Response to Ergon Energy's Consultants' Reports on Economic Benchmarking

Report prepared for
Australian Energy Regulator

7 October 2015

Denis Lawrence, Tim Coelli and John Kain

Economic Insights Pty Ltd
Ph +61 2 6496 4005
Email denis@economicinsights.com.au
WEB www.economicinsights.com.au
ABN 52 060 723 631

An appropriate reference to the report and models is:

Economic Insights (2015), *Response to Ergon Energy's Consultants' Reports on Economic Benchmarking*, Report prepared by Denis Lawrence, Tim Coelli and John Kain for the Australian Energy Regulator, Eden, 7 October.

Disclaimer

Economic Insights Pty Ltd (Economic Insights) has prepared this report and the associated economic benchmarking models exclusively for the use of the Australian Energy Regulator (AER) and for the purposes specified in the report. The report and the associated economic benchmarking models are supplied in good faith and reflect the knowledge, expertise and experience of the consultants involved. They are accurate to the best of our knowledge. However, Economic Insights accepts no responsibility for any loss suffered by any person or organisation, other than the AER, taking action or refraining from taking action as a result of reliance on the report and the associated economic benchmarking models.

CONTENTS

DNSP Name Abbreviations iii
Executive Summary iv
1 Introduction 1
2 Response to Huegin Report for Ergon 2
  2.1 Summary 2
  2.2 Reliance on economic benchmarking 4
  2.3 Regulatory robustness 5
  2.4 Range of results 10
  2.5 Service area issues 15
  2.6 Frontier Economics letter 18
3 Response to Synergies Report for Ergon 20
  3.1 Output allocative efficiency 21
  3.2 Input allocative efficiency 22
  3.3 Scale efficiency 23
4 Updated Findings 25
  4.1 Incorporating operating environment factors not explicitly included in the opex cost function model 26
  4.2 Adjustment to Ergon’s base year opex 27
  4.3 Opex productivity, output and price growth forecasts to include in the rate of change 29
References 31

DNSP NAME ABBREVIATIONS

The following table lists the DNSP name abbreviations used in this report and the State in which the DNSP operates.

Abbreviation	*DNSP name*	*State*
ACT	ActewAGL	Australian Capital Territory
AGD	Ausgrid	New South Wales
AND	AusNet Distribution	Victoria
CIT	CitiPower	Victoria
END	Endeavour Energy	New South Wales
ENX	Energex	Queensland
ERG	Ergon Energy	Queensland
ESS	Essential Energy	New South Wales
JEN	Jemena Electricity Networks	Victoria
PCR	Powercor	Victoria
SAP	SA Power Networks	South Australia
TND	TasNetworks Distribution	Tasmania
UED	United Energy	Victoria

EXECUTIVE SUMMARY

The Australian Energy Regulator has requested Economic Insights to review the reports by Huegin (2015d) and Synergies (2015b) submitted by Ergon Energy with its revised regulatory proposal. Updated recommendations for base year opex adjustments and the opex partial productivity growth rate to be included in opex forecasts for Ergon Energy are also presented.

Huegin report for Ergon

Huegin (2015d, p.1) summarises its position by arguing that the AER's economic benchmarking analysis is 'inherently sensitive' and does not adequately allow for the heterogeneous nature of DNSPs. It argues that the use of a common cost function is not appropriate given Ergon's different attributes.

However, as discussed in Economic Insights (2014, 2015), the results of the economic benchmarking analysis were broadly consistent across two quite different benchmarking methods (index number versus econometric modelling), two different econometric estimation methods (stochastic frontier analysis versus least squares econometrics), two different functional forms (Cobb–Douglas versus translog), several output specifications (inclusion and exclusion of reliability, inclusion and exclusion of energy delivered) and different datasets (inclusion or exclusion of international data and varying cut–off points for exclusion of small DNSPs). The results of the economic benchmarking analysis are hence quite stable rather than being 'inherently sensitive'.

With regard to Ergon Energy's 'different attributes' such as its longer line length, the Economic Insights econometric opex cost function models do not indicate that this DNSP has characteristics different from other rural DNSPs. This finding was consistent with engineering analysis commissioned by the AER (see EMCa 2015).

Despite the relative robustness of the findings of the economic benchmarking analysis, Economic Insights (2014, 2015) recommended adoption of a conservative approach to target setting to allow for any residual data imperfections and limitations of the modelling approaches. This is consistent with the approach adopted by overseas regulators such as Ofgem in the UK. We examine multiple models, as does Ofgem, and we make adjustments for regional effects such as climatic differences and subtransmission intensiveness which are difficult to model. Whereas Ofgem allows for hard to model factors by excluding estimated costs from the analysis ex ante, we allow for these effects ex post which we believe to be a more robust and transparent method.

Huegin (2015d, p.1) goes on to argue that data from the 2006–2008 period exerts an undue influence on the economic benchmarking results and notes that overseas regulators sometimes include the DNSP's own forecast data in benchmarking analyses. As discussed in AER (2015a,b), the Victorian DNSPs have increased their opex since 2011 to meet more stringent bushfire risk–reduction requirements introduced following the Victorian Bushfires Royal Commission. Key aspects of the current Victorian bushfire regulations are now considerably more onerous than those in place in other states.

Prior Victorian bushfire regulations were at least as onerous as those in other states. Rather than 'inflating' the efficiency target as claimed by Huegin (2015d, p.1), inclusion of data from

2006–2008 helps establish a more accurate target by including data from a period when bushfire regulations were more comparable in their impact. To only include more recent data would be to bias the efficiency target downwards as it would artificially advantage non–Victorian DNSPs which have not moved to fully meet the now more onerous Victorian regulations as the Victorian DNSPs have been required to do.

We are also of the view that it is inappropriate to include forecast data for the DNSP being reviewed in the economic benchmarking analysis. This would be fundamentally incompatible with the base/step/trend approach to forming a forecast of efficient opex. Establishing the efficient level of base year opex requires independent observations of actual opex. Including forecast opex for the DNSP being reviewed would remove the required independence of observations included in the modelling while creating additional opportunities for gaming by the DNSP. It also runs counter to the objective of forming a reference forecast of efficient opex against which the DNSP's own forecast is compared.

Huegin's (2015d, p.30) figure 4 claims there is a wide range of possible base year efficiency adjustments from our models. This appears to be based on the incorrect assumption that AusNet Distribution would be the target in each case. However, the opex MPFP model does not include allowance for the degree of undergrounding whereas the SFA and LSE models do. If one were to base recommendations on the opex MPFP model then allowance would need to be made for differences in the degree of undergrounding across DNSPs.

Finally, Huegin (2015d, p.1) argues that the AER's benchmarking contains no consideration of Ergon's large service area. We consider that line length is the main influence on DNSP opex. Furthermore, Economic Insights (2015, p.15) noted that spatial measures are subject to significant subjectivity and measurement issues. The line length based customer density measure used in our study is the only objective and verifiable measure available and captures the most important dimensions of customer location affecting DNSP costs.

Synergies report for Ergon

No weight can be placed on the Synergies (2015b) data envelopment analysis (DEA) analysis. Its construction of the reliability variable is problematic as it involves adding an arbitrary constant to the negative of SAIDI and will produce different DEA efficiency results depending on what arbitrary constant value is chosen. To put this another way, DEA models are not translation invariant whereas this property would be required for the method used to construct the Synergies reliability variable to be valid. Furthermore, we believe both the output and input allocative efficiency results presented are not meaningful as they appear to involve the assumption that output and input prices, respectively, are all equal to one. And, the scale efficiency result of decreasing returns to scale presented for Ergon does not appear to be consistent with either economic or engineering logic.

Updated finding on Ergon's base year opex

Based on our review of Ergon's consultants' reports, we have found no reason to change the general approach adopted in our earlier benchmarking analysis. However, we do make two changes to the estimation of our opex cost function model and include two OEF revisions.

The first of these changes involves using non–coincident maximum demand across all three countries to derive our ratcheted maximum demand output. Previously, coincident maximum demand was used for Australia and New Zealand and non–coincident maximum demand for Ontario. Making this change has minimal impact on model results as the model makes off–setting changes to the country dummy variable coefficients. This highlights the efficacy of the approach we have adopted to allow for differences in variable definitions and coverage.

The second change involves a revision to Ergon's network services opex to exclude items related to metering services previously included in Ergon's EBRIN reporting but which were in fact not part of network services opex. This change also affects the conversion between network services opex and base year opex as used in Ergon's revised regulatory proposal.

There have also been some minor revisions to the operating environment factors for Ergon not explicitly included in the opex cost function model based on additional information from Ergon. This has led to small changes to the operating environment factor adjustments for OH&S regulations and for cyclones. The combined effect of these adjustments is to increase the operating environment factor adjustment by 1.5 percentage points to 26.2 per cent.

We undertake a five step process in calculating the adjustments to base year opex required to reach the relevant efficiency target for Ergon. These include adjustment of the econometric model's average efficiency score to allow for operating environment factors not included in the model, rolling resultant efficient opex forward to 2013, conversion of 2013 total opex from Ergon's revised Reset RIN to a basis consistent with network services opex, and comparison of Ergon's network services–equivalent opex and the 2013 efficient network services opex to calculate the adjustment required to Ergon's base year opex.

The results of these calculations are presented in table A.

Table A **Ergon's average opex efficiency score, adjusted efficiency target and 2013 network services opex and base year opex adjustment to reach the target**

DNSP	*Efficiency score*	*Target allowing for additional OEFs*	*Reduction to base year opex*
Ergon Energy	52.1%	61.3%	–1.4%

Table A indicates an increase in base year opex being required to achieve Ergon's efficiency target, but this simply indicates that Ergon is already exceeding its (conservatively set) target and so no adjustment to its base year opex is required.

The main reason for the change from the 10.7 per cent base year opex reduction for Ergon in Economic Insights (2015) is the revision to Ergon's opex data to more accurately identify its metering expenses. This has a two fold effect. Firstly, it reduces Ergon's network services opex somewhat and hence increases its opex efficiency score. Secondly, because Ergon's metering services opex increases steadily over the 8 year period, the amount deducted from total opex in 2013 in the translation between total opex and network services opex is larger so that the rolled–forward efficient opex derived from the benchmarking analysis now exceeds the equivalent–basis actual opex for 2013 by just over $4 million.

None of the DNSP consultant reports have challenged our view that a zero opex partial productivity growth rate should be used in the rate of change formula used to form the forecast of future opex requirements.

1 INTRODUCTION

The Australian Energy Regulator (AER) is currently reviewing the expenditure proposals of electricity distribution network service providers (DNSPs) in Queensland for the five year regulatory period commencing on 1 July 2015.

The AER has engaged Economic Insights to assist with the application of economic benchmarking and to advise on:

a) whether the AER should make adjustments to base year operating expenditure (opex) for the Queensland DNSPs based on the results from economic benchmarking models, and

b) the productivity change to be applied to forecast opex for the Queensland DNSPs.

Economic Insights (2015) presented the results of our analysis for the Queensland DNSPs based on a range of economic benchmarking techniques including stochastic frontier analysis (SFA), least squares econometrics (LSE) and opex multilateral partial factor productivity (MPFP) indexes. Downwards adjustments were recommended for the base year opex of each of the Queensland DNSPs based on the results of the economic benchmarking analysis.

On 3 July 2015 the two Queensland DNSPs (Energex and Ergon Energy) submitted their revised regulatory proposals. Ergon Energy's revised proposal included two supporting consultants' reports critiquing the analysis in Economic Insights (2015). These were reports by Huegin (2015d) and Synergies (2015b).

The AER has requested Economic Insights to review the reports by Huegin (2015d) and Synergies (2015b) which we do in the following sections of this report. Updated recommendations for base year opex adjustments and the opex partial productivity growth rate to be included in opex forecasts for Ergon Energy are presented in section 4.

2 RESPONSE TO HUEGIN REPORT FOR ERGON

The Huegin (2015d) report largely raises issues previously covered in earlier Huegin reports (see Huegin 2015a,b,c). Economic Insights (2015) addressed these issues and rebutted Huegin's arguments. In this section we summarise the main points raised previously and concentrate on new issues raised by Huegin.

2.1 Summary

Huegin (2015d, p.1) summarises its position by arguing that the AER's economic benchmarking analysis is 'inherently sensitive' and does not adequately allow for the heterogeneous nature of DNSPs. It argues that the use of a common cost function is not appropriate given Ergon's different attributes. However, as discussed in Economic Insights (2014, 2015), the results of the economic benchmarking analysis were quite consistent across two quite different benchmarking methods (index number versus econometric modelling), two different econometric estimation methods (stochastic frontier analysis versus least squares econometrics), two different functional forms (Cobb–Douglas versus translog), several output specifications (inclusion and exclusion of reliability, inclusion and exclusion of energy delivered) and different datasets (inclusion or exclusion of international data and varying cut–off points for exclusion of small DNSPs). The results of the economic benchmarking analysis are hence quite stable rather than being 'inherently sensitive'.

With regard to Ergon Energy's 'different attributes' such as its longer line length, the Economic Insights econometric opex cost function models do not indicate that this DNSP has characteristics different from other rural DNSPs. If this were the case there would be a divergence of results between the Cobb–Douglas and translog econometric cost function models for Ergon. This is because in the more flexible translog model the frontier would bend to meet the Ergon observations if Ergon had unusual characteristics and hence it would have a higher efficiency score (ie the model may find it efficient by default). In the less flexible Cobb–Douglas model, DNSPs with unusual characteristics can exert some leverage on the general shape of the estimated function but the frontier shape will be largely determined by the smaller data points when there are a majority of smaller points. However, this divergence of results is not observed. This finding was consistent with engineering analysis commissioned by the AER (see EMCa 2015).

Despite the relative robustness of the findings of the economic benchmarking analysis, Economic Insights (2014, 2015) recommended adoption of a conservative approach to target setting to allow for any residual data imperfections and limitations of the modelling approaches. We did this by taking the performance of the fifth most efficient DNSP as the target instead of that of the most efficient DNSP and by making further allowance for operating environment factors not explicitly included in the econometric modelling. This is consistent with the approach adopted by overseas regulators such as Ofgem in the UK. We examine multiple models, as does Ofgem, and we make adjustments for regional effects such as climatic differences and subtransmission intensiveness which are difficult to model. Whereas Ofgem allows for hard to model factors by excluding estimated costs from the analysis ex ante, we allow for these effects ex post which we believe to be a more robust and transparent method which makes optimal use of the information available.

Huegin (2015d, p.1) goes on to argue that data from the 2006–2008 period exerts an undue influence on the economic benchmarking results and notes that overseas regulators sometimes include the DNSP's forecast data in benchmarking analyses. As demonstrated in Economic Insights (2014, 2015) there are significant advantages in including several years' worth of data in the benchmarking analysis to smooth out the influence of unusual events and to reduce the scope for DNSPs to game the reset by reducing expenditure in years close to the reset. Rather, a better approach is to take period–average opex based on an average efficiency score and roll this forward to the base year using the same rate of change method used to roll the base year forward under the base/step/trend forecasting approach.

As discussed in AER (2015a,b), the Victorian DNSPs have increased their opex since 2011 to meet more stringent bushfire risk–reduction requirements introduced following the Victorian Bushfires Royal Commission (VBRC). While regulations differ between states and have been implemented differently, key aspects of the current Victorian bushfire regulations are considerably more onerous than those in place in other states. Prior Victorian bushfire regulations were at least as onerous as those in other states. We have adopted a conservative approach to this situation by assuming that DNSPs in other states will progressively move to meet aspects of the post–VBRC Victorian requirements for duty of care reasons, even though they are not technically required to. Hence, rather than 'inflating' the efficiency target as claimed by Huegin (2015d, p.1), inclusion of data from 2006–2008 helps establish a more accurate – but still conservative – target by including data from a period when bushfire regulations were more comparable in their impact. To only include more recent data would be to bias the efficiency target downwards as it would artificially advantage non–Victorian DNSPs which have not moved to fully meet the now more onerous Victorian regulations as the Victorian DNSPs have been required to do.

We are also of the view that it is inappropriate to include forecast data for the DNSP being reviewed in the economic benchmarking analysis. This would be fundamentally incompatible with the base/step/trend approach to forming a forecast of efficient opex. The objective is to establish an efficient level of base year opex given the circumstances of the DNSP being reviewed which is then rolled forward using changes in output quantities, input prices and productivity through the forecast period. Establishing the efficient level of base year opex requires independent observations of actual opex. Including forecast opex for the DNSP being reviewed would remove the required independence of observations included in the modelling while creating additional opportunities for gaming by the DNSP. It also runs counter to the objective of forming a reference forecast of efficient opex against which the DNSP's own forecast is compared.

Finally, Huegin (2015d, p.1) argues that the AER's benchmarking contains no consideration of Ergon's large service area. However, we consider that line length is the main influence on DNSP opex in this instance as it is kilometres of line that the DNSP has to operate and maintain, irrespective of the size of the purported service area. Furthermore, Economic Insights (2015, p.15) noted that spatial measures are subject to significant subjectivity and measurement issues. For example, the NSW and ACT DNSPs' consultant, CEPA (2015a,b), included the area of all of Queensland in its spatial variable for Ergon Energy when large areas of remote and outback Queensland have no electricity lines within hundreds of kilometres. Rather, the line length based customer density measure used in our study is the only objective and verifiable measure available and captures the most important dimensions of customer location affecting DNSP costs.

2.2 Reliance on economic benchmarking

Huegin (2015d, p.4) presents a series of graphs purporting to show that Ergon's proposed opex involves an opex reduction and productivity gains 'greater than any other National Electricity Market (NEM) business'. The basis on which the graphs are calculated is not explained. However, our reservations regarding the use of DNSP forecast data noted in the previous section apply. And the Huegin analysis does not address the basic question of how Ergon's proposed opex compares in present value terms with a reference opex forecast calculated using the base/step/trend approach.

Huegin (2015d, p.5) argues that the AER's approach relies too heavily on a specific economic benchmarking model without allowing due caution given modelling uncertainties. We reject this argument. As noted in the preceding section, our analysis and recommendations are based on analysis of a range of econometric and index number models which all produce broadly similar findings. We then proceed to allow for additional operating environment factors not explicitly included in the models and apply a very conservative efficiency target to allow for data imperfections and modelling uncertainty.

Huegin (2015d, p.5) proceeds to argue that, by applying Stochastic Frontier Analysis Cobb–Douglas (SFACD) model, the economic benchmarking analysis fails to take account of Ergon's 'outlier' characteristics. However, as noted in the preceding section, the models estimated provide no support for Huegin's proposition that Ergon cannot be compared with other DNSPs in the sample. Rather, the more flexible translog model produces similar results to the SFACD model and the AER's engineering analysis supports a similar relationship applying to Ergon as to other rural DNSPs (see EMCa 2015).

Finally, Huegin (2015d, p.5) argues that no recognition is given to Ergon's proposed opex savings. This misses the point that the purpose of forming a forecast of efficient opex using the base/step/trend approach is to provide a reference point against which to compare the DNSP's own opex proposal. And, as noted in the preceding section, Huegin's complaint that there is a focus on 'very aged historic data' fails to recognise that there is a significant advantage in taking average efficiency over a sufficiently long period to smooth out abnormal factors and to reduce the impact of potential DNSP gaming. This average efficiency score is used as the starting point for the roll forward of efficient opex, taking account of the DNSP's operating environment, to the base year. In this case, adopting a more recent time period would artificially advantage the non–Victorian DNSPs who have not yet fully complied with the more stringent bushfire regulations introduced in Victoria in 2011.

Contrary to Huegin's (2015d, p.5) claim that the economic benchmarking is 'not yet fit for purpose', we believe a rigorous and thorough approach has been adopted and relevant safeguards implemented through the adoption of a conservative target and extensive allowance for operating environment differences.

2.3 Regulatory robustness

Huegin (2015d, p.9) repeats a number of arguments it has previously made that the economic benchmarking has been unduly influenced by a desire to adopt the ‘neat’ SFACD model and that accompanying assumptions and data use limit the applicability of the results to a particular DNSP such as Ergon. As outlined in Economic Insights (2015), this is not an accurate representation of the situation. Firstly, the adoption of any economic benchmarking method other than index numbers necessitates drawing on a dataset with considerably more observations and variation than that found within the EBRIN sample – this is not something that is peculiar to the use of the SFACD model. Secondly, a number of different models have been examined and they all produce broadly similar findings. In particular, the more flexible translog LSE model produces similar results to the somewhat more restrictive Cobb–Douglas model and hence Huegin’s arguments regarding varying returns to scale are not material. And, thirdly, Economic Insights (2014, 2015) has adopted an appropriately conservative approach to its recommendations by extensive allowance for operating environment differences and provision of a generous margin for any remaining modelling uncertainties.

Huegin (2015d, pp.10–12) next compares the approach adopted by the AER with that adopted by Ofgem and several other regulators. The AER (2015a, p.7–53) noted that its approach was consistent with that used by Ofgem. Both approaches involve extensive data checking, both use a number of models, both make adjustments for operating factors not explicitly modelled, and both adopt a conservative approach to target setting rather than adopting the most efficient firm as the target. The main point which Huegin attempts to make is that the other regulators it examines use so–called ‘totex’ efficiency comparisons rather than opex efficiency comparisons as used by the AER. However, this fails to recognise that the exact approach adopted by a regulator will depend on the regulatory regime it has to implement.

Under the building blocks regime the AER is required to implement, opex and capex allowances are incorporated quite separately and so separate decisions have to be made about the efficiency of a DNSP with respect to both. This contrasts with many overseas regulatory regimes where only an assessment of overall cost requirements is made. An example is the Ontario Energy Board which uses a form of productivity–based regulation where the X factor is set based on the past industry productivity growth rate and a ‘stretch factor’ based on each DNSP’s overall cost performance. Benchmarking in these jurisdictions is driven by the requirements of their form of regulation and not specifically by the aim of reducing the impact of opex/capex trade–offs as appears to be implied by Huegin. In the AER’s economic benchmarking of opex in its building blocks regime, opex/capex trade–offs are accounted for in the ex post adjustment for additional operating environment factors. Huegin’s attempt to highlight differences across regulators is thus misguided as it fails to compare like with like.

Huegin (2015d, pp.13–17) next attempts to argue that estimation of an opex cost function with common slope coefficients across the three–country sample does not make adequate allowance for Ergon’s unusual characteristics. Huegin’s figure 1 will overstate service area differences across the sample as, like the CEPA (2015a,b) studies mentioned above, it appears to allocate almost all of Queensland’s land area to Ergon’s service area. Since large sections of the outback are effectively not serviced, this approach will significantly overstate Ergon’s service area and understate its customer density.

Despite making qualitative arguments as to why Ergon might be different to other DNSPs, Huegin produces no convincing quantitative evidence as why Ergon’s efficiency score is inappropriately measured by the SFACD model. As noted above, we have estimated a range of econometric opex cost function models and they all produce similar results. In particular, if Ergon actually exhibited different cost characteristics to other rural DNSPs, we would expect its score under the more flexible translog models to be higher than under the less flexible Cobb–Douglas models. This is because the more flexible functional form would ‘bend’ the frontier to accommodate the unique characteristics of the unusual DNSP. That is, it would be found to be relatively efficient by default.

Huegin (2015d, p.14) makes the observation that ‘This issue would not be so material had the AER not used the single efficiency score from the SFA CD model to forecast Ergon Energy’s opex’. However, Economic Insights (2014, p.36) listed the opex efficiency scores for Ergon as being 0.482 for the SFACD model and 0.509 for the least squares translog model. This is a very small difference and, when the difference in the highest efficiency scores is allowed for (0.95 for the SFACD model and 1.00 for the translog model), the opex reduction required to reach the efficiency of the most efficient DNSP (before adjustment for additional operating environment factors) is 49.3 per cent for the SFACD model and 49.1 per cent for the translog model. We conclude, therefore, that there is no evidence of Ergon being inappropriately treated in the economic benchmarking analysis.

Huegin (2015d, p15) claims that models estimated for Australia and New Zealand combined and for Ontario produce output coefficients which differ from each other and from those produced by the three–country model. However, no significance levels are provided and no efficiency scores are reported. Huegin make the statement that ‘This suggests that had the AER used only Australian data, or even just Australian and NZ data, the cost function, and by extension the cost frontier from which Ergon was measured, would have been different than that obtained by Economic Insights’. This is rather surprising because it ignores the results presented in Economic insights (2015, p.24) of efficiency scores derived from the preferred SFACD model estimated using Australian data only. These results showed little difference between the efficiency scores derived from the same model applied to the Australian only data and the three–country data. In fact, Ergon’s efficiency score was slightly higher using the three–country data than it was using the Australian data only.

Huegin (2015d, pp.16–17) goes on to argue that the majority of opex costs are associated with the existence of assets and argues that, since line length is the closest of our output measures to a measure of asset quantity, the SFACD model underweights the importance of assets as a ‘driver’ of opex. While it would be preferable to include a capital assets measure explicitly in the estimated opex cost function, Economic Insights (2014, p.32) noted the following:

> ‘With regard to capital variables, due to the lack of comparable capital data available for Ontario, we were unable to include a capital measure in this instance. However, we do note that in the Australian data the aggregate capital quantity variable formed by aggregating physical measures of lines, cables and

> transformers and using annual user costs as weights has a very high correlation of 0.95 with the energy delivered (*Energy*) output and of 0.94 with the ratcheted maximum demand (*RMDemand*) output. Similarly the constant price capital stock variable had a correlation of 0.88 with both the customer number (*CustNum*) and *RMDemand* output variables. This suggests that the omission of a capital input variable is unlikely to have a significant bearing on the results as it is likely to be highly correlated with the included output variables.'

The Huegin argument regarding the size of line length coefficients is, therefore, not relevant.

Huegin (2015d, p.18) claims that economic benchmarking results for Ergon have varied considerably over a short space of time. However, Huegin confuses results from the first stage of the economic benchmarking analysis (ie efficiency scores derived from the econometric opex cost function models) with the overall outcome of the economic benchmarking analysis which comprises two stages with the second stage being the incorporation of allowances for additional operating environment factors not explicitly incorporated in the econometric models and setting of the appropriate target. Changes affecting Ergon have only comprised relatively minor refinements to the additional operating environment factor allowances and the move from the conservative target of the average of the scores of DNSPs in the top quartile of possible scores to the even more conservative target of that of the DNSP at the bottom end of the top quartile of possible scores. The adoption of this quite conservative target was in response to stakeholder feedback and has applied to all relevant regulatory resets to date.

Finally, Huegin (2015d, pp.18–19) questions the approach adopted to incorporating additional operating environment factor adjustments adopted in the economic benchmarking analysis. Firstly, Huegin incorrectly characterises this process as 'unstructured' and 'hastily adopted'. Rather, the process of assessing the additional operating environment factors has been thorough and rigorous and has been undertaken precisely to provide a structured consideration of issues raised by stakeholders. The extensive analysis behind the consideration of these factors was documented in detail in AER (2015).

Huegin presents three examples of why it thinks the process has lacked robustness. The first is that the size of the allowance for Endeavour Energy is around the same as that for Essential Energy. Huegin provides no reasons as to why it thinks this outcome is inappropriate. In fact, a large part of the explanation for this outcome lies in the differing subtransmission intensiveness of the two DNSPs with Endeavour having a much higher proportion of higher voltage lines than does Essential. This means Endeavour receives a relatively higher allowance for the higher costs of operating high voltage lines than does Essential. Essential, on the other hand, receives more allowance for other factors associated with its more rural service area such as more onerous license conditions and greater termite exposure.

Huegin's second example is rather confused and relates to the coverage of ActewAGL's assets classed as subtransmission assets. Huegin (2015d, p.18) claims that '[b]etween the draft and final decision, ActewAGL have had consideration of the influence of subtransmission assets removed from its decision, despite the known existence of dual function assets in the ActewAGL network'. However, ActewAGL has a lower proportion of subtransmission assets than do the Victorian and South Australian DNSPs. Consequently, no allowance was made for ActewAGL's subtransmission intensiveness in either the AER's draft or final decisions. However, ActewAGL was given an immaterial factor allowance of 0.5 per cent in the AER's final decision as having its subtransmission lines being predominantly overhead may marginally disadvantage ActewAGL compared to the frontier DNSPs. Huegin notes that the assumption that subtransmission lines are twice as costly to operate and maintain as lower voltage lines 'might be close to true on average'. It should be noted, however, that this assumption is in fact based on data from Ausgrid's regulatory accounts for its transmission assets of 66 kV and higher relative to data from its distribution regulatory accounts.

Huegin's third example relates to the AER's discovery of a minor clerical error in calculations in June 2015. While regrettable, minor clerical errors are inevitable in any large review and provide no valid reason to criticise the use of ex post adjustment for additional operating environment factors. In fact, such errors are likely to be more easily identified and corrected in such an approach than they are in much more complex and detailed bottoms–up engineering reviews.

In summary, Huegin's examples provide no evidence whatever for its claims that the calculation of the ex post operating environment factor adjustments has been either 'unstructured' or 'hastily adopted'.

Huegin goes on to question the efficacy of an ex post adjustment process compared to an ex ante data adjustment process (ie exclusion of selected costs from the analysis) as adopted by Ofgem. Huegin argues that the ex post process may produce a different outcome as the ex post adjustment is only focussing on differences between the DNSP being reviewed and the target DNSP whereas an ex ante process might lead to simultaneous adjustments being made for all DNSPs. In reality, all approaches to adjusting for operating environment differences not explicitly included in benchmarking models will have their own limitations. It is not proven that the ex ante and ex post approaches would have different outcomes. In the current case, adoption of the ex ante adjustment process is not feasible as it would involve the need to review the circumstances of all of the 68 included DNSPs across the three countries. Instead, we have adopted the approach of including country–specific dummy variables to allow for systematic differences across countries and undertaken ex post adjustment within the Australian sample. Ex post adjustment is more transparent and objective and overcomes information asymmetry and gaming issues that would be associated with excluding certain categories of DNSP costs ex ante.

The challenge with economic benchmarking for regulatory purposes is to determine how much of the unexplained residual from modelling to allocate to DSNP inefficiency and how much to heterogeneity among the included DNSPs (from factors that are not included in the modelling). Assuming all is inefficiency likely provides an upper bound for base year cost adjustments while assuming it is all due to latent heterogeneity will provide a lower bound for base year adjustments. The former may produce too large an adjustment while the latter will almost certainly produce too low an adjustment. Our use of the two step process for calculating the overall adjustment for operating environment differences provides a means of reaching the most appropriate point within this range of possible base year adjustments.

Huegin also raises the issue of cost allocation methodology (CAM) changes a number of DNSPs have proposed to make in future regulatory periods. In particular, CitiPower and Powercor have both proposed CAM changes to take effect from 2016 which would lead to both DNSPs expensing more of their total expenditure. Huegin questions whether efficiency comparisons would be affected, had these CAM changes applied in the 2006 to 2013 period given that both these DNSPs are currently top quartile opex performers.

We note that Powercor currently expenses an above average proportion of its total expenditure and considerably more than does Ergon (AER 2015a, p.7–181). However, while CitiPower currently expenses a similar proportion to Ausgrid, Endeavour and Energex, it is below the industry average and less than Ergon’s proportion. The proposed CAM changes would take Powercor’s already high expensing proportion to a level well in excess of the industry average. They would take CitiPower’s expensing proportion to somewhat above the industry average and above that of Ergon (AER 2015b, figure 1).

To assess the potential impact of these proposed CAM changes, we have undertaken a sensitivity analysis assuming that CitiPower’s proposed CAM change applied retrospectively back to 2006. Powercor’s proposed CAM change is not incorporated in the sensitivity analysis because it already has a relatively high expensing proportion and the proposed changes would make this higher again. Including such a high proportion of expensing would not give an accurate indication of Powercor’s opex efficiency.

Table 2.1 **SFACD model opex efficiency scores with and without backcast CitiPower CAM changes**

DNSP	*Opex efficiency – EBRIN data*	*Opex efficiency – EBRIN data but including CIT CAM change*
ACT	0.399	0.424
AGD	0.452	0.473
CIT	0.950	0.786
END	0.591	0.616
ENX	0.622	0.645
ERG	0.521	0.521
ESS	0.556	0.552
JEN	0.716	0.760
PCR	0.950	0.958
SAP	0.840	0.853
AND	0.774	0.791
TND	0.735	0.758
UED	0.843	0.888

Table 2.1 presents DNSP opex efficiency scores from the SFACD model discussed in more detail in section 4 using current EBRIN data for the period 2006–2013 and using current EBRIN data but with CitiPower’s proposed CAM changes backcast to 2006. The results show minimal change in Ergon’s opex efficiency score and a small increase in the opex efficiency score of the fifth most efficient DNSP when the model is rerun with the backcast CIT CAM changes. The results for Ergon are therefore relatively insensitive to this change.

At a general level, Economic Insights agrees that future CAM changes would make it harder to compare opex efficiency performance going forward and also open up avenues for additional DNSP gaming and exploitation of information asymmetries. To reduce the scope for potential gaming of both reporting and price resets, Economic Insights recommends the AER require all DNSPs to report EBRIN data on the basis of the CAMs in place for the initial EBRINs.

2.4 Range of results

Huegin (2015d, section 3) spends considerable time attempting to show that the results presented in Economic Insights (2014) lack consistency. Huegin commences by advocating use of the Bauer et al (1998) consistency criteria which Huegin claims state that models and methods should produce consistent efficiency scores, consistent efficiency rankings and consistent ranking of groups of observations as best and worst performers. Examination of figure A in Economic Insights (2014, p.iv) shows that the four models presented do satisfy these criteria. The tight banding of efficiency scores irrespective of whether index number or econometric methods are used, of whether least squares or stochastic frontier estimation methods are used, of whether Cobb–Douglas or translog functional forms are used and of whether a three output or a five output specification are used demonstrate the broad consistency of the results. In all cases either CitiPower or Powercor are found to be the best performer with the other being the second or third best performer. In all cases ActewAGL, Ausgrid and Ergon are the three worst performers. In all cases the Victorian and South Australian DNSPs as a group perform well and the ACT, NSW and Queensland DNSPs perform considerably less well. Given this, we consider Huegin’s efforts to paint the picture otherwise to be a case of tilting at windmills.

Huegin (2015d, pp.23–24) next complains that the AER (2015c, p.7–116) misinterpreted the content of its figure in Huegin (2015c, p.12) presenting results from a range of models. Specifically, Huegin questions the AER’s comments regarding Huegin having used superseded output specifications in some of its modelling. The AER’s comments related to the range of opex MPFP results presented by Huegin and are completely valid.

Huegin (2015a) also applied DEA models to the full sample and compared benchmarking results with respect to alternative outputs and alternative scale assumptions. The use of the full sample may fail to take account of cross–country differences and reporting inconsistencies, as noted by Economic Insights (2014, p.31). In addition, DEA does not accommodate random errors and therefore the results are sensitive to outlying observations. In each of the four models, ActewAGL is found to be the most inefficient Australian DNSP. This appears to be broadly consistent with the findings of Economic Insights (2014). In contrast, Ausgrid in some years (eg 2007 and 2013) appear to be efficient under the two variable returns–to–scale models. This illustrates the self–identification problem of DEA since Ausgrid has the largest customer base in the sample, 20 per cent higher than the next largest DNSP in terms of number of customers. It is self–identified as efficient due to non–comparability with other sampled firms on this or other related output dimensions. Once scale inefficiency is accounted for, Ausgrid appears to be highly inefficient. This highlights the inappropriateness of the comparison figures presented in Huegin (2015a, p.36; 2015c, p.12; 2015d, p.23).

We also note that the figure Huegin presented had transformed efficiency score results. The transformation is described as ‘Efficiency relative to upper quartile’ (Huegin 2015d, p.23). No details are given of how or why this transformation was done although it appears to involve assumptions regarding target setting and brings about an increase in the reported differences across the various models. A comparison of the Huegin efficiency scores for Ergon for what are described as the two Economic Insights models with the efficiency scores in Economic Insights (2014) shows the impact of the transformation undertaken on the results. When comparing the consistency of models it is necessary to consider the original results from each model (as presented in Economic Insights 2014, Figure A). The choice of an appropriate efficiency target is a separate question and involves an additional range of considerations, including what operating environment factors have been allowed for. For example, the opex MPFP models do not include allowance for the degree of undergrounding whereas Economic Insights’ SFA and LSE models do. To simply assume that the same DNSP that is the target DNSP in the SFA and LSE models would also be the target DNSP in the opex MPFP models would be misleading because the latter do not allow for the impact of undergrounding on opex levels.

Furthermore, the Huegin figure also includes results from PEGR (2015) which are incorrectly labelled as being ‘COLS’ (corrected ordinary least squares) when it is in fact an FGLS (feasible generalised least squares) model. As shown in Economic Insights (2015, pp.47–50) the PEGR model includes an operating environment variable for 132kV lines. Since it is only the NSW, ACT and Queensland DNSPs which have any significant lengths of this voltage, this variable incorrectly attributes inefficiency to the costs of operating these high voltage lines. Consequently, no weight can be placed on the PEGR (2015) results.

Huegin (2015d, pp.24) also claims to have run alternative SFA models using the ‘same’ specification as Economic Insights’ SFACD model but with each alternative using different error term assumptions which produced different results. However, although adequate information is again not provided, the alternative SFA models run by Huegin appear to produce gross efficiency scores which did not allow for the effect of undergrounding or the time trend, whereas including both variables directly in the model, as done in the Economic Insights SFACD model, produces net efficiency scores (ie ones which already allow for the effects of undergrounding and the time trend). There is no reason for gross and net efficiency scores to coincide so it is not surprising that the alternative Huegin models produce results different to the Economic Insights SFACD model.

In its discussion of alternative output specifications, Huegin (2015d, p.24) argues that Economic Insights could have handled the problem with the multiplicative nature of its original system capacity output variable (which was the product of circuit length and distribution transformer capacity) in a different manner. This is precisely what we have done in moving to incorporate the components of circuit length and ratcheted maximum demand (a demand side measure instead of the original supply side transformer capacity measure) separately. This removes the non–linearity of the original multiplicative measure and its associated distorting impact on benchmarking analysis.

Huegin (2015d, p.24) also notes that 'every model will present a bias against at least one network'. It is for this reason that we undertake the ex post adjustment process to allow for additional operating environment factors not explicitly modelled.

Huegin (2015d, pp.26–27) again attempts to paint the AER's economic benchmarking as being based solely on the SFACD model which in turn drives the need to include international data which in turn limits the scope to include operating environment factors directly in the modelling. This line of argument contains a number of errors. Firstly, as noted above, broadly similar results are obtained from all four of the models reported in Economic Insights' (2014). The choice of the SFACD as the preferred model is really one of it being 'first among equals' rather than it being an unusual ideologically driven choice as Huegin present it to be. Secondly, the quantity and variation of the Australian data will not robustly support any type of economic benchmarking model other than index number methods. As demonstrated in Economic Insights (2015), the use of any econometric model or a DEA model requires the use of additional observations – it is not something peculiar to an SFA model. Thirdly, the three–country model includes not only direct incorporation of the degree of undergrounding as an operating environment variable but also the key network densities of customer density, energy density and demand density (via the output specification as demonstrated by Ergon's own consultant, Frontier Economics (FE 2015a, p.39). And, fourthly, we allow for the impact of additional operating environment factors on the Australian DNSPs via our ex post adjustment process.

Huegin (2015d, p.28) questions the assumption of a truncated normal distribution for the inefficiency error term used in stochastic frontier analysis. Huegin claim there is 'no evidence that inefficiencies between DNSPs should be truncated normally distributed, half normally distributed or any other predetermined distribution'. However, the truncated normal is a two parameter distribution and is therefore more general than one parameter distributions such as the half normal and the exponential and hence can accommodate a wide range of efficiency distributions. This is illustrated in figure 9.3 in Coelli et al (2005, p.254). We again note that the SFACD efficiency results we obtain are similar to those obtained using the LSECD and LSETL models.

Huegin (2015d, p.28) next creates a 'straw man' argument as to why we chose the SFACD model as our preferred model and claim this choice was made due to our 'biases'. To again set the record straight, the four models presented in Economic Insights (2014) all give broadly similar efficiency results. As noted above, the choice of the SFACD as the preferred model is really one of it being the 'first among equals' rather than it being an unusual ideologically driven choice as Huegin presents it to be.

Huegin (2015d, pp.30–31) go on to present what they claim to be a wide range of possible base year efficiency adjustments from our models in their figure 4. While no information is given on how these claimed ranges of possible adjustments have been calculated, they appear to have been derived using AusNet Distribution as the target in each case. As noted above, this would likely provide an incorrect and misleading representation of the results of our models as the opex MPFP model does not include allowance for the degree of undergrounding whereas the SFA and LSE models do. To simply assume that the same DNSP that is the target DNSP in the SFA and LSE models would also be the target DNSP in the opex MPFP model would be misleading because the latter does not allow for the impact of undergrounding on opex levels. The effects of this can be seen with most urban DNSPs doing somewhat better on opex MPFP compared to the econometric models because they get an advantage from their relatively good reliability performance on the output side but no recognition of the opex advantage they have from higher levels of undergrounding. Conversely, most rural DNSPs – including AusNet Distribution – tend to do worse on opex MPFP because of their worse reliability output performance but with no recognition of their lower levels of undergrounding and subsequent higher opex requirements. The point we are making is that in spite of these differences, the results across the models are broadly consistent. However, if one were to base recommendations on the opex MPFP model then allowance would need to be made for differences in the degree of undergrounding across DNSPs. Consequently, the comparison performed by Huegin is not relevant.

A more sensible comparison can be made across the three econometric models because like is then being compared with like. As noted in the preceding section, our econometric models actually produce very similar results for the opex reduction required to reach the efficiency of the most efficient DNSP (before adjustment for additional operating environment factors). For Ergon this is 49.3 per cent for the SFACD model, 49.1 per cent for the translog model and 47.3 per cent for the LSECD model. For Energex, the corresponding figures are 38.2 per cent for the SFACD model, 32.9 per cent for the translog model and 39.6 per cent for the LSECD model. The range for Energex is less than 7 per cent – not the much larger 20 per cent claimed by Huegin.

Huegin (2015d, p.31) raises the issue of confidence intervals surrounding efficiency scores. While the confidence intervals provide the regulator with information regarding the fit of the estimated model, it is inappropriate to base recommendations on the upper and lower bounds of the confidence interval rather than the point estimate. This is because the point estimate is the midpoint of the range that has the highest probability of containing the true efficiency score. A similar range based on any other point will have a lower probability of containing the true value. Furthermore, our application of the SFACD results has incorporated an error margin by choosing a lower efficiency target than the estimated frontier or frontier business. It does not make any sense to apply a conservative error margin in combination with the upper bound of efficiency scores to test the reasonableness of proposed opex as proposed by Huegin.

Huegin (2015d, pp.32–35) present the results of 13 models that they claim show a lack of consistency in the economic benchmarking econometric models. These models are mainly variants of Economic Insights' SFACD model run over different time periods and, in some cases, with additional variables included. Huegin's figure 7 purports to show the efficiency scores derived from each of the 13 models with Ergon's score highlighted. However, for the three models that are described as being the three–country SFACD, LSECD and LSETLG models from Economic Insights (2014), none of the efficiency scores match those reported in Economic Insights (2014). In each case the Ergon 'efficiency' scores reported by Huegin are considerably higher than those produced by the models. Huegin again gives no explanation as to how it has derived the scores reported but Huegin is likely to have transformed efficiency scores to be expressed relative to that of AusNet Distribution. However, AusNet Distribution may not necessarily be ranked as the fifth most efficient DNSP in all cases and it may not be appropriate to apply the same extent of input margin adjustment for OEFs if the composition of the top five ranked DNSPs differs from that in Economic Insights (2014).

The AER has on two occasions sought further information from Huegin to support a fuller assessment of the model results Huegin reports. However, key files were not provided in a readable form as requested and key pieces of information such as the derivation of the reported efficiency scores do not appear to have been provided. We can, therefore, not assess the models in any detail. However, based on the limited information presented, the models are of limited use in assessing the consistency of the economic benchmarking results for a number of reasons.

Firstly, Huegin's model 4 is model reported in Economic Insights (2015) using Australian only data which includes more variables but performs poorly statistically. As noted in Economic Insights (2015) the results are relatively similar to the preferred three–country SFACD model but variable significance levels were poor. Huegin's model 5 is the SFACD model reported in Economic Insights (2015) applied to only the Australian data. However, we can again not reconcile the efficiency scores Huegin reports in its figure 7 with those obtained from the model (see Economic Insights 2015, p.24).

Huegin's models 8 and 9 are only estimated over the period from 2009 onwards rather than using the full time period from 2006. As noted in section 2.1, to only include more recent data would be to bias the efficiency target downwards as it would artificially advantage non–Victorian DNSPs which have not moved to fully meet the now more onerous Victorian regulations as the Victorian DNSPs have been forced to do. This would simultaneously advantage non–Victorian DNSPs and disadvantage the Victorian DNSPs which had to quickly meet the more onerous standards over this short period. A similar problem exists with Huegin's model 11 which only uses data from 2011 onwards. Furthermore, the use of only three years of data is unlikely to be sufficiently long to accurately represent prevailing operating environment conditions.

Huegin's models 12 and 13 use historic and forecast data out to 2019 for the Australian DNSPs based mainly on the DNSPs' regulatory proposals. As noted in section 2.1, it is inappropriate to use DNSPs' own forecast data when assessing base year opex efficiency. Establishing the efficient level of base year opex requires independent observations of actual opex. Including forecast opex for the DNSP being reviewed would remove the required independence of observations included in the modelling while creating additional opportunities for gaming by the DNSP.

Huegin's models 9 and 10 include DNSP data for 2014. However, the AER is not allowing Ergon to move its base year to 2014 from 2013 as proposed in its initial regulatory proposal. Just as it is not appropriate to include forecast data for future years in the assessment of base year efficiency, it is not appropriate to include years more recent than the base year in the assessment of base year efficiency.

This leaves Huegin's models 6 and 7 which include terms involving the square of circuit length. Huegin (2015d, pp.36–37) goes on to advocate a preference for its model 6 which directly includes the square of circuit length as an extra variable in our preferred SFACD model. This is analogous to FE's (2015a, pp.40–42) inclusion of the square of customer density. Economic Insights (2015, p.35) noted that the inclusion of the square of a particular output was a rather ad hoc way to deal with potential second–order model non–linearity. The LSE translog model reported in Economic Insights (2014) includes squared and cross product terms for all outputs. As noted in section 2.3, the Economic Insights (2014) opex efficiency score for Ergon Energy for the translog model (LSETLG) is very similar to the efficiency score obtained from the Cobb–Douglas model (SFACD) and the implied opex reductions required to reach the efficiency of the best performer is almost identical between the two models. The LSE translog model is a much more comprehensive way of dealing with potential second–order non–linearity, because it allows for this effect on all variables in the model, not just one hand–picked variable. We are therefore of the view that including this variable as an ad hoc add–on to the SFACD model adds nothing compared to the LSE translog model reported in Economic Insights (2014) which produces similar opex efficiency scores to the SFACD model.

Finally, it is not clear whether the base opex predictions from alternative models Huegin presents in its figure 9 have been calculated correctly. The trending forward calculation performed by Huegin may not properly account for the effects of relevant variables included. For example, models 4 and 6 include additional variables compared to Economic Insights' SFACD model and Huegin's adaption of the base year analysis appears to ignore the effect of these additional variables.

In summary, we believe none of the alternative models Huegin includes in its figure 7 provide relevant comparisons for the results obtained from the four economic benchmarking models presented in Economic Insights (2014).

Huegin (2015d, pp.38–40) again argues for the inclusion of DNSPs' own forecast data in models assessing base year efficiency. As noted in section 2.1, we are of the view this would be inappropriate. It would be fundamentally incompatible with the base/step/trend approach to forming a forecast of efficient opex. The objective is to establish an efficient level of base year opex given the circumstances of the DNSP being reviewed which is then rolled forward using changes in output quantities, input prices and productivity through the forecast period. Establishing the efficient level of base year opex requires independent observations of actual opex. Including forecast opex for the DNSP being reviewed would remove the required independence of observations included in the modelling while creating additional opportunities for gaming by the DNSP. It also runs counter to the objective of forming a reference forecast of efficient opex against which the DNSP's own forecast is compared. It could also lead to the costs of removing inefficiencies being borne by consumers rather than the DNSP's shareholders.

2.5 Service area issues

Section 4 of Huegin (2015d) argues the need to include an operating environment variable for a DNSP's service area, as well as for its customer density (customers per kilometre of line). The latter is included in the Economic Insights (2014) economic benchmarking models through the inclusion of both customer numbers and line length as DNSP outputs. However, Huegin (2015d) offers no suggestions on the construction of a realistic and accurate measure of rural and remote DNSPs' service areas. As discussed in Economic Insights (2015), the definition of exactly what constitutes a DNSP's service area is problematic.

Huegin (2015d, p.45) argues that a measure of customer density taken as customers per kilometre of line fails to adequately capture the cost disadvantages faced by rural networks. They argue that the DNSP's service area is a better guide to the requirement for the number of separate depots the DNSP has to maintain to manage the constraints imposed by travel times from any particular depot. While we acknowledge there are multiple dimensions of network density – including more than one concept of customer density – we remain unconvinced that the proposed alternative customer density measure of customers per square kilometre is a sufficiently robust or appropriate measure to be used in an economic benchmarking study. This is particularly the case in Australia where many outback areas are larger than some European countries while being very sparsely populated. And, it remains the case that DNSP decision–making and operational activities are based on the length of line the DNSP has deployed, not its service area.

The difficulty with specifying customer density in terms of customers per square kilometre in Australia is the arbitrariness involved in specifying exactly what constitutes the area 'serviced' given the sparseness with which outback areas are populated. In Economic Insights (2015) we gave the example of the Northern Territory where the DSNP services Darwin and Katherine (with a line between the two) on its main network and then there are outposts around the Territory serviced by isolated, diesel generator–based systems. It is problematic to determine the DNSP's service area in this case. It is clearly not the whole Northern Territory. The network service area could include Darwin and Katherine plus an area of, say, 50 kilometres either side of the line connecting them but this would be entirely arbitrary.

Similar issues apply to large parts of Queensland, NSW, South Australia and Victoria. Indeed, as noted earlier, Huegin (2015d, p.13) suggests a figure of 1.7 million square kilometres as Ergon Energy's service area when the total area of Queensland as a whole is only 1.72 million square kilometres (Geoscience Australia 2015). The service area Huegin quotes therefore significantly overstates Ergon Energy's actual service area. In our view the line length based customer density measure used in our study is the only objective and verifiable measure available and captures the most important dimensions of customer location affecting DNSP costs.

Examination of figure 8 in AER (2014) indicates that Ergon Energy and Essential Energy have by far the lowest customer densities in terms of customers per kilometre of the Australian DNSPs while the predominantly urban DNSPs of Ausgrid, Endeavour Energy and Energex have much lower customers per kilometre values than the purely urban networks of CitiPower, Jemena and United Energy. And the other rural DNSPs in the sample (such as Powercor and AusNet Distribution) have densities between those of the remote area DNSPs and the mixed urban/rural networks. Since customer density is captured in our output specification which includes both customer numbers and line length, networks with low customer density receive credit for their relatively longer line lengths compared to otherwise similar networks. We also note that there is no correlation between customer density and either our opex efficiency scores nor our MTFP scores.

If customer density differences for remote networks were not adequately captured by our specification, we would expect the Ergon Energy and Essential Energy data points to have a sizable effect on the frontier shape in this part of the data space if flexible models such as the translog are used. However, this would tend to favour these points because the frontier bends to meet them and hence, in most cases, they are likely to have higher efficiency scores (ie the model may find them efficient by default). If less flexible frontier methods (such as the Cobb–Douglas) are used, these points can exert some leverage on the general shape of the estimated function but the frontier shape will be largely determined by the smaller data points when there are a majority of smaller points. Hence, if the Cobb–Douglas and translog opex cost functions give similar efficiency scores – as they do in Economic Insights (2014) – then there is less chance that the remote DNSPs such as Ergon Energy and Essential Energy are outliers that require special treatment.

This is supported by the EMCa (2015) engineering review commissioned by the AER which indicates the relationship between maintenance opex and line length and between non–maintenance opex and customer numbers can be expected to be approximately linear for rural and remote DNSPs. Being a logarithmic functional form, the Cobb–Douglas opex cost function is fundamentally non–linear but it will imply approximately linear relationships over the very large values of the variables' relevant ranges. Consequently, based on the available evidence, this would indicate no additional allowance for the characteristics of the remote DNSPs is required.

We also note that the material presented in Huegin (2015d, section 4) fails to recognise that remote DNSPs have a number of relative opex cost advantages which can be expected to mitigate some of the potential opex cost disadvantages Huegin concentrates on. For example, the use of single wire earth return (SWER) lines in rural and remote networks is likely to lower opex requirements. Advisian (2015, p.50) argue that having more SWER lines will lead to lower opex, all else equal, because 'its long span lengths lead to fewer poles per circuit km and its limited pole top hardware should result in lower Opex costs on a line kilometre basis than conventional two, three or four wire line construction'.

These characteristics of remote electricity networks make them less comparable with the case of other network industries quoted by Huegin (2015d). For example, 'dendritic' gas distribution networks pose special problems for gas distribution network service providers because of the need to maintain sufficient network pressure at all of the fringes of the network while addressing the potentially more pressing safety issues associated with operating such gas networks. As illustrated above, remote electricity DNSP networks, on the other hand, are actually simpler to operate and maintain compared to more complex 'meshed' networks.

In summary, we do not find the arguments raised by Huegin compelling and they do not take account of mitigating factors benefitting the operation and maintenance of remote electricity networks such as Ergon's. We also note that Huegin has not offered any practical solution to the problematic issue of how to realistically and accurately measure a remote DNSPs' service area. Our use of customer density based on line length remains the only practical and objective option. In making recommendations regarding Ergon's base year opex, Economic Insights (2015) made provision for the special challenges Ergon faces given the cyclonic and extreme weather conditions in its service area. Ergon was also given an allowance for the higher vegetation management requirements it faces and its higher degree of subtransmission intensiveness compared to the Victorian DNSPs. These allowances led to Ergon having by far the highest adjustment for additional operating environment factors not explicitly modelled of the NSW, ACT and Queensland DNSPs. This is on top of the generous allowance made in setting the target efficiency level to take account of possible remaining data errors and modelling limitations. In our view, no additional allowance for Ergon's service area is required.

2.6 Frontier Economics letter

Ergon has also submitted a letter from FE (2015b) described as a 'peer review' of Huegin (2015d). For the record, we note that FE is also Ergon's consultant and Ergon has previously submitted reports from both FE (2015a) and Huegin (2015c) covering similar material. Both these reports were reviewed in Economic Insights (2015) and none of their arguments were found to have merit.

FE (2015b, p.3) commences by claiming that Huegin (2015b) provides 'overwhelming' evidence of differences in service area between Ergon and the Ontario DNSPs. However, as demonstrated above, Huegin's depiction of Ergon's service area claims it to be nearly all of Queensland which will significantly overstate Ergon's actual effective service area.

FE (2015b) goes on to claim that their earlier statistical testing shows that Australian and Ontario data cannot be pooled. However, Economic Insights (2015, pp.20–25) demonstrates that the Australian data contains insufficient variation to support robust estimation of opex cost functions and, hence, also insufficient variation to support hypothesis tests of 'poolability'. FE (2015b) provides no additional information on this topic.

FE (2015b) next supports Huegin's claim that models extending the SFACD model to include arbitrary second order terms are 'statistically superior' and provide more flexibility. However, as demonstrated above, such models are less general than the translog functional form which includes second order and cross product terms for all outputs. Since the LSETLG model meets key required technical properties and produces similar results to the SFACD model, we conclude that the SFACD model provides a good representation of underlying relationships.

In its discussion of alternative models, FE (2015b, p.4) states the following:

> '[Economic Insights] dismissed one such model, the SFA translog (TL) model, on the grounds that this model results in some elasticities having the 'wrong' sign. I believe that [Economic Insights'] objections are unwarranted since these so–called violations are typically very minor and statistically highly insignificant.'

We find this statement to be rather extraordinary. As discussed in Economic Insights (2014, pp. 32–33), it is important that econometric opex cost function models satisfy the technical requirement that an increase in output can only be achieved with an increase in cost – this is known as the monotonicity requirement. It is an important economic requirement. In simple terms, it is the requirement that there are no free lunches. If it is not satisfied, it implies that DNSPs could produce more output without any additional cost or, if the cost elasticity is negative, at less cost – something that does not reflect engineering reality. Because the translog models include second order terms, it is necessary to check that the estimated cost elasticities for each output are positive. For the dataset used, all the Australian DNSPs satisfied monotonicity for the translog LSE model but 6 of the Australian DNSPs had monotonicity violations for the translog SFA model (ie had negative output cost elasticities for at least one output). Furthermore, where monotonicity violations occurred, they occurred for all observations for the relevant DNSP. Thus, 48 of the 104 Australian DNSP observations had monotonicity violations and one DNSP (Ausgrid) had two outputs with monotonicity violations. Economic Insights concluded that the translog SFA model did not produce robust and reliable results because it did not meet this basic requirement and it was therefore not further considered. It is unclear why Ergon's consultant would advocate the AER placing reliance on models that did not satisfy such basic economic requirements.

FE (2015b, p.5) expresses support for Huegin's (2015d, p.31) figure 5 based on confidence intervals for opex efficiency scores. However, as noted above, Huegin have not explained how they have presented their efficiency scores but they appear to include allowance for targets and ex post allowance for additional operating environment factors. It is therefore not reasonable for FE (2015b) to compare the Huegin figure with the SFACD raw scores as like is not being compared with like. Furthermore, as noted above, our application of the SFACD results has incorporated an error margin by choosing a lower efficiency target than the estimated frontier or frontier business. It does not make any sense to apply a conservative error margin in combination with the upper bound of efficiency scores to test the reasonableness of proposed opex as proposed by Huegin and supported by FE.

FE (2015b, p.5) supports Huegin's assertion that Ergon has become relatively more efficient in more recent years and supports the view that 'the AER's methodology leads to estimated efficiency scores that could badly misrepresent a DNSP's current level of efficiency'. However, as discussed in section 2.2 above, such statements ignore the effects of more stringent bushfire requirements imposed on the Victorian DNSPs in 2011. Limiting consideration to the most recent years would be to bias the efficiency target downwards as it would artificially advantage non–Victorian DNSPs which have not moved to fully meet the now more onerous Victorian regulations as the Victorian DNSPs have been forced to do.

We do, however, agree with FE's (2015b, p.5) rejection of Huegin's arguments for the inclusion of the DNSP's own forecast opex in efficiency assessments:

> 'In this approach there is a risk that some DNSPs could seek to influence the outcome of the benchmarking exercise in their favour by submitting 'strategic' forecasts. One of the ways Ofgem mitigates the risk of such gaming is through a form of menu regulation, which provides incentives to businesses to forecast accurately, and to reveal those forecasts truthfully to the regulator. The AER's regulatory framework does not feature menu regulation, and hence it would be inadvisable to follow this approach in Australia.'

Finally, we note FE's (2015b, p.6) comment that overseas regulators use a number of different approaches 'to mitigate the risk that regulatory decisions are influenced excessively by model errors'. Economic Insights (2014, 2015) use four different models in the assessment of DNSP base year efficiency and these four models all produce similar results which are in turn similar to and supported by other sources of analysis and information in AER (2015).

3 RESPONSE TO SYNERGIES REPORT FOR ERGON

In February 2015 Ergon Energy submitted a report by Synergies Economic Consulting (2015a) containing an application of DEA using the Australian and New Zealand components of Economic Insights (2014) database. This model was reviewed in Economic Insights (2015) and found to contain a number of shortcomings and to be of limited relevance to assessing DNSP base year opex efficiency.

Ergon has submitted another Synergies (2015b) report containing a DEA model with its revised regulatory proposal which we review in this section. The Synergies (2015b) report appears to be primarily motivated by an observation (obtained from the results of a customer consultation/survey commissioned by Ergon) that Ergon customers value supply reliability.[1] It is then noted that supply reliability is not included explicitly in the Economic Insights (2014, 2015) SFACD economic benchmarking model. We note, however, that supply reliability was included in the Economic Insights (2014) opex MPFP index number model and those results were quite similar to those from our SFACD econometric model.

Synergies (2015b) makes use of DEA methods to produce a variety of new models that extend the variable set used in the Economic Insights (2014) SFACD model to include variables that measure supply reliability (as an extra output) and capital stock (as an extra input).

They report a range of efficiency measures, including technical efficiency (TE), allocative efficiency (AE) and scale efficiency (SE). The AER has on two occasions sought further information from Synergies to support a fuller understanding and assessment of the model results Synergies (2015b) reports. However, key pieces of information have not been provided, including a description of the derivation of output and input prices used. In some cases it is unclear exactly what DEA methods have been used. We can, therefore, not assess the models in detail and, for the purposes of this review, will assume that the methods used correspond to the standard DEA methods described in Coelli et al (2005).

Synergies (2015b, p.15) argue that the CD function is restrictive because it assumes constant elasticities and that scale economies are similarly uniform. They use this to argue for the use of DEA which is more flexible. We note that efficiency scores derived from a flexible translog function were reported in Economic Insights (2014) and these scores did not differ notably from the SFACD scores. Hence, this issue of flexibility has already been addressed.

Synergies (2015b, p.18) state that they ‘adopted a data envelopment analysis (‘DEA’) model comprising two inputs, operating costs and capital, and four outputs, ratchetted (sic) peak MW, customer numbers, circuit km and total minutes of supply interruptions’.

Synergies (2015b, p.18) further state that:

> ‘because of the inclusion of supply reliability in the analysis, the database was confined to NZ and Australian DNSPs. To remain consistent with the AER’s SFA analysis, DNSPs with fewer than 20,000 customers were excluded.’

---

[1] The survey was conducted by Colmar Brunton.

And that:

> ‘supply reliability in this analysis is represented as an output in terms of SAIDI minutes of unplanned interruption. This is a negative output in the sense that an increase in its value indicates a reduction rather than an increase in output. It was converted to a positive output by subtracting the value for each DNSP from the largest observed value in the sample.’

The construction of the supply reliability measure as the product of customer numbers and this transformed measure of SAIDI is problematic. Standard DEA models are not translation invariant. Hence making SAIDI negative and adding an arbitrary constant (such as maximum SAIDI in the sample data) is arbitrary and will produce different results depending on what arbitrary constant value is chosen. For example, if we add one extra firm or one extra year of data to the data set it is possible for maximum SAIDI to change and, hence, all the results for all observations will change as well.

Note that standard DEA models are units invariant, in that one can multiply any input or output by an arbitrary constant and not affect the efficiency scores obtained. However, standard DEA models are not translation invariant, in that one cannot add or subtract an arbitrary constant from any input or output without affecting the efficiency scores obtained.

This translation invariance problem in DEA has been well known for some decades. For example, see Lovell and Pastor (1995) and Aparicio et al (2015).

A second problem with the primary DEA model reported in the body of the report is that it includes a capital input variable. This is not a problem in terms of economic analysis, since this is not unusual for one to include both capital and non–capital inputs in a production function. However, in the context of the building blocks price regulation process that the AER is required to follow, it is a measure of operating cost efficiency that is required. The proposed primary DEA model does not produce an operating cost efficiency measure and, hence, is not relevant to the question at hand.

Synergies (2015b, pp.31–32) also present results from a DEA model with opex as the only input. Based on additional information provided in response to an information request from the AER, the four–output DEA model’s constant returns to scale efficiency results are quite similar to Economic Insights’ (2014) SFACD opex cost function results. However, the Synergies one–input DEA models have a number of problems. The constant returns to scale model identifies a very small number of observations as the peers, against which the performance is compared. This makes the model very sensitive to outlier observations. The Synergies one–input variable returns to scale model suffers from a self–identification problem. For some heterogeneous Australian DNSPs without peers, the eight year observations are benchmarked against each other to derive relative efficiency scores.

The primary DEA models produce measures of output allocative efficiency, input allocative efficiency and scale efficiency. We now address each of these three measures in turn.

3.1 Output allocative efficiency

With respect to measures of output allocative efficiency, Synergies (2015b, p.23) state:

> ‘The foregoing essential (sic) defines allocative efficiency as a measure of the extent to which a firm could increase its revenues by changing its output mix. It is therefore based on knowledge of both the relative prices and quantities of outputs. This is challenging in the case of DNSP outputs because they are not individually priced. Nor is there generally available data on the relative value that customers place on each.’

We agree with this statement. However, Synergies (2015b, p.24) then go on to state that:

> ‘It is possible to get some assessment the impact that increasing the relative value of supply reliability has on DNSP efficiency, leaving the weights of all other outputs unchanged. The impact of changing the weight of supply reliability for Ergon to 1.1, 5, and 10 was investigated using the DEA VRS model comprising 3 outputs and 2 inputs. If the weight was increased from 1 to 1.1, Ergon’s output allocative efficiency score would be 99%; if the weight was increased from 1 to 5, Ergon’s allocative efficiency score would be 68%; and weight was increased from 1 to 10, Ergon’s allocative efficiency score would be 50%.’

We have studied the computer files provided to us and it appears that the base ‘weights’ that Synergies refer to are all equal to one. That is, they have implicitly assumed that the price of a km of line is equal to the price of 1,000 customers which is turn equal to the price of a million unplanned customer minutes off supply. It is not clear how this assumption can be justified at all.

To draw an analogy, if we had a factory producing 3 outputs: cars, motor bikes and trucks but we had no information of the prices of these 3 outputs, this would be equivalent to assuming that all 3 outputs sell for exactly the same price.

As a consequence, we believe that the output allocative efficiency scores obtained are meaningless.

3.2 Input allocative efficiency

Synergies (2015b, p.27) present plots of price series for labour and capital from 1996 to 2012 for Australia, NZ and Canada and argue that these plots:

> ‘suggest that:
>
> - a DNSP investing in 2000 would adopt a low capital, high labour production technology in order to minimise costs; and
> - a DNSP investing in 2012 would adopt a high capital, low labour production technology in order to minimise costs.’

This is a very unusual argument since it implies that managers in these DNSPs make decisions about long–lived capital investments based on very short term price fluctuations. This is difficult to believe. One would expect that managers would look at average price ratios over a period of more than 20 years before making decisions regarding long–lived capital investments.

Synergies (2015b, p.28) go on to provide estimates of input allocative efficiency using DEA methods. They state that:

> ‘While it is not possible to undertake a full analysis of cost efficiency, Synergies examined the impact of changing the relative weight of operating costs and capital over relatively large ranges for Ergon and for a number of other DNSPs. Ergon’s input allocative efficiency scores were insensitive to quite large changes in the relative price of inputs, with allocative efficiency scores of close 99% or so, unless there were changes in relative costs of the order of 10 fold. The allocative efficiency scores of other Australian DNSPs also showed only limited sensitivity to changes in relative input cost.’

We have studied the computer files provided to us and it appears that the base ‘weights’ that Synergies refer to are again all equal to one. That is, they have implicitly assumed that the price of $1,000 in opex = the price of $1m of capital stock. Again, this price ratio assumption makes no sense at all. If one was to make the assumption that the user cost of capital is approximately 10 per cent (eg 6 per cent risk free rate plus 4 per cent depreciation) then the price ratio should arguably be approximately 1/100 for opex/capex.

As a consequence, we believe that the input allocative efficiency scores obtained are also meaningless.

3.3 Scale efficiency

With regards to their measures of scale efficiency, Synergies (2015b, p.32) state that:

> ‘These figures represent the results of the pure technical efficiency model under variable returns to scale. That is, they do not explicitly identify the contribution of scale efficiency. Under the constant returns to scale DEA model, Ergon’s overall technical efficiency is approximately 8% lower at 56.5%. Ergon exhibits a scale efficiency score of 91% and shows decreasing returns to scale. Typically, scale inefficiency is considered to be uncontrollable by the DNSP. Accordingly, 64.5% represents the best estimate of Ergon’s controllable operating cost efficiency.’

This discussion implies that Ergon is too large and hence faces uncontrollable efficiency disadvantages. It is difficult to understand how this might be explained. It is possible to argue that a DNSP might be too small and hence has cost disadvantages because it might be limited in the degree to which it can exploit cost savings from using large scale equipment or labour specialisation or from negotiating good deals on goods and services with suppliers, etc and hence might be operating on the increasing returns to scale (IRS) portion of the production technology. However, it is not clear how one could explain why a DSNP might be too large and hence face decreasing returns to scale (DRS). The economic or engineering logic for this is not apparent. Furthermore, if tangible reasons for DRS can actually be identified, then this might suggest the DNSP could be divided into two or more smaller DNSPs to solve the problem. It is not clear how this process would result in cost savings.

A possible explanation for this seemingly anomalous result could be that with the given the characteristics of the database (ie relatively sparse data points for DNSPs of large scale), the DEA analysis cannot distinguish between technical inefficiency and scale inefficiency. So, if the true technology is non–decreasing returns to scale but was incorrectly modelled as variable returns to scale, then over the large scale range, technical inefficiency of the large DNSPs may be incorrectly assigned to scale inefficiencies.

In summary, we believe no weight can be placed on the Synergies (2015b) DEA analysis. Its construction of the reliability variable is problematic as it involves adding an arbitrary constant to the negative of SAIDI and will produce different DEA efficiency results depending on what arbitrary constant value is chosen. To put this another way, DEA models are not translation invariant whereas this property would be required for the method used to construct the Synergies reliability variable to be valid. Furthermore, we believe both the output and input allocative efficiency results presented are not meaningful as they appear to involve the assumption that output and input prices, respectively, are all equal to one. And, the scale efficiency result of decreasing returns to scale presented for Ergon does not appear to be consistent with either economic or engineering logic.

4 UPDATED FINDINGS

In the preceding sections of this report we have reviewed the critiques by Ergon's consultants of the Economic Insights (2014, 2015) economic benchmarking of Australian electricity DNSPs. Based on our review of the arguments presented and of the alternative models presented by the consultants, we have found no reason to change the general approach adopted in our earlier benchmarking analysis. However, we do make two changes to the estimation of our opex cost function model.

The first of these involves using non–coincident maximum demand across all three countries to derive our ratcheted maximum demand output. Previously, coincident maximum demand was used for Australia and New Zealand and non–coincident maximum demand for Ontario. Given the high degree of correlation between coincident and non–coincident maximum demand across Australian and New Zealand DNSPs, making this change has minimal impact on model results as the model makes off–setting changes to the country dummy variable coefficients. This highlights the efficacy of the approach we have adopted to allow for differences in variable definitions and coverage across the three jurisdictions.

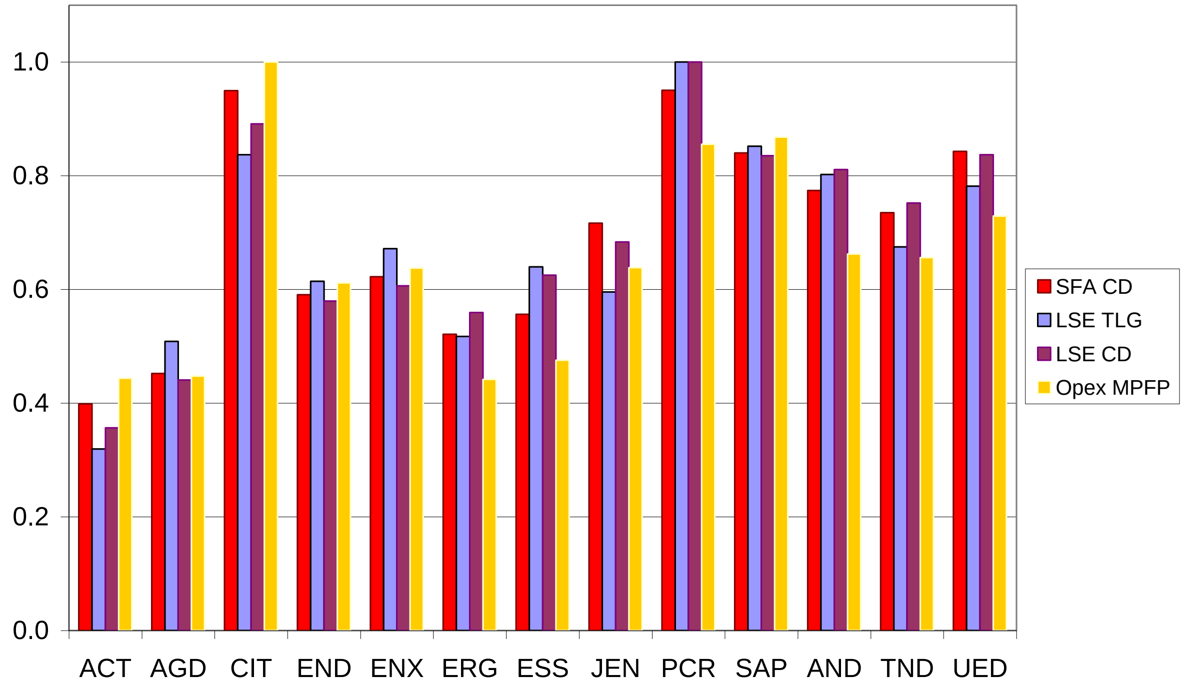
The second change involves a revision to Ergon's network services opex to exclude items related to metering services previously included in Ergon's EBRIN reporting for network services opex but which were in fact not part of network services opex. This change also affects the conversion between network services opex and base year opex as used in Ergon's revised regulatory proposal.

The updated SFACD opex cost function model estimates are presented in table 4.1 while the updated average opex cost efficiency scores from the three econometric opex cost function models and the opex MPFP index number method are presented in figure 4.1. Given that the AER is retaining 2013 as the base year for the Ergon Final Determination, the estimation period remains 2006–2013 in all cases.

Table 4.1 **SFA Cobb–Douglas cost frontier estimates using medium dataset**

Variable	*Coefficient*	*Standard error*	*t–ratio*
ln(Custnum)	0.666	0.086	7.720
ln(CircLen)	0.097	0.038	2.530
ln(RMDemand)	0.220	0.076	2.890
ln(ShareUGC)	–0.138	0.034	–4.080
Year	0.018	0.002	9.300
Country dummy variables:			
New Zealand	0.071	0.103	0.690
Ontario	0.169	0.073	2.300
Constant	–27.418	3.965	–6.920
Variance parameters:			
Mu	0.372	0.070	5.320
SigmaU squared	0.040	0.010	3.940
SigmaV squared	0.010	0.001	15.296
LLF			368.521

Figure 4.1 **DNSP average opex cost efficiency scores, 2006–2013**



Ergon's average opex efficiency from the SFACD model has increased to 0.52, mainly as a result of the revision to its network services opex.

There have also been some minor revisions to the operating environment factors for Ergon not explicitly included in the opex cost function model which will be discussed in the following section.

4.1 Incorporating operating environment factors not explicitly included in the opex cost function model

As discussed in Economic Insights (2014, 2015), our opex cost function models include allowance for different network densities across DNSPs via the output specification used which includes customer numbers, line length, energy throughput and a maximum demand measure. We also explicitly include allowance for different degrees of undergrounding across DNSPs. And our inclusion of country dummy variables allows for systematic differences in operating environments across the three countries. Where relevant detailed data are available for the Australian DNSPs, we allow for differences in other material operating environment factors by adjusting the input use of the target efficient DNSP to allow for operating environment differences between that DNSP and the DNSP in question. This then produces a modified efficient target for the DNSP in question taking account of the additional operating environment factors it faces.

Economic Insights (2015) allocated a relatively large margin of 24.4 per cent representing the amount by which the target DNSP's input use would increase by if had to operate under the same operating environment conditions as Ergon. The AER later discovered a clerical error which further increased this margin by 0.3 per cent to 24.7 per cent. The most significant factors in this margin were cyclones and other extreme weather conditions Ergon faces relative to other parts of Australia. Associated vegetation management differences also played a significant part as did the higher subtransmission intensiveness of Ergon.

In its revised proposal, Ergon made submissions on some of the operating environment factor adjustments. This has led to small changes to two of the operating environment factor adjustments: those for OH&S regulations and for cyclones. The combined effect of these adjustments is to increase the operating environment factor adjustment by 1.5 percentage points from 24.7 to 26.2 per cent.

Both of the changes are due to additional information being provided by Ergon that was not available previously. For the OH&S adjustment Ergon's consultant (PwC) provided additional information on the relationship between OH&S costs for network service providers and the broader economy. For cyclones, PwC noted that cyclone Oswald had been a costly event for Ergon. Ergon had not included the impost of Cyclone Oswald in its original submissions. The impact of Cyclone Oswald was estimated using data from the category analysis RINs and added to the original adjustment for cyclones.

The change to the OH&S operating environment factor is an increase of 0.7 per cent. The increase in the cyclone operating environment factor is 0.5 per cent. However, because we have increased these operating environment factors, the impact of operating environment factors that have been estimated using historical opex must also be increased. This is because if no further adjustment is made, the base opex to which adjustments based on historical opex are being compared is then too large. As a result, this makes the adjustments too small. The result of this adjustment is a further increase in Ergon's total operating environment factor adjustment of 0.3 per cent to 26.2 per cent.

4.2 Adjustment to Ergon's base year opex

We undertake five steps in calculating the adjustments to base year opex required to reach the relevant efficiency target for Ergon. These are:

1) calculate the average efficient network services opex quantity for Ergon taking account of the efficiency target adjusted for relevant operating environment factors (OEFs) not included in the econometric modelling
2) roll forward the average efficient network services opex quantity for Ergon to 2013 using the rate of change method described in Economic Insights (2014)
3) convert the 2013 nominal total opex from Ergon's Reset RIN to a basis consistent with network services opex
4) convert both the Reset RIN 2013 network services–equivalent opex and the 2013 efficient network services opex quantity to end of 2015 financial year prices, and
5) compare the resulting Reset RIN 2013 network services–equivalent opex and the 2013 efficient network services opex to calculate the adjustment required to Ergon's base year opex.

The results of these calculations are presented in table 4.2.

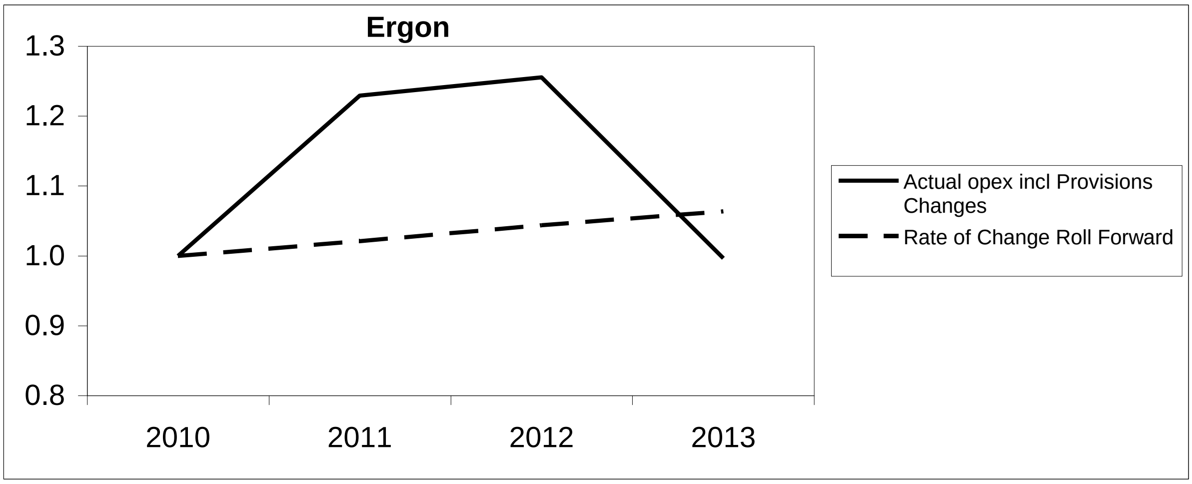
Table 4.2 **Ergon's average opex efficiency score, adjusted efficiency target and 2013 network services opex and base year opex adjustment to reach the target**

DNSP	*Efficiency score*	*Target allowing for additional OEFs*	*Reduction to base year opex*
Ergon Energy	52.1%	61.3%	–1.4%

Table 4.2 actually indicates an increase in base year opex being required to achieve Ergon's efficiency target, but this simply indicates that Ergon is already exceeding its (conservatively set) target and so no adjustment to its base year opex is required.

There are two main reasons for Ergon exceeding its conservatively set target for the 2013 base year despite its relatively low average efficiency score. The first relates to Ergon's pattern of actual opex quantity change over the second half of the period compared to the rate of change–based roll forward over the same years. This is presented in figure 4.2 below (which is analogous to figure 7.2 in Economic Insights 2014).

Figure 4.2 **Indexes of actual opex quantity (including changes in provisions) and rate of change rolled forward opex quantity, 2010–2013**



While Ergon's opex quantity increased markedly in 2011 and more modestly in 2012, it fell substantially in 2013 and was lower in that year than the rolled forward opex quantity based on the rate of change method using actual changes in Ergon's outputs and degree of undergrounding and relevant parameters from the SFACD opex cost function model.

The second reason relates to the revision to Ergon's opex data to more accurately identify its metering expenses which also explains the change from the 10.7 per cent base year opex reduction for Ergon in Economic Insights (2015). This has a two–fold effect. Firstly, it reduces Ergon's network services opex somewhat and hence increases its opex efficiency score. Secondly, because Ergon's metering services opex increases steadily over the 8 year period, the amount deducted from total opex in 2013 in the translation between total opex and network services opex is larger so that the equivalent–basis actual opex for 2013 now exceeds the rolled–forward efficient opex derived from the benchmarking analysis by just over $4 million.

4.3 Opex productivity, output and price growth forecasts to include in the rate of change

In Economic Insights (2014) we expressed the view that a forecast opex productivity growth rate of zero should be used in the rate of change formula. This was because there is a reasonable prospect of opex productivity growth moving from negative productivity growth towards zero change in productivity in the next few years as energy use and maximum demand stabilise, given the excess capacity that will exist in the short to medium term and as the impact of abnormal one–off step changes recedes. We also expressed concerns with the incentive effects of including negative opex partial productivity growth rates in the rate of change formula – to some extent this would be akin to rewarding the DNSPs for having previously overestimated future output growth and now entrenching productivity decline as the new norm. We also noted that if the effects of step changes can be clearly identified, the forecast opex growth rates should be adjusted to net these effects out.

None of the DNSP consultant reports have challenged our view that a zero opex partial productivity growth rate should be used in the rate of change formula used to form the forecast of future opex requirements. As noted in Economic Insights (2015), the case for adopting a zero forecast opex partial productivity growth rate is, in fact, further strengthened by the adoption of a more conservative opex efficiency target in calculating the adjustment required to base year opex. We, therefore, remain of the view that a zero forecast opex partial productivity growth rate is appropriate.

We also note that Ergon (2015, p.12) has suggested that installed transformer capacity should be included in place of ratcheted maximum demand in forming the output growth component of the rate of change forecast. Installed transformer capacity is argued by Ergon to better reflect the opex required to maintain newly installed transformer assets, some of which will be catering for future demand growth rather than current demand. However, as noted in Economic Insights (2014), the output specification used in our economic benchmarking has the advantage of capturing both the demand side transformer dimension of system capacity and the line length dimension.

It thus addresses another criticism of the preferred specification listed in Economic Insights (2013) which was that it placed insufficient weight on demand side outcomes. In consultation undertaken by the AER in 2013, user groups argued for the inclusion of demand side functional outputs so that the DNSP is only given credit for network capacity actually used and not for capacity that may be installed but excess to users' current or reducing requirements (AER 2013). Including observed maximum demand instead of network capacity was argued to be a way of achieving this. However, this measure would fail to give the DNSP credit for capacity it had been required to provide to meet previous maximum demands which may have been higher than those currently observed.

Economic Insights (2013) suggested that inclusion of a 'ratcheted peak demand' variable would be a way of overcoming this problem and PEGR (2013) also used the same variable (that it described as 'system peak demand') in economic benchmarking work for the Ontario Energy Board. This variable is simply the highest value of peak demand observed in the time period up to the year in question for each DNSP. It thus recognises capacity that has actually been used to satisfy demand and gives the DNSP credit for this capacity in subsequent years, even though annual peak demand may be lower in subsequent years.

PEGR (2013, p.76) noted:

> ‘We began by noting that four of the seven cost driver variables were related to distribution output: customer numbers; system peak demand; kWh deliveries; and circuit km of line. For each distributor, these four output variables can be aggregated into a comprehensive output quantity index using the cost elasticity shares presented ... This approach weights each of the four outputs by its respective, estimated impact on distribution cost.’

We note that Ergon’s non–coincident maximum demand peaked in 2010. However, instead of reducing Ergon’s output growth as a result of lower maximum demands, the ratcheted maximum demand output recognises that Ergon has capacity it had to install to meet previous peaks which is not currently fully utilised. The customer number and line length components of output recognise ongoing growth in the network. We are of the view, therefore, that there is no case for substituting installed transformer capacity for ratcheted maximum demand in the output growth component of the rate of change forecast. Furthermore, making this substitution would not be consistent with the weights used in forming the overall rate of output growth which are derived from the SFACD model which uses ratcheted maximum demand, not installed transformer capacity.

Finally, Ergon (2015, pp.10–11) questions the use of opex price indexes and weights based on Pacific Economics Group’s (2004) study of Victorian DNSPs and used in Economic Insights (2014, 2015). This approach allocates a weight of 62 per cent to the Electricity, Gas, Water and Waste Services (EGWWS) wages price index (WPI) for labour and a weight of 38 per cent spread across five producer price indexes (PPIs) for materials and services. The five PPIs cover business, computing, secretarial, legal and accounting, and public relations services. Ergon argues that more up–to–date weights should be used.

It has become increasingly difficult to ascertain what the exact split between the labour component and the materials and services component of opex should be with the move to greater (and varying) use of contracting out of field services by DNSPs. This could be addressed in a number of ways. Firstly, all contracts (both field–related and non–field–related) could be allocated to labour. This would generally produce a labour share of opex considerably higher than the 62 per cent currently used. Alternatively, all contracts could be allocated to material and services which would generally produce a labour share of opex considerably lower than the 62 per cent currently used.

Our view is that the labour component of opex should include both labour directly employed by the DNSP and labour employed by contractors to provide field services – these are the core functions of the electricity distribution business, regardless of whether they performed in–house or contracted out. Labour employed by contractors who provide non–field services (including services such as legal, accounting, IT and other administrative services) are more appropriately allocated to materials and services because they are not unique to providing electricity distribution services. Consequently, we believe the existing 62 per cent share of labour in opex remains the best estimate of the labour required to perform a DNSP’s core functions.

REFERENCES

Advisian (2015), *Review of AER Benchmarking*, Report prepared for Networks NSW, 16 January.

Aparicio, J., J.T. Pastor and F. Vidal (2015), 'The directional distance function and the translation invariance property', *Omega – The International Journal of Management Science* 58, 1–3.

Australian Energy Regulator (AER) (2013), *Expenditure Forecast Assessment Guidelines Working Group meeting No. 5, Summary of meeting,* Melbourne, March.

Australian Energy Regulator (AER) (2014), *Electricity Distribution Network Service Providers Annual Benchmarking Report,* Melbourne, November.

Australian Energy Regulator (AER) (2015a), *Preliminary Decision: Ergon Energy Determination 2015–16 to 2019–20 – Attachment 7: Operating Expenditure*, Melbourne, April.

Australian Energy Regulator (AER) (2015b), *Final Decision: Ergon Energy Determination 2015–16 to 2019–20 – Attachment 7: Operating Expenditure*, Melbourne, October.

Australian Energy Regulator (AER) (2015c), *Final Decision: Ausgrid Distribution Determination 2015–16 to 2018–19 – Attachment 7: Operating Expenditure*, Melbourne, October.

Bauer, P., A. Berger, G. Ferrier, and D. Humpherey (1998), "Consistency conditions for regulatory analysis of financial institutions: a comparison of frontier efficiency methods", *Journal of Economics and Business* 50, 85–114.

Cambridge Economic Policy Associates Ltd (CEPA) (2015a), *Benchmarking and Setting Efficiency Targets for the Australian DNSPs*, Report prepared for ActewAGL Distribution, 19 January.

Cambridge Economic Policy Associates Ltd (CEPA) (2015b), *Networks NSW – AER Draft Determination,* Report prepared for Ashurst Australia, 16 January.

Coelli, T., D.S.P. Rao, C. O'Donnell and G. Battese (2005), *An Introduction to Efficiency and Productivity Analysis*, 2nd Edition, Springer.

Economic Insights (2013), *Economic Benchmarking of Electricity Network Service Providers*, Report prepared by Denis Lawrence and John Kain for the Australian Energy Regulator, Eden, 25 June.

Economic Insights (2014), *Economic Benchmarking Assessment of Operating Expenditure for NSW and ACT Electricity DNSPs*, Report prepared by Denis Lawrence, Tim Coelli and John Kain for the Australian Energy Regulator, Eden, 17 November.

Economic Insights (2015), *Response to Consultants' Reports on Economic Benchmarking of Electricity DNSPs*, Report prepared by Denis Lawrence, Tim Coelli and John Kain for the Australian Energy Regulator, Eden, 22 April.

Energy Market Consulting associates (EMCa) (2015), *Relationship between Opex and Customer Density for Sparse Rural Networks*, Report prepared for the Australian Energy Regulator, April.

Ergon Energy (2015), *Submission to the AER on its Preliminary Determination: Operating Expenditure*, 3 July.

Frontier Economics (FE) (2015a), *Taking Account of Heterogeneity between Networks When Conducting Economic Benchmarking Analysis*, Report prepared for Ergon Energy, February.

Frontier Economics (FE) (2015b), *Peer review of Huegin report*, Report prepared for Ergon Energy, 23 July.

Geoscience Australia (2015), *Area of Australia – States and Territories*, http://www.ga.gov.au/scientific–topics/geographic–information/dimensions/area–of–australia–states–and–territories

Huegin (2015a), *Huegin's Response to Draft Determination on behalf of NNSW and ActewAGL: Technical Response to the Application of Benchmarking by the AER*, Report prepared for Networks NSW and ActewAGL, 16 January.

Huegin (2015b), *Heterogeneity in Electricity Distribution Networks: Testing for the Presence of Latent Classes*, Report prepared for Ergon Energy, 12 February.

Huegin (2015c), *Benchmarking Ergon Energy's Operating Expenditure: A Study of the Relevance of the NSW Draft Decision Outcome on Ergon Energy's Benchmarking Results*, Report prepared for Ergon Energy, 10 February.

Huegin (2015d), *AER Benchmarking of Ergon Energy Opex: Huegin Review of the Preliminary Determination*, Report prepared for Ergon Energy, 1 July.

Lovell, C.A.K. and J.T. Pastor (1995), "Units invariant and translation invariant DEA models", *Operations Research Letters* 18, 147–151.

Pacific Economics Group Research (PEGR) (2013), *Empirical Research in Support of Incentive Rate Setting in Ontario: Report to the Ontario Energy Board*, Report prepared for the Ontario Energy Board, Madison, May.

Pacific Economics Group Research (PEGR) (2015), *Statistical Benchmarking for NSW Power Distributors*, Report prepared for Networks NSW, Madison, 19 January.

Synergies Economic Consulting (2015a), *Concerns over the AER's Use of Benchmarking as it Might Apply in its Forthcoming Draft Decision on Ergon*, Report prepared for Ergon Energy, January.

Synergies Economic Consulting (2015b), *Further analysis of Ergon's efficiency in the light of customer consultations: revised 29 July 2015*, Report prepared for Ergon Energy, July.