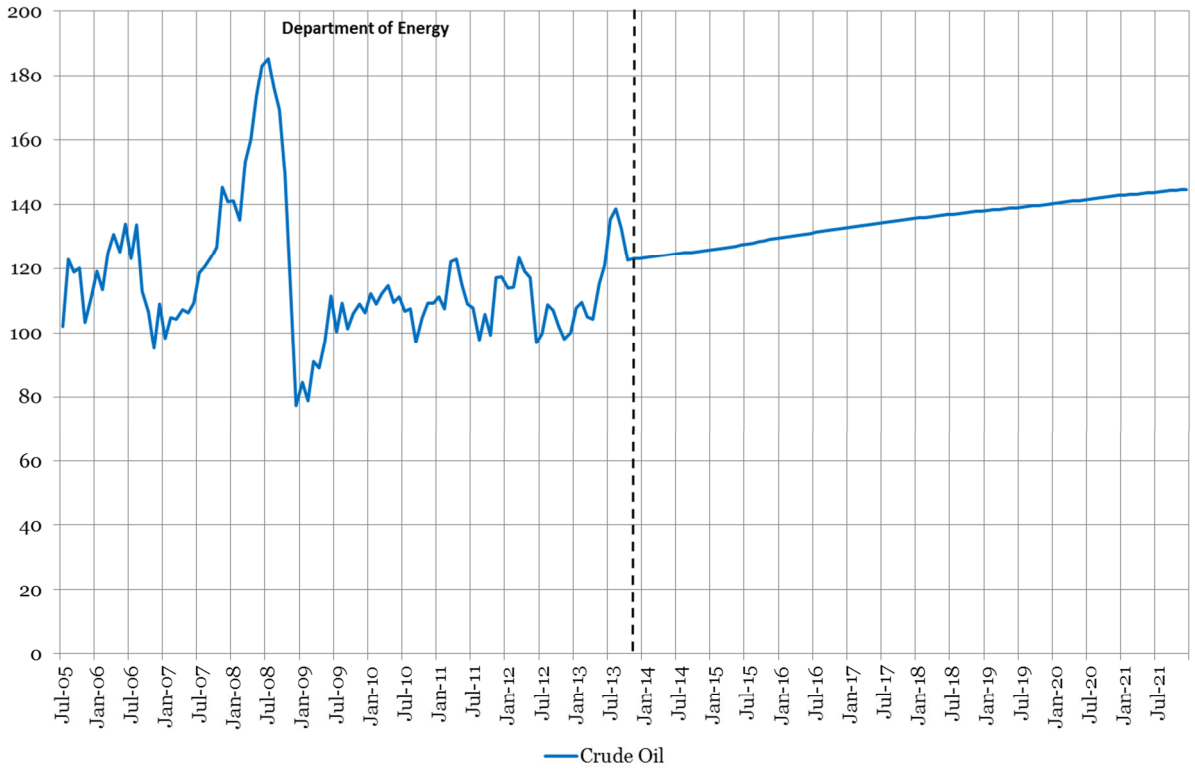
Table 8: Escalation factors for crude oil (constant real US prices), real

Financial year		2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Ausgrid		6.5%	18.8%	-0.5%	2.8%	2.6%	2.1%	1.8%
Endeavour Energy		n.a.	18.8%	-0.5%	2.8%	2.6%	2.1%	1.8%
Essential Energy		n.a.	18.8%	-0.5%	2.8%	2.6%	2.1%	1.8%
Transend - opex		n.a.	18.8%	-0.5%	2.8%	2.6%	2.1%	1.8%
Transend - capex		9.8%	18.8%	-0.5%	2.8%	2.6%	2.1%	1.8%
ActewAGL		n.a.	18.8%	-0.5%	2.8%	2.6%	2.1%	1.8%
Calendar year	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Ausgrid	n.a.	19.8%	4.0%	2.4%	2.8%	2.3%	1.9%	1.6%
Endeavour Energy	n.a.	12.5%	4.0%	2.4%	2.8%	2.3%	1.9%	1.6%
Essential Energy	n.a.	12.5%	4.0%	2.4%	2.8%	2.3%	1.9%	1.6%
Transend - opex	n.a.	12.5%	4.0%	2.4%	2.8%	2.3%	1.9%	1.6%
Transend - capex	11.7%	10.6%	4.0%	2.4%	2.8%	2.3%	1.9%	1.6%
ActewAGL	n.a.	12.5%	4.0%	2.4%	2.8%	2.3%	1.9%	1.6%

Source: CEG analysis, US Department of Energy data

[19] http://www.cbo.gov/publication/43902

Figure 5: Indexed real price levels for crude oil



December 2012 = 100
Source: CEG analysis, US Department of Energy data

97. We have presented crude oil escalation factors in this report in line with AER precedent, amended as set out above. Previously, we relied upon NYMEX crude oil futures to develop escalation factors for crude oil. As outlined at section 2.1 above, we consider that there are strong theoretical reasons to believe that futures prices are superior to other methods of forecasting. In particular:

    - if there were better forecasts of crude oil available than futures prices, this would make a profit-making opportunity available to those with the best information that would eliminate this gap; and
    - futures prices reflect the views of market participants with funds placed 'at risk'.

98. We note that the paper relied upon by the AER does not establish that futures provide biased forecasts of crude oil prices, but that using constant real prices results in a lower mean-squared prediction error over a sample period between 1973 and 2009. Also, the paper does not provide a robust explanation for why the strong theoretical reasons for preferring futures prices over constant real prices are not realised in its results. We consider this to be an important area for future research.

4.4 Construction

99. CEG is aware of a set of forecasts for construction costs in Australia by ACIL Allen Consulting (AAC), available at the Construction Forecasting Council (CFC) website.

100. Consistent with the practice previously proposed by CEG and accepted by the AER in its Final Determinations for the New South Wales and Tasmanian electricity businesses, we have estimated escalation factors using 'total engineering' construction forecasts. We have also included forecasts based on 'non-residential' construction forecasts.

101. Since construction forecasts likely contain a significant labour component, it is likely to be double counting to obtain a forecast of construction costs specific to the utilities industry sector, even if such a forecast were available. These labour costs have already been adequately measured by the utilities industry labour cost estimates.

102. The AAC forecasts are expressed in terms of the average price movement between financial years, so we have converted these to a quarterly index using the formulae set out at section 2.6 above.

103. Table 10 below, and graphically in Figure 6 below.

Table 9: Escalation factors for engineering construction, real

Financial year		2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Ausgrid		0.1%	0.5%	0.5%	0.7%	0.5%	0.4%	0.1%
Endeavour Energy		n.a.	0.5%	0.5%	0.7%	0.5%	0.4%	0.1%
Essential Energy		n.a.	0.5%	0.5%	0.7%	0.5%	0.4%	0.1%
Transend - opex		n.a.	0.5%	0.5%	0.7%	0.5%	0.4%	0.1%
Transend - capex		6.1%	0.5%	0.5%	0.7%	0.5%	0.4%	0.1%
ActewAGL		n.a.	0.5%	0.5%	0.7%	0.5%	0.4%	0.1%
Calendar year	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Ausgrid	n.a.	0.8%	0.0%	0.6%	0.6%	0.4%	0.2%	0.1%
Endeavour Energy	n.a.	0.7%	0.0%	0.6%	0.6%	0.4%	0.2%	0.1%
Essential Energy	n.a.	0.7%	0.0%	0.6%	0.6%	0.4%	0.2%	0.1%
Transend - opex	n.a.	0.7%	0.0%	0.6%	0.6%	0.4%	0.2%	0.1%
Transend - capex	2.0%	4.8%	0.0%	0.6%	0.6%	0.4%	0.2%	0.1%
ActewAGL	n.a.	0.7%	0.0%	0.6%	0.6%	0.4%	0.2%	0.1%

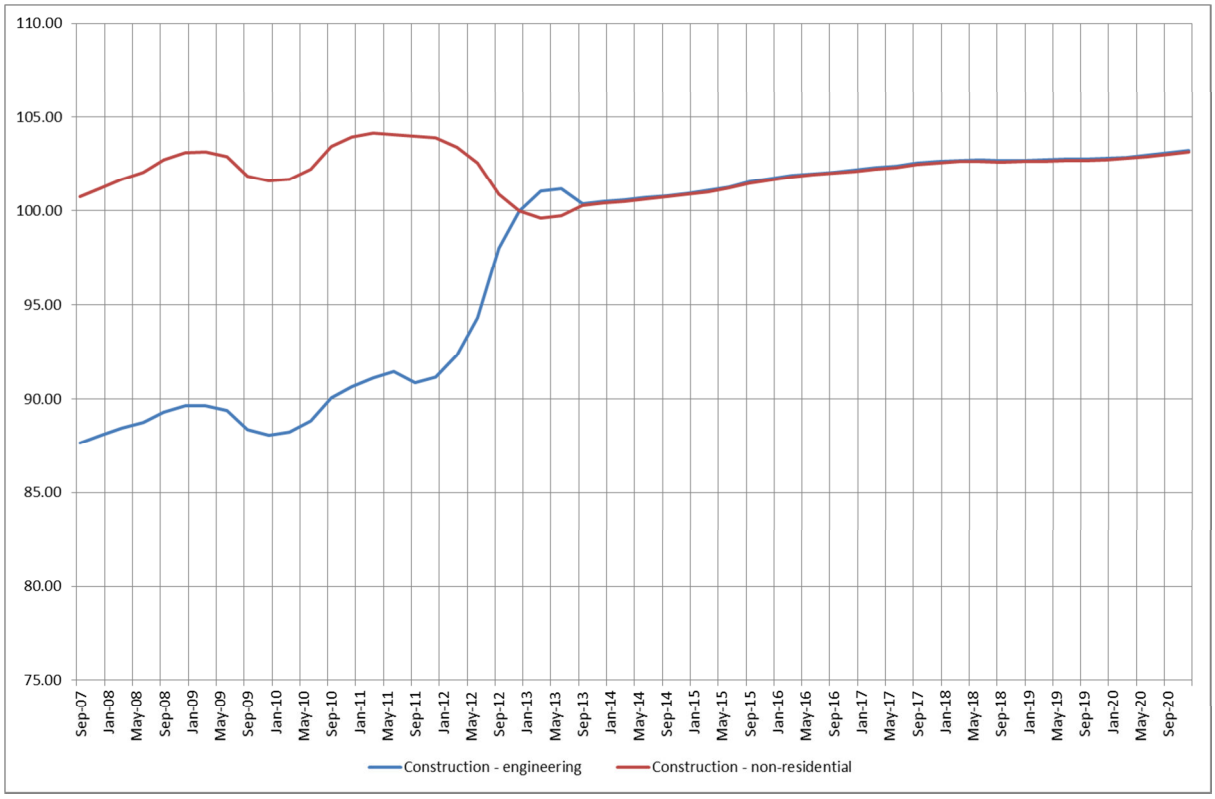
Source: CEG analysis, AAC CFC data

Table 10: Escalation factors for non-residential construction, real

Financial year		2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Ausgrid		0.1%	0.4%	0.5%	0.7%	0.5%	0.4%	0.1%
Endeavour Energy		n.a.	0.4%	0.5%	0.7%	0.5%	0.4%	0.1%
Essential Energy		n.a.	0.4%	0.5%	0.7%	0.5%	0.4%	0.1%
Transend - opex		n.a.	0.4%	0.5%	0.7%	0.5%	0.4%	0.1%
Transend - capex		-2.4%	0.4%	0.5%	0.7%	0.5%	0.4%	0.1%
ActewAGL		n.a.	0.4%	0.5%	0.7%	0.5%	0.4%	0.1%
Calendar year	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Ausgrid	n.a.	0.0%	0.7%	0.6%	0.6%	0.4%	0.2%	0.1%
Endeavour Energy	n.a.	0.0%	0.7%	0.6%	0.6%	0.4%	0.2%	0.1%
Essential Energy	n.a.	0.0%	0.7%	0.6%	0.6%	0.4%	0.2%	0.1%
Transend - opex	n.a.	0.0%	0.7%	0.6%	0.6%	0.4%	0.2%	0.1%
Transend - capex	-0.8%	-1.7%	0.7%	0.6%	0.6%	0.4%	0.2%	0.1%
ActewAGL	n.a.	0.0%	0.7%	0.6%	0.6%	0.4%	0.2%	0.1%

Source: CEG analysis, AAC CFC data

Figure 6: Indexed real price levels for construction



December 2012 = 100
Source: CFC data

Appendix A Derivation of escalation factors for utilities industry labour

104. This appendix describes in greater detail the derivation of the escalation factors for utilities industry as well as professional services and general labour employed by the NSPs, as reported at section 3 above. Whilst the appendix is self-contained, it can most easily be understood in conjunction with the spreadsheets accompanying this report, where the calculations described here are set out in full.

A.1 Utilities industry labour costs

105. The NSPs have provided CEG with a history and timeline of committed EBA salary increases.

106. Since these are nominal increases, it is reasonable to treat these as increases to a nominal index of wages at the dates that they occur and to deflate this nominal index to create a real index that can be used for the purpose of estimating real escalation factors. We have created a quarterly nominal index of each NSP's salaries and deflated this index by the quarterly index of inflation, the derivation of which is described at section 2.4.

107. Beyond the period in which the NSPs' actual EBA salary increases are available, the index of utilities industry wages can be extended by using professional forecasts. We have relied on Independent Economics forecasts.

108. The timing of these forecasts also lend themselves to the use of the formulae, described in section 2.6, to derive a quarterly index based on the average annual forecast wage changes. We use this quarterly index, so derived, to extend forward the index based on actual EBA salary increases.

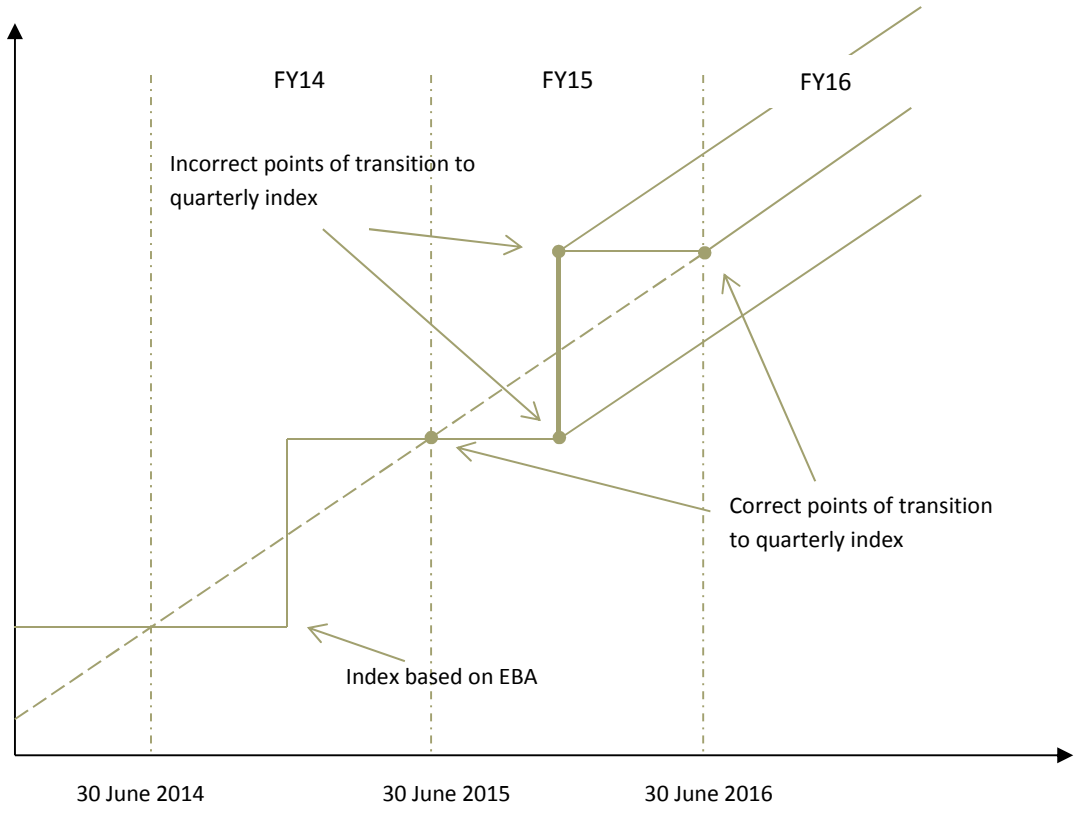
109. However, the timing and nature of this transition to forecasts must be carefully considered since, if implemented at the wrong time or incorrectly, the transition from an index based on discrete wage increases to an index based on quarterly changes in wages can result in a biased estimate of wages escalation. That is, we are transitioning from an index that measures actual wage-setting processes, where the NSP pays its employees wage increases 'up front', to a stylised framework that assumes it can spread these increases out over a year. Under such a transition, even if the actual EBA outcomes and the wages forecasts are perfectly consistent, escalation factors may be underestimated.

A.1.1 Estimating financial year escalators

110. Figure 7 provides a stylised example of the transition from EBA outcomes to forecasts at the final committed EBA increase on 1 January 2015. The escalation factor for the following financial year will underestimate the correct level of wages

escalation, relative to what would have been estimated if the index based on wage increases were extended from 1 January 2015 onwards.

Figure 7: Illustration of potential for error transitioning to utilities industry quarterly index, financial year escalators



111. As Figure 7 demonstrates, unbiased financial year escalators can be derived by transitioning to quarterly forecasts on 30 June. In this context, it makes most sense for this transition to occur on 30 June 2016, since this uses all the actual EBA data available which, as we stated earlier, should receive preference over more generalised forecasts due to its greater specificity.

A.2 Estimating calendar year escalators

112. Although the methodology described above can be used to estimate financial year escalation factors that are unbiased with respect to a single, consistent underlying view regarding the rate of change of utilities industry wages, the same methodology does not yield consistent calendar year escalators.

113. As Figure 8 indicates, transitioning to a quarterly index from 1 January 2016 without applying a step change from that date will underestimate the average level of wages in the 2015 calendar year. However, applying a full year of wage increase on 1 January 2016 will cause wages in the subsequent calendar year to be too high.

114. The correct method of transition, in order to accurately calculate the 2015 calendar year escalator, is to apply as at 1 January 2016 half a year of escalation in a step change. This increase can be constructed using the forecasts of utilities industry wages.

Figure 8: Illustration of potential for error transitioning to utilities industry quarterly index, calendar year escalators