Jemena Gas Networks (NSW) Ltd

Revised 2020-25 Access Arrangement Proposal

Attachment 5.4

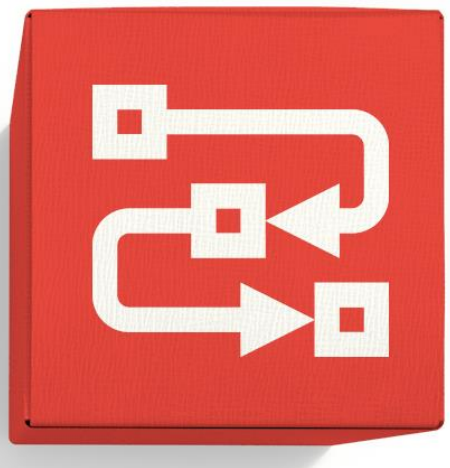
Response to the AER's draft decision - Review of AER approach to JGN cost escalators

Jemena
bringing energy to life

Review of the Australian Energy Regulator's approach to Jemena Gas Networks' cost escalators

Jemena Gas Networks

19 December 2019



Final Note

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1. EXECUTIVE SUMMARY

CEPA has been engaged by Jemena Gas Networks (JGN) to consider the Australian Energy Regulator's (AER's) approach to operating expenditure (opex) escalators ('cost escalators'). This follows the AER's recent draft decision, on JGN's opex proposals for 2020-25, to rely only on wage price index (WPI) forecasts for the utilities (electricity, gas, water and waste services) sector that the AER commissioned Deloitte Access Economics (DAE) to provide. This is in contrast to the AER's previous approach for JGN's determinations which was to rely on an average across DAE's forecasts and those produced by BIS Oxford Economics (BISOE).[2] JGN's proposal was to continue to use the average across the two forecasts.

The AER's draft decision is also to accept JGN's proposed opex productivity target (0.74%). JGN's proposed opex productivity target is higher than what the AER assumes for electricity distributors (0.5%),[3] however the AER uses the same WPI forecast for the electricity distributors. In addition, the AER's draft decision was to apply JGN's opex productivity forecast to capitalised opex, this was not proposed by JGN.

JGN has asked us to consider the following questions:

- Are there any inconsistencies and/ or issues with the AER's assessment of the accuracy of the WPI forecasts compared to its assessment of consumer price index (CPI) expectation forecasts?
- Is the AER's approach to assessing the forecasting appropriate?
- Is it appropriate/ correct for the AER to apply the opex productivity factor to capitalised overheads?

In developing our responses to these questions, we identified what appears to be an error in DAE's 2020-21 real WPI forecast. DAE's estimate appears to be too low given its nominal WPI forecast and CPI forecast.

Our responses are summarised below. Our more detailed responses are set out in Section 3. To provide context to our responses, we have provided a high level summary of the AER's use of opex escalators in Section 2.

Are there any inconsistencies and/ or issues with the AER's assessment of the accuracy of the WPI forecasts compared to its assessment of CPI expectation forecasts?

During its review of the best estimate of CPI expectations, the AER noted that assessing the accuracy of CPI expectations against CPI outturn was not necessarily the appropriate way of determining the best expectations estimate. This is because it was more concerned with the market's expectations of CPI at the time of setting the revenue control, rather than identifying the forecast that was most accurate against outturn CPI.

Wage growth is also considered on an expectations basis similar to consumer price inflation. We consider that the AER's has used inconsistent approaches for selecting CPI and WPI forecasts, even though both are based on expectations. For WPI, it has adopted an approach of assessing the most accurate forecast based on historical performance, while it has not done the same for CPI.

Is the AER's approach to assessing the forecasting appropriate?

We consider that the AER's approach to using the mean absolute error (MAE) is appropriate, however we consider that the root mean squared error (RMSE) should be reviewed as we are dealing with compounding forecasts. Regarding the mean error, which the AER reported and considered, we agree with the AER that this can be useful in determining whether a forecaster is under-/over-forecasting compared to outturn (although this can also be

[2] BIS OEBISOE was formed following Oxford Economics purchase of BIS Shrapnel. DAE was formed through a merger between Deloitte and Access Economics. For simplicity we have referred to all forecasts as being either from BIS OEBISOE or DAE.

[3] AER (2019a) *Final decision paper: Forecasting productivity growth for electricity distributors*, March.

observed through graphing the data). However, beyond this we do not consider that the mean error provides much valuable information for assessing the accuracy of results given the issue that positive and negative differences can cancel each other out.

In 2012, during the AER's last forecasting accuracy review, Professor Borland[4] highlighted that there was theoretical support for the use of averages to help to improve forecast accuracy. We agree with this view. Averaging mitigates the risk of placing weight solely on a forecast that has potential errors in it. If both forecasts have errors, and if they are independent (ie., the errors were not correlation) the errors may offset each other. During the AER's 2012 review, BISOE's forecasts were closer to outturn values than DAE's but the AER choose to use the average across the forecasts. The AER current (2019) assessment indicates to it that DAE's forecasts have been closer to actual WPI than BISOE but the AER is now opting to move away from the use of the average.

We also note that there are other recent examples of the AER using averages across other elements in recent determinations. For example, the AER uses multiple econometric models for the electricity distribution sector for benchmarking and output growth weights.

In addition, our analysis indicates that, at the national level, when assessing the forecasts from 2007 to 2017, DAE's forecast accuracy has not been better than the average of BISOE's and DAE's forecasts. We also note that recent analysis carried out by BISOE of the AER's approach, and its and DAE's forecast accuracy, indicates that the AER's assessment of forecast accuracy may not be robust.[5] Like us, BISOE is also of the view that averaging across the forecasts is still the most appropriate approach.

Finally, it is also important to note that the AER's assessment is carried out on data at the national level because the Australian Bureau of Statistics (ABS) does not publish state level WPI measures for the 'electricity, gas, water and waste services' sector. It is not possible to assess if DAE or BISOE have had more accurate forecasts for the states. Therefore, given that the evidence at the national level in inconclusive as to the accuracy of the forecasters, we do not consider that there is evidence that the AER should move away from the 'averaging' approach for the state level forecasts.

Is it appropriate/ correct for the AER to apply the opex productivity factor to capitalised overheads?

The model used to inform JGN's position on opex productivity excludes capitalised overheads. If capitalised overheads were included in the modelling it could lead to a different productivity estimate. We do not consider it appropriate to apply the opex productivity adjustment to capitalised overheads without understanding how the estimate of historical productivity would be affected by including capitalised overheads in the model.

[4] Borland (2012) *Recommendations for methodology for forecasting WPI,* a report for Envesta Limited, SP AusNet, APA GasNet, and MultiNet gas, October.

[5] BIS Oxford Economics (2019) *Review of AER forecast comparison,* a report prepared for SA Power Networks, November.

2. AER'S CURRENT APPROACH TO OPEX ESCALATORS

Below we set out the AER's current approach to using input price inflation and productivity to escalate opex over the next regulatory period.

Input price inflation

The AER rolls forward a base year real opex by forecasting input price inflation for wages and other inputs. The AER assigns a 59.7% weight to labour and a 41.3% weight to other inputs. The AER and JGN have assumed that other inputs will inflate at the same rate as the CPI, therefore for those inputs no differential is applied.

For wage price inflation, for JGN's 2020-25 period, the AER has proposed using only DAE's forecast.[6] The wage differential is based on DAE's forecast of the wage growth for the utilities sector minus DAE's forecast of CPI.[7]

DAE's wage growth forecasts include its forecast of labour productivity, CPI, and any other factors affecting wage growth. DAE does not break down how each of these elements combine to form its wage forecasts. DAE does not provide a gas distribution specific wage forecast.

Productivity

The AER is proposing to adopt the 0.74% productivity target JGN set out in its proposal. The 0.74% target is based on modelling undertaken by Economic Insights in 2019.[8]

Economic Insights use WPI and producer price indices to deflate historical opex. This means that the Economic Insights' time trend (coefficient) captures the residual changes in opex over time not explained by the output drivers or annual changes resulting from input price changes.

Cost escalators

The above elements combine with the AER's forecast of CPI to provide a cost escalation for JGN's opex. Forecast changes in outputs are a key component of the cost escalators, but consideration of these is beyond the scope of this project. We assume, for simplicity, that output stays constant, this assumption has no impact on our conclusions.

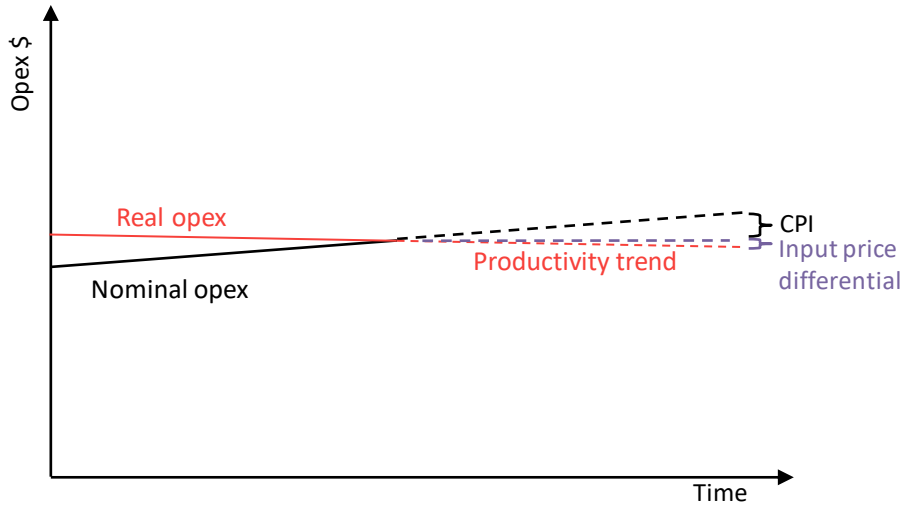
In the figure below we provide a simple illustration of how the opex productivity, CPI, and input price inflation combine to provide an opex forecast for JGN:

[6] DAE (2019) *Labour Price Growth Forecasts*, a report prepared for the Australian Energy Regulator, June.

[7] DAE's forecast of CPI differs from the AER's forecast.

[8] Economic Insights (2019) *Relative Efficiency and Forecast Productivity Growth of Jemena Gas Networks (NSW),* Report prepared for Jemena Gas Networks, April, page 9.

Figure 2.1: Illustration of the cost escalation



In summary:

- Historical nominal opex is deflated using WPI for labour (60% of opex) and 0% for other inputs (40% of opex), to give a 'real opex' estimate used in Economic Insights' modelling.[9]
- Economic Insights' modelling produces a time trend which is assumed to represent productivity change.
- The base year opex (the intersection between real and nominal opex in the figure) is rolled forward based on the productivity trend, the forecast input price inflation, and CPI.

[9] Economic Insights (2019), page 39.

3. OUR RESPONSES TO JGN'S QUESTIONS

3.1. ARE THERE ANY INCONSISTENCIES AND/OR ISSUES WITH THE AER'S ASSESSMENT OF THE ACCURACY OF THE WPI FORECASTS COMPARED TO ITS CPI EXPECTATION FORECAST ASSESSMENT?

This section examines whether there is any inconsistency with the way the AER evaluates forecasts of CPI and WPI.

CPI forecasts

The AER conducted an extensive review of its approach to estimating inflation in 2017.[10] The National Electricity Rules (NER) set out that to determine the inflation forecast the AER should use "*a method that the AER determines is likely to result in the best estimates of expected inflation*"[11]. The National Gas Rules (NGR) state that an estimate must be arrived at on a reasonable basis and must represent the best forecast or estimate possible in the circumstances.[12] How to determine the best estimate of expected inflation was a key issue of the AER's review. The rationale for using the 'best estimate of expected inflation' is that it enables the network service provider (NSP) to best manage its inflation risk as it issues debt in nominal terms.

It is worth highlighting that the best estimate of expected inflation may not be the same as the most accurate estimator of outturn CPI. This means that an analysis of how well an inflation expectations measure performed against outturn inflation does not provide clear evidence of its performance. Indeed, the AER stated that:

> *"We are required to estimate expected inflation in our regulatory framework, but the inflation outcome may turn out to be different to the original expectation. A difference between an initial expectation and the ultimate outcome does not necessarily mean that the expectation was not the best possible* ***expectation*** *available at the time."*[13] *[emphasis added]*

The AER's review concluded that its existing approach for setting CPI forecasts in the Post-Tax Revenue Model (PTRM), used since 2008, continued to meet the criteria of being the best possible expectation of inflation. The approach relies on the RBA's two-year inflation forecast and, for the next eight years after the end of the RBA's forecast, the mid-point of the RBA's target band for inflation (currently 2.5 percent). The AER's estimate of expected annual inflation is the average of these ten yearly figures.

Our views on the AER's approach were set out in the work we undertook for Energy Networks Australia.[14] In our report, and those of a number of other commentators,[15] it was noted that breakeven inflation generally appears to provide a closer estimate to outturn CPI than the AER's approach. This finding was based in part on the fact that breakeven forecasts were typically closer to outturn values.

WPI forecasts

Both the NER and NGR require a forecast of opex. The NER states that:

> *"The AER must accept the forecast of required operating expenditure of a Distribution Network Service Provider [/Transmission Network Service Provider] that is included in a building block proposal*

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[10] AER (2017) Regulatory treatment of inflation – Final Position, December.

[11] NER, Chapter 6.4.2(b)(1).

[12] NGR, Chapter 74(2).

[13] AER (2017) Regulatory treatment of inflation – Final Position, December.

[14] CEPA (2017) Best estimate of inflation expectations: Assessment of approaches, a report prepared for Energy Networks Australia, June.

[15] For example, CEG (2016) *Best estimate of expected inflation*, September.

if the AER is satisfied that the total of the forecast operating expenditure for the regulatory control period reasonably reflects each of the following (the operating expenditure criteria):

(1) The efficient costs of achieving the operating expenditure objectives; and
(2) The costs that a prudent operator would require to achieve the operating expenditure objectives; and
*(3) A realistic **expectation** of the demand forecast and cost inputs required to achieve the operating expenditure objectives"* [16] *[emphasis added]*

While the NGR guidelines are not as explicit, given that in both electricity and gas revenue/ access determinations the AER conducts a similar process we consider that it is reasonable to assume that the AER would follow the same principles. For instance, In the AER's letter to Jemena (dated 7 November 2019), the AER notes that:

"In developing the gas financial models we have started with the existing electricity models, and are considering whether there are any gas specific amendments required. The treatment of inflation is not a gas specific issue. As noted in our 2017 review, we consider it is important to preserve a consistent inflation approach across gas and electricity in order to prevent investment distortions across the sectors."[17]

As set out in Section 2, the AER uses forecast WPI in combination with a forecast for other opex input prices to escalate JGN's opex for the next regulatory period.

Assessing the accuracy of DAE's and BISOE's forecasts does not necessarily provide an indication of which forecast is the best estimate of wage inflation expectations. BISOE's forecasts may be a better estimate of wage inflation expectations than DAE's or vice versa, and this may change over time.

Conclusion

We consider that the way in which the AER evaluates CPI and WPI forecast expectations is inconsistent:

- For CPI, the AER uses a best estimate of expected inflation and has found that this estimate need not be the same as the best estimate of outturn inflation.
- For WPI, the AER has assessed the forecaster's accuracy against outturn WPI.

As both wages and consumer price inflation should be considered on an expectations basis, we think it is reasonable that both forecasts should be considered on the same basis, i.e. the chosen forecast should be the best estimate of (the respective) inflation.

Whatever approach is taken, the AER should be consistent in its assessment of inflation forecasts. In this context if the AER sticks with its approach to using only DAE's real WPI forecast, on the basis that it is more accurate, then it should consider moving to breakeven approach for estimating CPI as the evidence indicated this was more accurate than the mid-point of the RBA's target band.

3.2. Is the AER's approach to assessing the forecasts appropriate?

The AER is assessing two independent forecasts to determine whether one has been historically more accurate than the other. While this approach can determine the historical accuracy of a forecaster it does not reveal whether their future forecasts will be closer to outturn WPI.

Before setting out our assessment of the forecasts, we consider it important to set out why the AER was using the averages across the forecast previously.

[16] NER Chapter 6.5.6 and NER Chapter 6A.5.6.

[17] AER, Letter to Jemena, *RE: Response to model consultation - inflation compensation,* 7 November 2019.

The use of averages across forecasts

In its 2012 review, the AER gave weight to the views of Professor Jeff Borland. In his report, Professor Borland noted the following in regard to using averages across forecasts:

> *"Each forecast of the change in WPI made by DAE and BIS can be thought of as being equal to the actual change in WPI plus a forecast error. Suppose that the forecast error associated with any forecast made by DAE and BIS is regarded as being 'independent'; that is, knowing the forecast error made for example by DAE does not provide information about what the forecast error made by BIS is likely to be (and vice-versa). Then it follows that a forecast that is the average of the two forecasts will have a lower expected absolute prediction error than using either of the DAE or BIS forecasts. One way to think of this result is that, because the forecast errors are independent, taking the average of the DAE and BIS forecasts will tend to reduce the average size of the forecast error; that is, the forecast errors offset each other. Hence, the average of the DAE and BIS forecasts will be a better estimate of the actual change in WPI. The approach of taking an average, putting equivalent weight on the forecasts made by DAE and BIS, is optimal where it is considered that those forecasts are likely to be associated with equal-sized forecast errors (Bates and Granger, 1969, pages 452-53).*
>
> *…*
>
> *A variety of statistical studies have endorsed the value of combining forecasts - on the basis of the theoretical justification and the practical outcome. For example, Newbold and Harvey (2002, p.280) conclude: 'In a world of increasingly complex technical methodology, much of it, one suspects, destined never to be used outside of academic econometrics, the combination of forecasts is a beautiful rarity - a simple idea, easily implemented, that works well and therefore is used in practice.' I note that the AER (2012, p.106) has also concluded that: 'This result [the superior performance of a combined AEIDAE+BIS forecast] is consistent with a significant body of literature concluding forecast accuracy can be improved by combining multiple forecasts'; in support of which statement they cite the study by Clemens (1989). Armstrong (2005) also summarises general principles designed to improve forecast accuracy, one of which is to combine competing forecasts."*[18]

As Professor Borland points out, averaging across forecasts can improve accuracy.

We also note that there is precedent in other areas of the AER's determinations for using averages across estimates or forecasts. Examples include:

- For estimating the **allowed return on debt**, the AER averages data from three third party data providers: the RBA, Bloomberg and Thomson Reuters.[19] In their averaging the AER puts equal weight on each of the data providers. The AER concluded that a decision to put equal weight on all providers was justified as each provider had unique strengths and weaknesses, an equal weight was intuitively reasonable, and any weighting scheme would rely on contentious assumptions.[20]
- For determining the **weight placed on output growth** for electricity distribution network service providers (DNSPs), the AER's approach now relies on four models rather than a single one.[21]

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[18] Borland (2012), page 10.

[19] AER (2018a) *Rate of Return Instrument*, December.

[20] AER (2018b) *Draft – Rate of Return Guidelines – Explanatory Statement*, July, page. 58.

[21] AER (2018c) *Draft Decision: Essential Energy Distribution determination 2019–24 – Attachment 6 Operating expenditure*, November, page 6-28-6-29.

- The AER uses multiple (four) models to **assess DNSPs' relative opex efficiency**.[22]

For the WPI forecasts, the AER appears to be moving away from good statistical practice, and its own recent practices.

Assessing historical accuracy

Below we carry out an assessment of both forecasters' accuracy against national outturn WPI. However, it is important to note that an assessment, by us or the AER, of the forecasters' accuracy for each state's WPI is not possible as the ABS does not publish state level WPI for the 'electricity, gas, water and waste services' sector.

We have used two statistical measures to assess BISOE's and DAE's forecasts:

- **Root mean squared error (RMSE).** The RMSE is the square root of the average of squared differences between the predictions and the actuals. As the errors are squared, we do not need to worry about positive and negative errors cancelling each other. The key difference between the approaches is that the RMSE places a relatively higher weight on large errors. This is useful when large errors are particularly undesirable. As we are assessing annual movements that compound, we consider that large errors are particularly undesirable.
- **Mean absolute error (MAE).** The MAE was used by the AER in its assessment and is explained in AER (2019).[23]

Regarding the mean error, a statistic the AER also looked at, we agree with the AER that this can be useful in determining whether a forecaster is under-/over-forecasting compared to outturn (although this can also be observed through graphing the data).[24] However, beyond this we do not consider that the mean error provides much valuable information for assessing the accuracy of results given the issue that positive and negative differences can cancel out.

Rather than following the AER's approach of assessing all of the BISOE's and DAE's forecasts, we:

- Firstly, identified forecast periods for which DAE and BISOE made forecasts at a similar time. We identified forecast periods from 2007, 2010, 2011, 2012, 2014, 2015 and 2017.
- Secondly, for each forecast period, we used BIS's and DAE's most recent forecast prior to the start of the period.[25] This avoids double-counting (or more) initial and revised forecasts.
- Lastly, we calculated the RMSE and MAE across all the forecasts. Further details of the differentials are provided in Appendix A.

In the table below, we provide the RMSE and MAE across the 14 forecasts i.e., RMSE and MAE across seven forecasts for BISOE and DAE, and the RMSE and MAE across the combined 14 forecasts for the 'average' forecast.

[22] AER (2019b) *Draft Decision: Ergon Energy Distribution Determination 2020 to 2025 – Attachment 6 Operating expenditure*, page 6-32 to 6-34.

[23] AER (2019c) *Draft Decision: SA Power Networks Distribution Determination 2020 to 2025 – Attachment 6 Operating expenditure,* page 6-32, October.

[24] AER (2019c), page 6-31.

[25] In other words, we assess 14 forecasts, seven for each company.

Table 3.1: Errors across DAE's, BISOE's, and the average WPI forecasts

Forecast	RMSE	MAE
BISOE	1.1	1.0
DAE	1.0	0.6
Average	0.9	0.7

We can see that the RMSE and MAE for the average forecast are similar (to one decimal place) as those for DAE's forecasts – RMSE is slightly lower for the average and MAE is slightly higher. As we discussed above, the use of averages across multiple independent forecasts can offer a material benefit over a single independent forecast.

We note that BISOE has provided a number of network service providers with its commentary on the AER's assessment approach and its own assessment of its and DAE's forecast accuracy.[26] BISOE has taken a different approach to assessing the forecast accuracy than the AER's or ours.

BISOE identified that both its and DAE's utilities forecasts are estimated from 'all-industries' WPI forecasts.[27] Both companies start with a forecast for all-industries and then adjust this for their view of how the utilities sector's wages will change relative to the other industries. Given this, BISOE considered that it was appropriate to review both parts of the forecast separately as it considered that "*two offsetting forecast errors could be accidentally misconstrued as a better forecast performance.*"[28] BISOE's analysis indicates that this is the case for DAE's forecasts.

BISOE's assessment identified that both it and DAE had over forecast the all-industries WPI. However, unlike BISOE, DAE forecasted that the utilities WPI would be below that of the all-industries WPI. DAE was incorrect (i.e., utilities' wages grew at a faster rate than all-industries wages) but this lower differential offset DAE's higher all-industries WPI. This resulted in DAE's utilities WPI being closer to the actual WPI than BISOE's forecasts. BISOE concludes that the AER's assessment of DAE's forecasting accuracy leads to a spurious result as DAE's forecasts were only closer to actual WPI due this "*forecasting 'fluke'*"[29].

While we consider that there is value in reviewing the forecast for the utilities WPI as a whole, BISOE's approach appears to be robust given the methods both companies employ. BISOE's analysis supports our assessment that DAE's forecasts do not systematically statistically outperform the 'average' forecast.

In addition, as we cannot assess the accuracy of DAE's and BISOE's forecasts for NSW, we do not consider that there is compelling evidence that solely using DAE's forecasts would be better than using the average across DAE's and BISOE's forecasts for NSW (or any of the other states).

3.3. Is it appropriate/ correct for the AER to apply the opex productivity factor to capitalised overheads?

The AER, in its draft decision for JGN, stated that:

> *"We require JGN to adjust its capitalised overheads to account for the same productivity factors used in the opex forecast. Given the nature of overheads and JGN's ability to move overheads between capex and opex, as well as across and within regulatory periods, we find that the productivity factors associated with opex should also be applied to capitalised overheads to better reflect reality given that*

[26] See for example, BIS Oxford Economics (2019).

[27] BIS Oxford Economics (2019), page 4.

[28] BIS Oxford Economics (2019), page 4.

[29] BIS Oxford Economics (2019), page 4.

> *JGN cannot identify the specific capex* [capital expenditure] *and opex projects that drives productivity."*[30]

Economic Insights' models use opex data that is post-capitalisation. In other words, all the GDNs' overheads that are capitalised are excluded from Economic Insights' modelling. This means that the opex productivity target does not represent changes in overheads that the GDNs associate with capex.

As the capitalised overheads have not been included in the modelling, there is no direct link between the opex productivity estimate and any productivity that might be achievable for capitalised overheads. As the AER noted in its draft determination for SA Power Networks:

> *"We also note that SA Power Networks' capitalisation policy may impact the comparability of the benchmarking results and that this is an area we will consider as a part of our ongoing benchmarking development program"*[31]

The impact on modelling of capitalisation policy is not limited to the relative efficiency assessment but will also affect the coefficient on the time trend (the productivity estimate). Therefore, the productivity trend may not represent the historical productivity achieved by gas networks across all opex type activities (i.e., pre-capitalisation). This will be much more pronounced for the gas network modelling undertaken by Economic Insights as it uses a much smaller sample than its modelling in the electricity sector, and the gas sample is largely made up of Australian firms.

We do not consider the AER has evidence to support its draft decision for JGN that the historical opex productivity estimate should be applied to capitalised overheads.

[30] AER (2019d) *Draft Decision: Jemena Gas Networks (NSW) Ltd Access Arrangement 2020 to 2025: Attachment 5 – Capital expenditure*, November, page 5-67.

[31] AER (2019c), page 6-26. We note that the AER does not appear to have applied a productivity adjustment to SA Power Networks' capitalised overheads, see AER (2019d) *Draft Decision: SA Power Networks Distribution Determination 2020 to 2025: Attachment 5 – Capital expenditure*, October, pages 5-87 to 5-88.

4. DAE'S 2020-21 ESTIMATE

While we were reviewing the available information, we identified that DAE's real WPI estimate for NSW for 2020-21 appears to be incorrect.[32] DAE's reported estimate is 0.2%, however we cannot calculate this estimate using the numbers presented in DAE's report. We used the Fisher equation for each annual calculation:

The table below presents our estimates of the wage differential using the fisher equation.

Table 4.1: DAE's annual forecasts for WPI, CPI and real WPI, and our calculation of real WPI (%)

	2020-21	2021-22	2022-23	2023-24	2024-25
CPI					
CPI DAE	2.3	2.4	2.5	2.3	2.2
WPI forecast					
NSW	2.7	2.9	2.9	2.8	2.9
Real WPI (DAE reported)					
NSW	0.2	0.6	0.4	0.5	0.7
Real WPI (calculated using the Fisher equation)[33]					
NSW	0.4	0.5	0.4	0.5	0.7

Our analysis on the rounded data indicates that it should be 0.4%.[34]

[32] DAE (2019), page xiii.

[33] The Fisher equation as applied: $real\ WPI = \frac{(1+WPI)}{(1+CPI)} - 1$

[34] The estimate could range between 0.3% and 0.5% depending on the unrounded values.

Appendix A REAL WPI FORECAST TO OUTTURN DIFFERENTIALS

The differential between DAE's and BISOE's forecasts, and the calculated RMSE and MAE, for each forecast period are shown in the tables below.

We have used the ABS' September 2019 WPI series id 'A2639399R' from Catalogue Number 6345 and CPI series id 'A2325846C' from Catalogue Number 6401. These series lead to minor differences in the 'actual' real wage compared to those reported in AER (2019).

Table A.1: Differential between forecast and actuals, 2007 to 2012

	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
BISOE	0.9	2.0	0.5	-0.1	0.7	0.7						
DAE	-0.7	2.9	3.3	-0.6	0.2	1.1						
Average	0.1	2.5	1.9	-0.3	0.4	0.9						

Source: BIS Shrapnel, Outlook for Wages to 2012/13: Electricity, Gas and Water Sector Australia and Victoria, March 2007; Access Economics, Labour Cost Indices for the energy sector, April 2007; ABS; CEPA analysis

Table A.2: Differential between forecast and actuals, 2010 to 2015

	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
BISOE				-1.0	0.8	0.6	0.6	1.9	1.0			
DAE				-0.5	-0.4	-0.2	-0.4	1.8	0.5			
Average				-0.7	0.2	0.2	0.1	1.8	0.7			

Source: BIS Shrapnel, Wages outlook for the electricity distribution sector in Victoria, July 2010; Access Economics, Forecast growth in labour costs: update of March 2010 report, September 2010; ABS; CEPA analysis

Table A.3: Differential between forecast and actuals, 2011 to 2016

	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
BISOE					0.8	0.5	-0.2	1.5	1.0	0.8		
DAE					0.4	0.9	-0.1	1.3	0.4	-0.2		
Average					0.6	0.7	-0.2	1.4	0.7	0.3		

Source: BIS Shrapnel, Wages outlook for the electricity distribution sector in Victoria, July 2010; Access Economics, Forecast growth in labour costs: update of March 2010 report, September 2010; ABS; CEPA analysis

Table A.4: Differential between forecast and actuals, 2012 to 2018

	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
BISOE*						-0.1	0.3	1.7	1.5	1.2	1.9	
DAE						0.1	-0.5	0.7	0.1	0.1	0.4	
Average						0.0	-0.1	1.2	0.8	0.6	1.2	

** December year end forecast*

Source: BIS Shrapnel, Real Labour Cost Escalation Forecasts to 2017 – Australia and Victoria, October 2012; Deloitte Access Economics, Forecast growth in labour costs: Victoria and South Australia, October 2012; ABS; CEPA analysis.

Table A.5: Differential between forecast and actuals, 2014 to 2018

	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
BISOE							1.1	0.1	0.3	1.2	1.1	
DAE							0.4	-0.1	0.0	0.6	0.4	
Average							0.7	0.0	0.1	0.9	0.7	

Source: BIS Shrapnel, Real Labour Cost Escalation Forecasts to 2017 – Australia and Victoria, September 2013; Deloitte Access Economics, Forecast growth in labour costs in Victoria, June 2013; ABS; CEPA analysis

Table A.6: Differential between forecast and actuals, 2015 to 2018

	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
BISOE									0.6	0.4	1.2	2.4
DAE									0.2	-0.4	-0.6	0.5
Average									0.4	0.0	0.3	1.4

Source: BIS Shrapnel, Utilities Sector Wage Forecasts to 2019/20 > Australia and South Australia, May 2015; Deloitte Access Economics, Forecast growth in labour costs in NEM regions of Australia, June 2015; ABS; CEPA analysis

Table A.7: Differential between forecast and actuals, 2017 to 2018

	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
BISOE											0.4	0.9
DAE											-0.4	0.5
Average											0.0	0.7

Source: BIS Shrapnel, Report on expected wage changes to 2022/23 > FINAL, February 2017; Deloitte Access Economics, Labour Price Forecasts, February 2017; ABS; CEPA analysis

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