Advisian
WorleyParsons Group

Review of AER Benchmarking

Networks NSW

16 January 2015

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Disclaimer

This report has been prepared in accordance with the instructions of Ausgrid on behalf of Networks NSW (the client), as set out in the attached Terms of Reference.

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Declaration

I have read, understood and complied with the Federal Court of Australia's Practice Note CM 7 – Expert Witness in Proceedings in the Federal Court of Australia.

The opinions contained in this report are based wholly or substantially on the specialised knowledge gained through the training, study and experience outlined in the Curriculum Vitae that is attached in Appendix B.

Signature:

Bill Glyde, Principal, Advisian Pty Ltd

Evan Mudge, Associate, Advisian Pty Ltd

Executive Summary

Advisian (formerly Evans & Peck) was engaged by Networks NSW (NNSW)[1] on behalf of the NSW DNSPs, to provide an independent expert report into the cost drivers for the NSW electricity distribution network. The purpose of the engagement was to inform the NSW distribution network service providers (DNSPs) in preparing their response to the Australian Energy Regulator's (AER's) Draft Decisions for Ausgrid, Endeavour Energy and Essential Energy covering the 2014/15-2018/19 regulatory control period, as published on 27 November 2014.

A key component of the AER Draft Decision is a proposal to reduce each distributor's proposed operating expenditure significantly over the 5 year period covered by the Draft Decision. The AER did not accept the NSW DNSPs proposals with its draft decision resulting in reductions to the allowable operating expenditure against the amounts proposed of 39.4% ($1.1b) for Ausgrid, 22.8% ($0.4b) for Endeavour Energy and 38.6% ($0.9b) for Essential Energy[2].

In undertaking our assessment, Advisian has taken account of the requirements of the National Electricity Rules (NER) in relation to preparation and assessment of DNSP Opex forecasts, the findings of the AER's Annual Benchmarking Report and the application of the AER's opex benchmarking findings in its Draft Decisions for the NSW DNSPs.

Our approach firstly reviewed the Economic Insights productivity benchmarking analysis that was relied on by the AER in making its draft decision. Our aim was to identify whether that analysis provided an appropriate basis to support the AER's proposed reduction to operating expenditure. This review revealed that there were significant differences between the DNSP's used for benchmarking purposes, with limited meaningful consideration by the AER or its consultant to ensure that the benchmark data has appropriately been normalised. These mainly relate to the lack of evidence that the DNSPs used to derive the benchmarks (as well as the reported figures on which the analysis is based) are genuinely comparable. This concern is supported by the Australian Energy Market Commission (AEMC) determination for the 2012 rule change which clarified the discretion of the regulator as follows:

> *"In addition, the AER can conduct its own analysis, including using objective evidence drawn from history, and the performance and experience of* ***comparable NSPs."*** [3]

Advisian's main concern is that the AER's benchmarking approach does not fully account for the technical and reporting differences between the NSW DNSPs and the frontier businesses. Consequently, we are concerned that limited effort has been made to ensure that the cohort DNSPs used for benchmarking purposes are truly *comparable*. The specific issues addressed in this report, along with Advisian's conclusions are summarised below:

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[1] *NNSW refers to a cooperative operating model across Ausgrid, Endeavour Energy and Essential Energy. The objective of NNSW is to contain the costs of building, maintaining and operating the NSW electricity networks in a safe, reliable and sustainable manner*

[2] *Draft Decision p.17*

[3] AEMC, *Rule Determination – National Electricity Amendment (Economic Regulation of Network Service Providers) Rule 2012*,29 November 2012, p. 112.

Benchmarking Approach

1) **The AER's benchmarking approach was not designed to assess Opex efficiency** but to produce a measure of relative productivity of the electricity networks and associated DNSPs. The AER has developed a measure of one parameter (opex productivity) that simply establishes that DNSPs that are able to meet historical maximum demand with fewer assets and at lower cost are more productive. The AER's assessed opex productivity is then assumed to be equivalent to efficient opex (this is equivalent to measuring a person's weight to determine their 'optimal' height). The use of the AER's opex productivity measure as a proxy for efficient opex does not take account of the fact that businesses who have historically required a greater volume of assets will in turn require a greater opex to maintain their network, all else being equal.

In particular Advisian has identified issues with the AER's benchmarking approach relating to:

(a) Comparability of the DNSPs used for benchmarking purposes;
(b) The failure to appropriately consider the effect of spatial density (customers/km^2) in addition to linear density (customers/km) on efficient Opex;
(c) The application of alternative approaches to determine efficient Opex; and,
(d) The need for DNSPs to operate and maintain, in a safe and reliable manner, the assets they actually have, rather than the assets they might have had.

As a result, Advisian considers that, as a starting point, the use of the DNSPs revealed base year represents the most appropriate and robust means of accounting for the difference in spatial density <u>and all other network specific factors</u>. This removes the substantial regulatory risk that the AER has incorrectly attributed inherent productivity differences to inefficiency in Opex expenditure. We note that if this is not addressed in the final decision, Advisian is concerned that it will:

- lead to material under-expenditure on operating and maintaining the 'non-frontier' networks in a safe and reliable manner which is not in the long term interest of the NSW DNSP's customers[4];
- not promote efficient investment or operations in the NEM or the NSW DNSPs[5]; and,
- not allow the NSW DNSPs to recover the efficient cost of achieving the operating expenditure objectives[6] for their networks.

In the event that the AER chooses to rely on any benchmarking analysis (particularly where the AER places significant weight on the findings to determine a substitute amount) it is only appropriate where it can be demonstrated that the cohort DNSPs and variables are genuinely comparable and where it is established that the information that has been relied on for benchmarking purposes is reported on a reliable and consistent basis.

[4] *In accordance with the National Electricity Objective*

[5] *In accordance with the National Electricity Objective*

[6] *In accordance with Opex Criteria under the NER*

Asset Types and Volumes

2) **The model itself does not account for exogenous factors (such as the nature of the assets and the development history of the network) that have influenced the development of the existing asset base.** These instead must be accounted for by specific ex-post adjustments to the model. In particular, Advisian has identified issues relating to:

   (a) The benchmarking results failing to provide intuitively credible results for Opex based on the line length measures of network scale;

   (b) Issues of comparability relating to installed transformer capacity and the scope of network services provided;

   (c) The material impact of SWER lines on circuit length of the notional frontier business.

   On the basis of our assessment, Advisian is of the opinion that the benchmarking approach used to determine the frontier businesses does not (and the preferred model specification cannot) appropriately account for the differences in the volume of assets that the businesses must operate and maintain.

   Whilst the modelling approach taken by Economic Insights *may* be appropriate for assessing a measure of relative productivity of the businesses (which simply demonstrates that DNSPs which can meet the historical maximum demand with fewer assets, generally do so at lower cost per customer), it is not a reasonable basis for setting efficient Opex because it does not account for the exogenous factors that have led to the need for historical investments in, and configuration of, the existing asset base.

Reliability Performance

3) **The benchmarking incorrectly assumes that reliability performance, and in some cases safety performance, has been stable over the analysis period**. This is not the case for a material proportion of the notional frontier businesses.

   In Advisian's opinion two conclusions can be drawn from our assessment of the reliability performance.

   Firstly, that the "ceteris paribus"[7] assumption of constant reliability implicit in the benchmark model does not hold, and some adjustment is necessary to reflect changes in reliability, an issue not dealt with at all in the preferred Stochastic Frontier Analysis (SFA) model.

   Secondly, the trade-off between SAIFI[8] and CAIDI[9] to achieve a SAIDI[10] target highlights that reliability can be achieved by a combination of Opex and Capex programs. No attempt has been made in the benchmarking exercise to "normalise" the approaches taken by DNSPs in this

[7] "All other things being equal"

[8] *SAIFI is the system average interruption duration index, that is a measure of the average number of interruptions that a customer would experience*

[9] *CAIDI is the customer average interruption duration index, that is, a measure of the average outage duration that any given customer would experience*

[10] *SAIDI is the system average interruption frequency index, that is, a measure of the average outage duration for each customer served*

regard. This gives rise to the potential for what otherwise may be a sensible and efficient Opex / Capex trade off being judged as an Opex efficiency / inefficiency.

In Advisian's opinion, this further highlights the inadequacy of the analysis that has been completed in the context of its application to Opex reductions of the magnitude proposed by the AER's draft decision, whilst still ensuring that the NSW DNSPs are able to operate a safe and reliable network.

Vegetation Management

4) **The AER has relied on an erroneous and inconsistent assessment of Essential Energy's vegetation management expenditure to support its conclusion that the NSW DNSPs are inefficient.** Advisian has identified a number of analytical inconsistencies in the AER's 'detailed review'. These include :

(a) The failure to fully consider the vegetation management information provided by the DNSPs in response to the AER's RIN requirements;
(b) The failure to account for differences in DNSP responsibility for vegetation management works between jurisdictions;
(c) Analytical inconsistencies and errors in the calculation of overhead route km.
(d) The ultimate reliance on a single year result for one business (Essential Energy) to infer that all NSW DNSPs are inefficient;
(e) Reliance on an erroneous assessment of the reliability impact of vegetation outages to infer that the impact of vegetation outages is increasing.

In Advisian's opinion, the AER's apparent pursuit of an outcome through a flawed analysis of vegetation management is highly concerning. The AER's Category Analysis exercise started out as a method of verifying the results of an international benchmarking exercise across 8 years and 3 countries. In this instance, Advisian is concerned that the analysis has been cherry picked down to comparing Essential Energy with one (otherwise non efficient) DNSP over one year.

On this basis, Advisian is of the view that the Vegetation Management related category analysis completed by the AER is of poor quality and the conclusions are not robust. As a result, Advisian considers that the AER's general conclusion that the benchmarking model's results for the NSW DNSPs are validated by the vegetation management category analysis is flawed.

Asset Age Profile

5) **The AER has erroneously relied on inconsistently reported financial data to form its view that the NSW DNSPs are relatively 'young'.** This is influenced by widely differing standard life assumptions that are used by the DNSPs for depreciation purposes. Advisian has made an alternative assessment based on the Asset Age Profile information that has been reported by the DNSPs.

The AER's own calculations for Weighted Average Remaining Life (WARL) highlight the problem with relying on the DNSPs financial information to form a view on asset age and consequently efficient expenditure requirements. Advisian considers that this is likely to be misleading as DNSPs that report longer standard lives for depreciation purposes will typically appear to have a longer remaining life (younger network) than DNSPs that depreciate the same assets over a much shorter period. For this reason, we consider that the AER's reliance on a WARL comparison of remaining lives for the purpose of determining replacement Capex allowances is fundamentally flawed as it is unduly influenced by accounting assumptions (depreciation lives that vary significantly between DNSPs) rather than economic factors.

When the DNSPs actual reported asset age profiles are used to calculate the proportion of installed assets that exceed the reported 'mean' life as well as assets that are greater than 50 years old, Ausgrid is found to be a "mature" network, Endeavour is a "young" network and Essential is on the high side of "middle aged". From our experience we would generally expect Opex to progressively increase as assets age past their notional service life, until an Opex / Repex trade off results in replacement.

Therefore Advisian concludes that the AER's assessment of the relative 'age' of the NSW networks is fundamentally misleading when compared to reported asset age profiles contained in the RIN information provided by the businesses. This is highly material to the total revenue for the NSW DNSPs as the AER's high level view of network age underpins its opinion on the level of efficient replacement Capex and total Opex required by the NSW DNSPs.

Conclusion

The AER's draft decision for the NSW DNSPs Opex is largely based on the analysis contained in the Economic Insights report and associated SFA Cobb Douglas (CD) model for Opex productivity benchmarking. Whilst benchmarking represents one of the operating expenditure factors, the overarching operating expenditure criteria and objectives in the NER must also be taken into account.

In our view, the AER's proposed adjustment to the NSW DNSPs' forecast Opex does not satisfy the operating expenditure criteria insofar as it does not represent:

(a) *"the costs that a prudent operator would require to achieve the operating expenditure objectives"* [11]*;* or

(b) "*a realistic expectation of the demand forecast and cost inputs required to achieve the operating expenditure objectives*"[12]

Whilst the AER's proposed adjustment represents a lower cost, and apparently 'more efficient' forecast than the NSW DNSPs' proposal, the first operating expenditure criterion is that the forecast Opex must reasonably reflect *"the efficient costs of achieving the operating expenditure objectives"*[13].

In our opinion, the AER's alternative forecast is insufficient for the NSW DNSPs to achieve the operating expenditure objectives over the 2014/15 to 2018/19 period, as the underlying

[11] *NER 6.5.6 (c) criterion 2*

[12] *NER 6.5.6 (c) criterion 3*

[13] *NER 6.5.6 (c) criterion 1*

benchmarking approaches do not adequately take into account the fundamental differences between DNSPs.

Additionally the basis for adopting the SFA CD results relies substantially on a flawed analysis of Essential Energy's vegetation management expenditure.

As the impact of these material factors are not reflected in the AER's alternative Opex forecast, the alternative forecast does not reflect the efficient costs of achieving the operating expenditure objectives for the NSW DNSPs.

Therefore Advisian concludes that the AER's benchmarking analysis, comparisons between businesses and the selected notional efficiency 'frontier' is not a reasonable basis for an alternative Opex forecast without a fundamental engineering and commercial assessment of the components of NSW DNSPs forecast Opex or otherwise, the transparent normalisation for differences in reporting factors.

On this basis, Advisian recommends against the use of the AER's benchmarking analysis results as the basis for alternative Opex forecasts for NSW DNSPs until such time as these factors can be transparently and robustly accounted for in the benchmarking methodology.

Instead, Advisian considers that any alternative forecast based on the Opex benchmarking approach should be reconciled to the DNSP's revealed base year, whether by the AER's historical approach, or by demonstration that the specific DNSP business can be operated at the level of Opex determined by the AER. Should the Opex benchmarking approach be used to set total Opex in the AER's final decision, the inputs for other DNSPs must, in any case, be normalised to be reported on a demonstrably consistent basis with each business' Opex, taking account of the impact of the issues identified by Advisian on both the NSW DNSPs under consideration and issues that are unique to the frontier DNSPs.

1 Introduction

Advisian (formerly Evans & Peck) was engaged by Networks NSW (NNSW)[14] on behalf of the NSW DNSPs, to provide an independent expert report into the cost drivers for the NSW electricity distribution network. The purpose of the engagement was to inform the NSW DNSPs in preparing their response to the AER's Draft Decisions for Ausgrid, Endeavour Energy and Essential Energy covering the 2014/15-2018/19 regulatory control period, as published on 27 November 2014.

A key component of the AER Draft Decision is a proposal to reduce each distributor's proposed operating expenditure significantly over the 5 year period covered by the Draft Decision. The AER did not accept the NSW DNSPs proposals with their draft decision resulting in reductions to the allowable operating expenditure against the amounts proposed of 39.4% ($1.1b) for Ausgrid, 22.8% ($0.4b) for Endeavour Energy and 38.6% ($0.9b) for Essential Energy[15].

In making their assessment the AER has adopted a two stage process. A series of benchmarking models have been created to form a view of the three distributors' efficiency in comparison to a number of other Australian Distributors (notably Citipower, Powercor, United Energy, Ausnet (all Victorian) and South Australian Power Networks). Having determined a base level of efficient expenditure from the benchmarking exercise, the AER has made a series of "adjustments" that it believes reasonably reflects "circumstances" pertinent to each distributor.

1.1 Advisian's Experience

This report has been prepared by William (Bill) Glyde and Evan Mudge.

Bill Glyde has 43 years' experience in the electricity industry. He holds a Bachelor of Electrical Engineering and a Master of Commerce. He has held senior positions with distributors, retailers and generator trading companies. As a consultant Bill has provided advice on regulatory issues and network performance to industry, government and regulators.

In 2004 he was engaged as the technical advisor to the Independent Review of Electricity Distribution and Service Delivery for the 21st Century (Queensland). Following release of the associated report in July 2004, Bill has spent almost 9 years assisting the Queensland Government and Queensland Competition Authority overseeing the implementation of the findings from that Review. [16]

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[14] *NNSW refers to a cooperative operating model across Ausgrid, Endeavour Energy and Essential Energy. The objective of NNSW is to contain the costs of building, maintaining and operating the NSW electricity networks in a safe, reliable and sustainable manner*

[15] *Draft Decision p.17*

[16] The resulting independent panel report summarises the outcomes of the review as follows:

"The Review was established by the Queensland Government in response to concerns expressed about the performance of distribution networks during a series of storms and hot weather in January and February 2004.

Whilst the Review came about as a result of the storms, the Terms of Reference required the Panel to look at the distributor's network performance, expenditure programs and systems and processes. In view of the findings of the Panel outlined in this Report, it was timely that this Review took place when it did "

Evan Mudge has over 10 years of experience in the energy sector. He holds a Bachelor of Engineering and a Master of Applied Finance. Evan has worked as a consultant on a broad range of matters in relation to more than 25 Australian regulatory decisions for electricity and gas network service providers.

His experience includes engagements with the vast majority of Australian network service providers as well as with the AER for the previous TransGrid, ETSA Utilities, Ergon Energy and Energex decisions, the Economic Regulation Authority of WA in relation to Horizon Power's funding arrangements and the Independent Public Business Corporation of Papua New Guinea in relation to a review of reliability and investment in PNG Power.

1.2 Terms of Reference

Advisian was engaged to provide an expert opinion on the engineering inputs and assumptions used in the AER and related consultants benchmarking report. In summary, Advisian has been asked to respond to the following scope:

- *Identification and quantification of the key cost drivers for each of the Ausgrid, Essential Energy and Endeavour Energy distribution networks;*
- *Reviewing whether these key cost drivers should be incorporated into a benchmarking exercise such as the one undertaken by the AER and, if so, how they should be incorporated;*
- *Where a relevant key cost driver has been incorporated into the AER's benchmarking exercise, reviewing whether it was appropriate to incorporate that particular cost driver and whether it has been appropriately incorporated;*
- *Where a relevant key cost driver has not been incorporated into the AER's benchmarking analysis, reviewing whether it was appropriate to exclude that particular cost driver and quantifying the significance of any impact of the exclusion of such cost drivers on the outcome of the analysis had it been included;*
- *Identify how these key cost drivers differ, if at all, in scope or significance for other DNSP's.*

The following factors, together with any other factors you consider relevant, are to be taken into consideration:

- *Regulatory & legislative requirements both legacy and current*
- *Legacy design issues*
- *Asset diversity – types and volumes*
- *Asset age and condition profiles*
- *Scale & complexity of the networks*
- *Network area & geography*

Full Terms of Reference are included in Appendix A.

Qld Department of Natural Resources, Mines and Energy, *Detailed Report of the Independent Panel – Electricity Distribution and Service Delivery for the 21st Century*, July 2004, p.5.

1.3 Report Structure

To address the questions raised in the Terms of Reference, Advisian has first considered the requirements of the National Electricity Rules (NER) as applicable to NSW DNSPs' Opex. We have then summarised the relevant background information provided to the AER with each distributor's regulatory proposal and the AER's Draft Benchmarking Report[17] and Category Analysis information[18], as provided to Networks NSW.

This Section 1 introduces the report, outlines the scope of our engagement and provides a summary of the report structure. We have then outlined our assessment approach and detailed the basis for our opinion through the remainder of the report, as follows:

Section 2: Provides a background to the NER requirements, AER analysis and findings as published in the AER's Draft Decision.

Section 3: Outlines the Advisian's approach to the analysis.

Section 4: Reviews the AER's benchmarking approach

Section 5: Discusses and provides Advisian's opinion on issues relating to asset types and volumes.

Section 6: Discusses and provides Advisian's opinion on issues relating to reliability performance

Section 7: Discusses and provides Advisian's opinion on issues relating vegetation management

Section 8: Discusses and provides Advisian's opinion on the key issues relating to asset age.

Section 9: Concludes the report.

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[17] AER, *Annual Benchmarking Report – Electricity Distribution Network Service Providers,* August 2014

[18] AER, *Category Analysis Benchmarking Metrics for DNSP's,* 19 August 2014

2 Background

This section summarises the background information that is relevant to our assessment, including the NER requirements for DNSP's forecast operating expenditure, the AER's Annual Benchmarking Report and Category Analysis findings as well as the Draft Decision.

2.1 NER Requirements

In undertaking our assessment, Advisian has taken account of the requirements of the NER in relation to preparation and assessment of DNSP Opex forecasts. The NER essentially requires that:[19]

a) a DNSPs' forecast operating expenditure (Opex) is necessary to meet the *operating expenditure objectives* that are described in NER6.5.6(a).
b) the *operating expenditure criteria* are used by the AER to determine whether the forecast Opex represents the reasonable and efficient cost of meeting the *operating expenditure objectives*.
c) the *operating expenditure factors* are used by the AER to assess whether the *operating expenditure criteria* are satisfied.
d) Following the submission of the DNSP's regulatory proposal, the AER must either accept or reject the DNSP's proposed forecast Opex on the basis of the *operating expenditure criteria* which are described in NER6.5.6(c).
e) the AER takes into account the *operating expenditure factors* in determining whether or not it is satisfied with the DNSP's proposed forecast Opex. The *operating expenditure factors* are described in NER 6.5.6(e).

Importantly, the NER's have recently been revised following a rule change that was approved by the AEMC in November 2012[20] which provides useful guidance on the application of the regulator's discretion when applying benchmarking techniques in accordance with the revised rules.

2.2 AER Annual Benchmarking Report

The AER's Annual Benchmarking Report[21] summarises the benchmarking that was undertaken based on the information provided by the DNSPs in response to the AER's Economic Benchmarking RIN. Under the NER, the AER is required to consider the Annual Benchmarking Report as a factor in determining whether it is satisfied with the NSW DNSPs' proposed Opex forecast.

The first annual benchmarking report was published at the same time of the Draft Decision and the AER summarised the findings as follows:

> *"The results of our MTFP analysis show:*

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[19] National Electricity Rules 6.5.6, Version 65, 1 October 2014

[20] AEMC, *Rule Determination – National Electricity Amendment (Economic Regulation of Network Service Providers) Rule 2012,*29 November 2012, pp. 111 to 113.

[21] AER, *Electricity Distribution Network Service Providers – Annual Benchmarking Report*, November 2014

- *the state wide average indicates that the Victorian and South Australian distributors appear to be the most productive. That said, one Queensland distributor Energex outperforms a Victorian distributor Ausnet Services on average over the observed period.*
- *The ACT, NSW and Tasmanian distributors appear to be the least productive*
- *Productivity across the sector is declining. This has been caused by large increases in the expenditure of distributors at a time when demand for their services has been relatively stable or declining. We recognise however, that some of the decrease in productivity may be attributable to changes in the operating environment, which are unaccounted for in the modelling, for example changes to bushfire related regulatory requirements.*

> *Taken together, the PPIs also show that the Victorian and South Australian distributors generally appear the most productive. They also highlight the impact customer density has on distributors' expenditure."*[22]

In the report, the AER also identifies that the key network outputs that it has used for 'efficiency' purposes are:

- Customer Numbers
- Route Line Length
- Maximum Demand, Capacity and Energy Delivered
- Reliability[23]

In comparison, the network inputs are identified as:

> *"the resources that distributors use to deliver services (outputs) to their customers. The inputs used to provide distribution services can be separated into those that are consumed in the year that they are purchased and those that may be used over several years or, in the case of energy networks, over several decades. The former is normally referred to as operating expenditure (Opex) and the latter as assets or capital stock."*[24]

Effectively, the models provide a measure of how 'efficiently' the capital stock and opex components of customer charges are (statistically speaking) translated into Customer Numbers, Route Line Length, Maximum Demand and Reliability by the DNSPs.

2.2.1 Benchmarking Findings

Having discussed the benchmarking model, tthe AER's benchmarking report then presents a range of Multilateral Total Factor Productivity (MTFP), Partial Factor Productivity (PFP) and Partial Performance Indictors (PPI) that illustrate the differences and relative 'performance' of the businesses on an absolute level (index score) and the change in the index score over time.

Overall the AER's analysis found that the NSW DNSPs' *absolute productivity* scores were generally at the lower end of the industry. However with regard to the *change in productivity*:

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[22] *ibid, p. 6.*

[23] *ibid, pp. 11-15*

[24] ibid, *p.16.*

- The NSW DNSPs' absolute MTFP score declined over the 2006-13 analysis period by 0.1423 index points[25] which is comparable to the industry average (customer weighted) decline of 0.1418 index points. For the NSW DNSPs this represents a customer weighted average annual decline of 1.88% against a customer weighted industry average decline of 1.63%[26][27].
- The NSW DNSPs' absolute PFP score for Opex decreased over the 2006-13 analysis period by 0.0842 index points which is less than the industry average (customer weighted) decline of 0.2014 index points. For the NSW DNSP's, this represents an average annual decline of 1.10% against an industry average decline of 1.92%[28].
- The NSW DNSPs' absolute PFP score for capital reduced over the 2006-13 analysis period by 0.1642 index points (on a customer weighted average basis[29]) which is greater than the industry average (customer weighted) decline of 0.1103 index points. For the NSW DNSPs, this represents an average annual decline of 2.15% against an industry average decline of 1.37%.[30]

These results indicate that in comparison to the industry average *change in productivity,* the NSW DNSP's experienced:

1) **a comparable change in overall MTFP productivity** when expressed in absolute or percentage terms, with Ausgrid recording the third smallest (best) overall decline in productivity amongst the 13 DNSPs;

2) **a significantly lower (better) than industry average decline in Opex productivity** when expressed in absolute or percentage terms;

3) **a higher (worse) than industry average decline in capital productivity** when expressed in absolute or percentage terms, consistent with the substantial recent security and replacement capital investment in the networks.

Therefore the benchmarking report shows that the NSW DNSPs have generally experienced a comparable (or better) decline against the AER's opex benchmarking measures and total factor measures in comparison to the industry averages.

On the basis of *absolute productivity* score, the NSW DNSPs fall towards the lower end of the cohort mainly due to the capital measures that reflect recent investment in assets that either:

(a) do not increase the productive capacity of the network (reliability, security of supply, like for like replacement); or,

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[25] On a customer weighted average basis. Individual change in DNSP MTFP scores: Ausgrid (-0.061), Endeavour (-0.178) and Essential (-0.262)

[26] AER*, Electricity Distribution Network Service Providers – Annual Benchmarking Report*, November 2014, Figure 16, p.32

[27] Economic Insights, *Economic Insights AER DNSP MTFP & MPFP 10Nov2014.xls*, 'DNSP MTFP & MPFP Sorted ', Column I (2013 MTFP) minus Column B (2006 MTFP)

[28] Ibid (note that changes are from different bases therefore percentage declines are not proportional to changes in Index points) ibid

[29] On a customer weighted average basis. Individual change in DNSP Capital PFP scores: Ausgrid (-0.101), Endeavour (-0.232) and Essential (-0.214)

[30] Economic Insights, *Economic Insights AER DNSP MTFP & MPFP 10Nov2014.xls*, 'DNSP MTFP & MPFP Sorted ', Column I (2013 MTFP) minus Column B (2006 MTFP)

(b) increase the productive capacity of the network but there has been no subsequent increase in production (outputs).

In this respect, Advisian notes the Productivity Commission's comments in relation to the effect on measured productivity of recent capital investment within the Australian mining industry:

> *"Efficiency has a time dimension. It can be efficient to 'over-invest' in certain assets ahead of their full utilisation because investment must precede production or because it can be less costly to build in spare capacity at a given time, than to re-invest at a later time to add further capacity. One of the reasons for the recent slowdown in measured productivity of the Australian economy is that mining companies made large investments ahead of the extraction of output. Few suggest that the Australian mining industry is inefficient for this reason.*
>
> *Benchmarks that fail to recognise the implications of timing can be misleading…Static measures are still useful, but need to be carefully interpreted."*[31]

Due to the relative complexity and long life of network assets, differences in absolute productivity due to the timing of investment cycles will inevitably lead to different absolute productivity scores, particularly when assessed across a time frame that reflects only a portion of typical asset lives[32]. For this reason, all benchmarking should carefully and transparently correct for the inherent issues relating to differences between businesses and the results must always be interpreted with caution.

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[31] Productivity Commission, *Electricity Network Regulatory Frameworks – Productivity Commission Inquiry Report No. 62,* April 2013

[32] This is exacerbated by the AER's reliance on 'Annual User Cost' which reflects all legacy capital investment, substantial differences in depreciation lives for similar assets and material differences in technology between jurisdictions (e.g. steel and concrete Stobie poles v wood poles)

3 Advisian's Approach

This section outlines the approach taken by Advisian to respond to the Terms of Reference provided by Networks NSW. We first outline the key concerns arising from our review of the information provided to, and received from, the AER. This is followed by an explanation of how we considered the materiality of issues, assessed the relative differences between the NSW DNSPs and the 'top quartile' businesses.

Following our initial review, we have identified the key concerns that we have investigated in the remainder of the report.

3.1 Review of information

Advisian reviewed the information and supporting material published by the AER in support of the draft decision. This included the AER's benchmarking report, draft decision, supporting models and consultant reports. We have also considered other relevant publically available material. A list of the information considered by Advisian is included in Appendix C

3.1.1 Application of Benchmarking Techniques

In preparing their Draft Decision, the AER has adopted a multistage approach in assessing the level of operating expenditure. On the basis of benchmarking analysis prepared by Economic Insights[33], the regulator has assessed the relative efficiency of the NSW DNSPs in comparison to other Australian DNSPs. The "validity" of the benchmarking results has been "confirmed" by making a number of efficiency comparisons on specific tasks (such as Vegetation Management) using information provided by all DNSPs in the AER's "Category Analysis" Regulatory Information Notice returns. Out of model adjustments have then been made on the "efficient" level of expenditure that the AER considers compensates for specific issues (for example, a notional allowance of 10% has primarily been provided for the double transformation step in NSW and Qld and all other miscellaneous factors).

From our review, we recognise the difficulties encountered by the AER and its consultants in developing appropriate benchmarking models for disparate Australian distribution businesses. In particular, we note the limitations of the number of variables that can defensibly be included in the type of statistical models that have been employed due to the limited number of Australian businesses. Therefore it is understandable to attempt to augment the Australian data set with international comparators; however care must be taken to ensure that the additional data is genuinely *comparable*.

Advisian also recognises that the key historical issue with respect to the application of statistical benchmarking techniques to Australian DNSPs remains the underlying statistical assumptions that the DNSP responsibilities, operating environment, reporting practices, business environment and legacy technology is relatively homogenous between businesses. Within Australia, this assumption of homogeneity does not hold across the vastly different operating environments for DNSPs. These

[33] *An alternative set of Benchmarking was also performed by PECG, but this has not been utilised)*

range from the tropical rainforest and outback areas of NSW and Queensland served by Essential Energy and Ergon Energy to the exclusively CBD and inner city service area of Citipower.

3.1.2 Statistical and Econometric Issues

Whilst Advisian has not been engaged to provide expert opinion on the technical aspects of the benchmarking models, it is necessary to consider the factors that form the basis of the benchmarking performed by Economic Insights.

Advisian recognises the historical difficulties experienced in accounting for the heterogeneous nature of Australian networks has led to the inclusion of additional international data from Ontario (Canada) and New Zealand to augment the Australian data set. However, the Ontario and New Zealand DNSPs almost exclusively represent much smaller scale businesses operating in significantly different conditions to the Australian DNSPs.

With regard to the Ontario data, Advisian notes that the Ontario Government's Ontario Electricity Distribution Sector Review Panel (OEDSRP) does not consider either its individual DNSPs or industry structure to be *comparable* to other provinces within Canada, or states in Australia[34], and has recently determined that there is a need to consolidate the existing DNSPs to an industry structure that is more consistent with other jurisdictions. Whilst also providing useful commentary on scale economies, unique operating factors and other issues that appear to be inconsistent with Economic Insights conclusions on these matters, the OEDSRP report notes that:

> *"Ontario's fragmented system for distributing electricity is unique in Canada, a product of history rather than the outcome of rational planning. No other jurisdiction has chosen this structure as a desired outcome…*
>
> *…The range and variety of the province's Local Distribution Companies (LDCs) is remarkable and cannot be found in any other jurisdiction in Canada. One of the smaller utilities, Hydro 2000, serves just 1,208 customers in the eastern Ontario towns of Alfred and Plantagenet. The largest distributor in the province, Hydro One Networks, has a thousand times as many customers.*
>
> *The province's electricity distribution system is also notable for the large number of small LDCs.*
>
> *• There are 29 LDCs in Ontario that have fewer than 12,500 customers each.*
>
> *• These 'small' LDCs account for over a third of all the utilities in Ontario, but less than 4% of the province's electricity customers"*[35]

From Advisian's review of New Zealand data, it is clear that similar issues of scale and *comparability* are evident in the New Zealand dataset. As an example Advisian notes one of the NZ DNSPs comments that:

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[34] Ontario Distribution Sector Review Panel, *Renewing Ontario's Electricity Distribution Sector: Putting the Consumer First*, December 2012, p.9

[35] ibid, p.6.

"For the size of our geographical area of 13,700sq km our customer base of 24,000 is one of the smallest in New Zealand.

To reach all of our customers we need 4,500km of lines – that's more than the distance from Auckland to Sydney and back. The lines include 1,500km of single wire earth return – a cost-saving technology for extensive rural networking for which we are internationally recognised. Each year 300km of lines on the network are inspected and maintained. This is done on a 15 year cycle."[36]

In relation to termite damage, (which is a major driver for DNSP line maintenance costs in Australia, increasingly so the further north the DNSP's service area is located[37]) the New Zealand Ministry of Primary Industries (MPI) responds directly to eradicate any identified colonies. To demonstrate the limited significance of termites in New Zealand, Advisian notes that the MPI identifies a total of four current instances of termite attack within New Zealand as follows:

"Coptotermes acinaciformis is a subterranean termite that forms nests in timber that is in contact with the ground. Of all native species in Australia, it is considered to have the most destructive impact on buildings and other wooden structures. They will also feed on living trees. They form large colonies and tunnel up to 50 metres from the nest to forage for food. They tunnel underground and, where necessary, form mud runways above ground.

There are four current MPI responses to this termite:

- *Nelson, 2009*
- *Auckland, 2010*
- *Pt Wells, 2012*
- *Karaka, South Auckland, 2012*

The Nelson infestation was treated with hexaflumuron baits and termite activity has ceased. The site will be monitored for five years before eradication is officially declared. The remaining three infestations are still being treated and termite activity is still present" [38]

In addition to the obvious climatic differences between the Australian States, Ontario and New Zealand, we are concerned that there are a range of environmental, reporting and industry factors that have not been taken into account to ensure that the benchmarking is based on *comparable* DNSPs.

Consequently, whilst we are cognisant of the economic, econometric and statistical issues, the primary focus of this report is on the technical, business practices and jurisdictional factors that affect the interpretation of the NSW ' benchmarking results in relation to the AER's 'frontier businesses'.

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[36] The Lines Company Website, http://www.thelinescompany.co.nz/network (pole inspection cycles for Australian DNSP's are typically in the order of 5 years based on the reported RIN information)

[37] Huegin Consulting, *Huegin's response to Draft Decision on behalf of NNSW and ActewAGL, Technical response to the application of benchmarking by the AER,* Exhibit 4.6 Termites

[38] New Zealand Ministry for Primary Industries website http://www.biosecurity.govt.nz/publications/biosecurity-magazine/issue-82/aus-termites

3.1.3 Technical Issues

Notwithstanding the AER's consideration of the issues that were identified in Advisian's (formerly Evans & Peck) previous report[39] that was submitted as an attachment to the Ausgrid proposal, we are of the view that the AER's benchmarking model does not appropriately take a number of the factors raised into account and that the materiality of these factors has been understated in the AER's analysis of specific 'out-of-model' adjustments.

3.2 Key Concerns

On the basis of our review of the AER's Draft Decision, Advisian notes that the AER and its consultant have focused almost exclusively on the relative productivity of the businesses. We recognise that this *may* be an appropriate approach to measure the efficiency with which DNSPs can serve customer demands, however it does not fully account for the fact that some networks are inherently less 'efficient' (more expensive) to operate than others on a unitised basis (e.g. per customer, per km, per MVA). Consequently we are concerned that the AER has simply considered that Opex productivity is an equivalent measure to Opex efficiency.

3.2.1 Opex Productivity v Efficient Opex

In determining the efficient Opex for a network business it must be recognised that there are a range of factors that are reflected in the existing asset base that create inherent and unavoidable differences in the efficient Opex required to operate and maintain a distribution network. These include issues such as system security requirements, legacy planning decisions, differences in service responsibilities, and differences in customer type and location on the network.

To this end, we note that the Opex efficiency relates to the cost with which the existing assets can be operated and maintained at the required safety and reliability levels, whilst Opex productivity relates to the cost with which the existing assets have served existing customers at the historical safety and reliability levels (whether these were appropriate or not). Under a productivity measure, the businesses with the fewest assets per customer will almost always appear to be more productive.

The AER's underlying assumption that productivity is equivalent to efficiency does not take into account the fact that the efficiency of Opex is driven by:

- The physical volume, type and capacity of assets installed (and cost per asset);
- The reliability performance of the network (and historical trend in reported performance); and,
- The geographic distribution of assets and customers across the service area.

It is apparent from the AER's analysis that whilst some of these factors *may have* been considered for the purpose of calculating a relative Opex productivity measure between Australian and international DNSPs, they *have not been* appropriately considered for the purpose of determining the efficient Opex for the NSW DNSPs.

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[39] Evans & Peck, *Review of factors contributing to variations in operating and capital costs structures of Australian DNSP's*, November 2012

3.2.2 Areas of Concern

In undertaking our assessment we have considered the AER's stated criteria for determining whether or not an operating factor should be taken into account. These are:

1) Is it outside of the service provider's control?

2) Is it material?

3) Is it accounted for elsewhere?[40]

Advisian's main concern is that the AER's benchmarking approach does not fully account for the technical and reporting differences between the NSW DNSPs and the frontier businesses. Consequently, we are concerned that limited effort has been placed into ensuring that the cohort DNSPs used for benchmarking purposes are truly *comparable*.

The remainder of this report is structured to address the following key issues:

1) **The AER's benchmarking approach was not designed to assess the Opex efficiency** but to provide a measure of the relative productivity of the DNSPs. In particular Advisian has identified issues with the AER's benchmarking approach relating to:

   (a) Comparability of the DNSPs used for benchmarking purposes;
   (b) The failure to appropriately consider the effect of spatial density (customers/km^2) in addition to linear density (customers/km) on efficient Opex;
   (c) The application of alternative approaches to determine efficient Opex; and,
   (d) The need for DNSPs to operate and maintain the assets they actually have (eg legacy 132/33/11kV systems), rather than the assets they might have had (e.g. a 66/22kV system), in a safe and reliable manner.

2) **The model itself does not account for exogenous factors that have influenced the development of the existing asset base.** These instead must be accounted for by specific ex-post adjustments to the model. In particular, Advisian has identified issues relating to:

   (a) The benchmarking results failing to provide intuitively credible results for Opex based on the line length measures of network scale;
   (b) Issues of comparability relating to installed transformer capacity, the scope of network services provided; and,
   (c) The material impact of SWER lines on circuit length of the notional frontier business.

3) **The benchmarking incorrectly assumes that reliability and safety[41] performance has been stable over the analysis period**. This is not the case for a material proportion of the notional frontier businesses.

4) **The AER has relied on an erroneous and inconsistent assessment of Essential Energy's vegetation management expenditure to support its conclusion that the**

[40] ibid, p. 7-92

[41] *In particular, Advisian notes the significant safety improvements that were required following the 2009 Victorian bushfire activity.*

NSW DNSPs are inefficient. Advisian has identified a number of analytical inconsistencies in the AER's 'detailed review' of Vegetation Management.

5) **The AER has erroneously relied on inconsistently reported financial data to form it's view that the NSW DNSPs are relatively 'young'.** This is influenced by widely differing standard life assumptions that are used by the DNSPs for depreciation purposes. Advisian has made an alternative assessment based on the Asset Age Profile information that has been reported by the DNSPs.

Furthermore, the AER has not made specific adjustments to the SFA results to account for factors that affect the Victorian and South Australian DNSPs, other than consideration of the additional cost of bushfire related expenditure on Victoria. Even with regard to this adjustment, Advisian highlights that it includes expenditure for items such as greater deployment of insulated conductor, reclosers, spreader bars etc. (on an accelerated scale), much of which other DNSPs are, or have been, conducting to varying extents as prudent risk management activities within their 'base' Opex and Capex allowances. These initiatives are described in each Australian DNSP's publically available Bushfire Risk Management Plan documents.

Failing to normalise all businesses for all material operating environment factors will mean that the productivity benchmark will be set artificially high in cases where the best performers are implicitly advantaged by operating environment factors (our previous report highlighted the degree of natural advantage that accrues to the Victorian businesses[42])

3.3 Quantification of Impacts on Opex

Advisian notes that it is not always possible to fully quantify the impact on Opex for all businesses; however it is possible in most cases to demonstrate a relative advantage or disadvantage of a business relative to its peers based on a comparison of the relevant results. Wherever possible we have quantified the impact of our analysis on the basis of a:

- Fixed dollar value;
- Percentage adjustment;
- Relative advantage/disadvantage and how this could best be addressed.

In some cases the specific issues discussed are most appropriately addressed through changes to the model specification or adjustments to the assessed productivity of the frontier businesses. The development and testing of alternative models or making specific adjustments to the AER's model is beyond the scope of this report.

[42] Evans & Peck, *Review of factors contributing to variations in operating and capital costs structures of Australian DNSP's*, November 2012 (submitted as an attachment to Ausgrid's substantive proposal in May 2014)

4 The AER's Benchmarking Approach

This section summarises Advisian's review of the AER's benchmarking approach. We first consider the models and data sets used by Economic Insights to establish the results that have been relied on by the AER. We then consider the extent to which the sample of DNSPs that have been used for benchmarking purposes are:

a) comparable across a reasonable range of measures;
b) robustly described by (only) the variables considered in the AER's alternative opex; and,
c) appropriate to capture the factors that drive opex within Australian DNSPs.

Finally we consider the options for, and the reasonableness of applying alternative approaches that more appropriately capture the range of factors that must be taken into account to establish a robust measure of efficient opex (as distinct from relative productivity).

4.1 Review of the AER Approach

In assessing the efficiency of Opex, the AER has been influenced by the results from four models prepared by Economic Insights. These are:

- Cobb Douglass stochastic frontier analysis (SFA CD)
- Cobb Douglass least squares estimate regression (LSE TLG)
- Translog least squares estimate regression (LSE CD)
- Opex Multilateral partial factor productivity (Opex MPFP)

The DNSP average Opex productivity scores over the period 2006-13 are shown in Figure 4-1[43] .

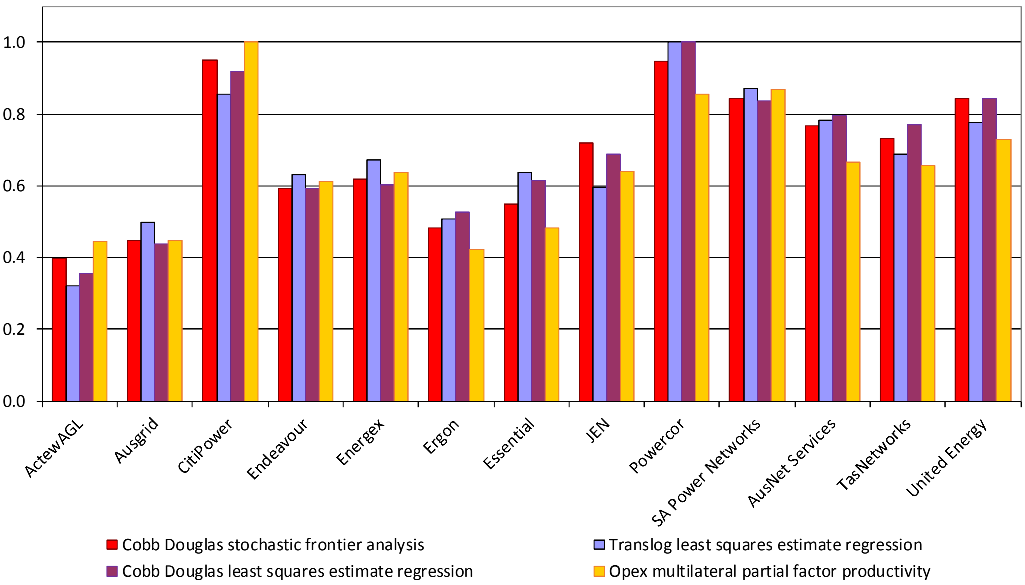

Figure 4-1 Comparison of AER Opex benchmarking approaches
Source: AER

[43] *AER Benchmarking Fact Sheet. Figure 1*

Based on these models, the Networks NSW Distributors are reported as having efficiency in the range 42 – 62% relative to a frontier 'efficient' business. In its Draft Decision, the AER has adopted the SFA CD results, but noted the relative consistency between the results from the four models.

In order to assess the capacity of the models to deal with differences between DNSPs it is necessary to assess the variables that have been used in the benchmarking models to "explain" relative efficiencies. These are shown in Table 4-1, together with the coefficients calculated by Economic Insights (in brackets)[44].

Table 4-1 AER Opex benchmarking model variables

SFA CD	LSE TLG	LSE CD	Opex MPFP
Customer Numbers (0.667)	Customer Numbers (0.580)	Customer Numbers (0.652)	Customer Numbers (0.458)
Circuit Length (0.106)	Circuit Length (0.093)	Circuit Length (0.097)	Circuit Length 0(.238)
Ratcheted Maximum Demand (0.214)	Ratcheted Maximum Demand (0.299)	Ratcheted Maximum Demand (0.253)	Ratcheted Maximum Demand (0.176)
Share UG (-0.131)	Share UG (-0.178)	Share UG (-0.201)	Energy Throughput (0.12)
Year (Common Value for DNSPs - used to determine trend in efficiency)			Minutes off Supply
Country dummy (not applicable to Australia)			-
-	Multiplicative combinations of first 3 above	-	-

Source: AER

Variables common to each of the models used in the AER's benchmarking analysis are:

- Customer Numbers
- Circuit Length
- Ratcheted Maximum Demand

[44] The regression coefficients calculated by Economic Insights reflect the relative influence of the factor in predicting the model output (productivity score). For the SFA CD model, Economic Insights explains the interpretation of these figures as follows:

"The estimated coefficient of the CustNum output is 0.667, implying that a 1 percent increase in customer numbers will lead to a 0.667 percent increase in opex." (Advisian notes that this statement incorrectly assumes that productivity score and opex are equivalent. Therefore it is more correct to say that "a 1 per cent increase in customer numbers will lead to a 0.667 percent increase in assessed productivity")

Economic Insights, *Economic Benchmarking Assessment of Operating Expenditure for NSW and ACT Electricity DNSPs*, 17 November 2014, p.33

Figure 4-2 below shows the relationship between Customer Numbers, Ratcheted Maximum Demand and Energy Throughput for the 13 DNSPs regulated by the AER. Both Ratcheted Maximum Demand and Annual Energy Throughput are highly correlated[45] with Customer Numbers (both having a correlation coefficient (R^2) of 0.95). We note that Economic Insights has rejected 'capital variables' from the Opex cost function estimates on the basis that it:

> *"has a very high correlation of 0.95 with energy delivered (Energy) output and of 0.94 with the ratcheted maximum demand (RMDemand) output"*[46]

Consistent with this approach, to enhance understanding of key drivers, Advisian is of the view that the models could be simplified without significant loss of statistical validity simply using Customer Numbers as a proxy for Ratcheted Demand and / or Energy Throughput. The resultant 'simplified' models then have only three exogenous variables explaining Opex (efficiency) variation between Australian DNSPs:

- SFA CD, LSE TLG and LSE CD
  - Customer Numbers
  - Line Length
  - Share underground (UG) Construction
- Opex MPFP
  - Customer Numbers
  - Line Length
  - Adjustment for Minutes off Supply

Whilst we do not consider that this would be a reasonable model for determining the efficient Opex, it highlights the underlying under-specification of the DNSP cost function that arises from the AER's use of Economic Insights preferred SFA CD approach. Notably, the resulting cost function is almost entirely driven by customer numbers, and uses very little of the detailed RIN information that was required to be submitted by the DNSPs to support the AER's benchmarking approach. (for example Ausgrid was required to report externally audited/reviewed historical values for over 400 variables in the Economic Benchmarking RIN alone)

In forming this opex cost function from its SFA CD model results, Economic Insights has utilised a compendium of Australian, New Zealand and Canadian (Ontario) DNSP data to gain sufficient observations to provide a statistically 'rich' data set from which to draw conclusions. Advisian understands that the SFA CD model is based on 68 DNSPs – 13 Australian, 18 New Zealand and 37 Ontario. These DNSPs have been considered in the following analysis.

As outlined above, Advisian has not been engaged to provide technical commentary on the modelling process adopted. However, integral to our understanding of the adequacy of the models in capturing

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[45] In a statistical sense correlation between two variables measures the extent to which one variable can predict the value of the other in the data set. A correlation co-efficient of 1 means that the two variables are essentially interchangeable from a mathematical perspective, as either value can perfectly predict the other.

[46] Economic Insights, *Economic Benchmarking Assessment of Operating Expenditure for NSW and ACT Electricity DNSP's*, 17 November 2014, p.32

the variability between the NSW DNSPs and 'frontier' DNSPs is an understanding of the characteristics of the DNSPs contributing to the model.

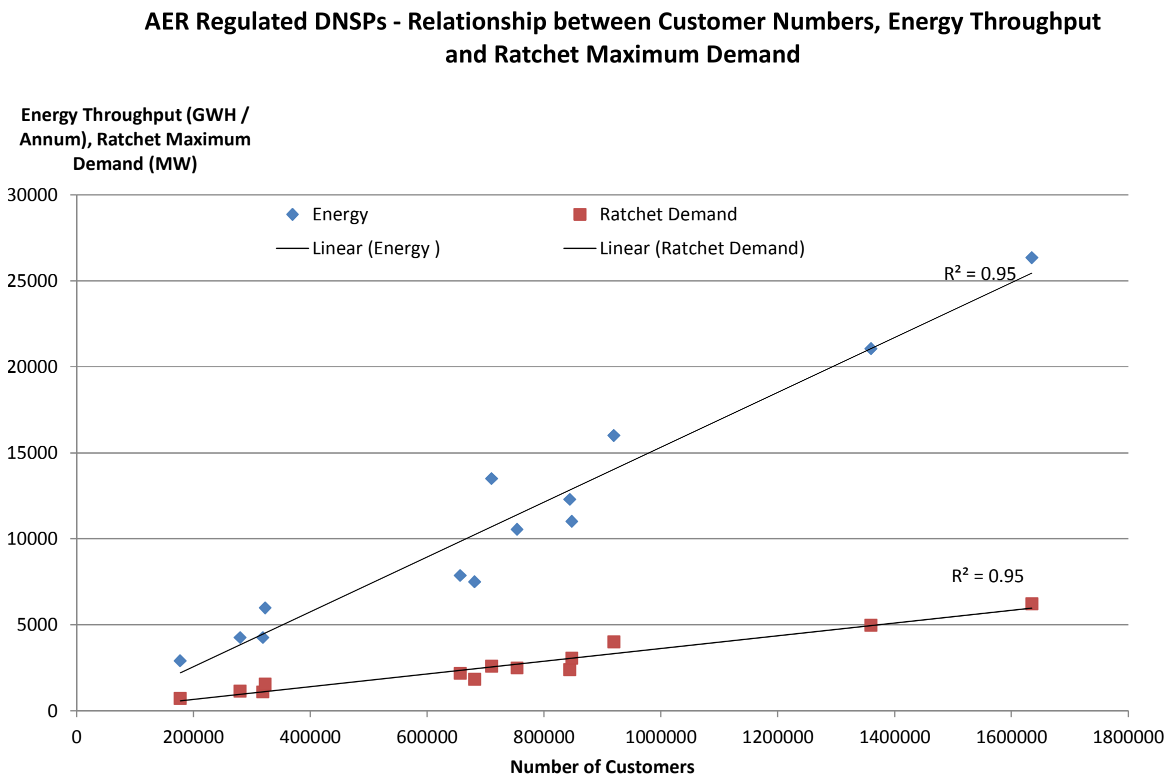

Figure 4-2 Customer Numbers, Ratcheted Maximum Demand and Energy Throughput
Source: Advisian Analysis

From the opex cost function, customer numbers arise as the dominant explanatory variable in determining Opex. Advisian notes that in round terms, a 1% change in customer numbers gives rise to a 0.8% change in Opex across the Economic Insights models[47]. Similarly, Economic Insights states that for the opex cost function derived from the SFA CD model that a *"1 per cent change in all outputs will lead to a 0.987 per cent increase in costs"*

Therefore Advisian has examined characteristics of the DNSPs in the benchmark set in relation to the customer number variable[48]. This is shown in Figure 4-3.

[47] Therefore customer numbers are by far the greatest driver of productivity results as they explain the vast majority (~80%) of the opex cost function derived by Economic Insights models. For example, for the SFA CD results Economic Insights states that a *"1 per cent change in in all outputs will lead to a 0.987 per cent increase in costs"* (ibid p.33)

[48] Advisian's data set has 2 more New Zealand DNSP's – we have not reconciled which two should be removed.

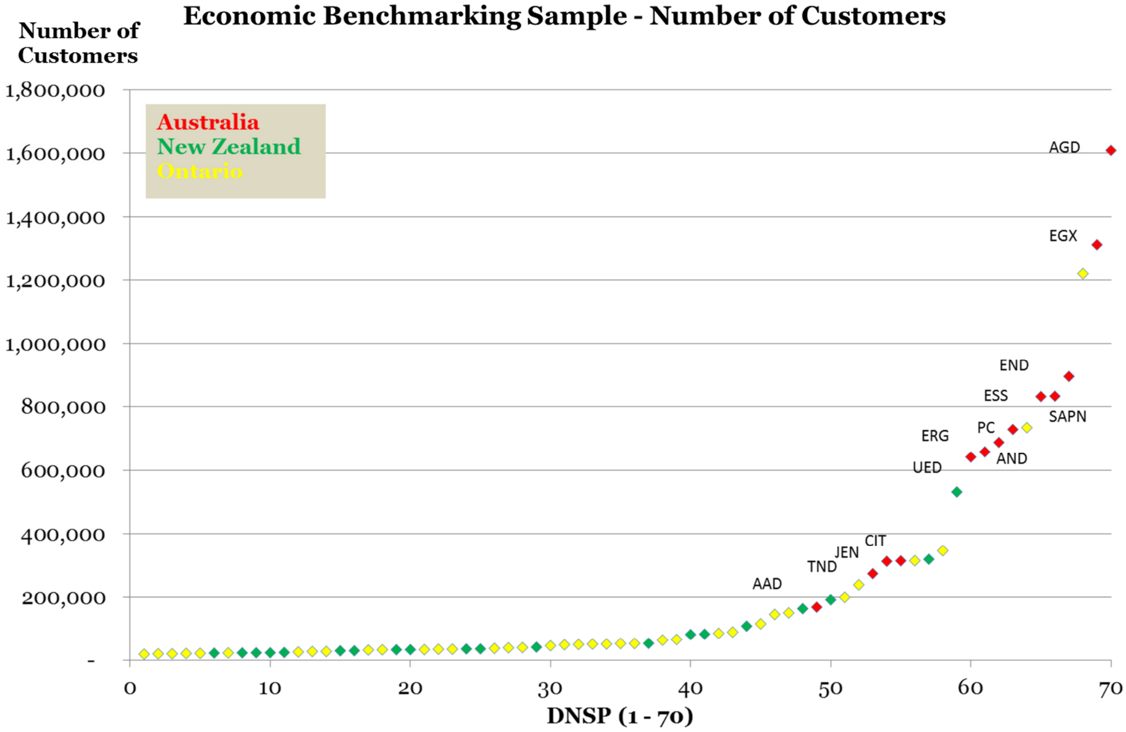

Figure 4-3 Customer numbers for combined Australian and international DNSPs
Source: Advisian Analysis

In terms of customer numbers, the Australian DNSPs are significantly larger than the benchmark sample as a whole, with only 9 of the international DNSPs having customer bases between the smallest (ActewAGL) and largest (Ausgrid) Australian DNSPs. Whilst largely a matter for technical analysis by specialist econometricians, in our opinion the lack of overlap[49] between the Australian, New Zealand and Ontario DNSPs in this parameter is the first signal that the results should be treated cautiously as the Australian DNSPs fall in a portion of the sample where there are limited international comparators. This is particularly pertinent in the context of the magnitude of the Draft Decision made in relation to the proposed reduction in the NSW DNSPs' Opex.

Only two Ontario distribution companies - Hydro One (#68 in Fig 4-3) and Toronto Hydro (#64) have a customer base overlapping the NSW DNSPs. Advisian notes a December 2012 review of the industry in Ontario noted:

> *"The OM&A costs of the two largest utilities in Ontario, Hydro One Networks and Toronto Hydro, are excluded from the charts in Fig. 6 and Fig. 7* [of the cited report] *because of their unique circumstances. Hydro One Networks has higher costs because its low overall customer density is spread out over a wide service area. Toronto Hydro also has unique cost pressures. Its aging assets have to serve a dense urban core that has the highest growth rate in multi-residential buildings in North America"*[50]

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49 The Australian DNSP's all fall at the 'larger' extreme of the combined dataset, with the results dominated by much smaller Ontario or New Zealand DNSP's.

50 *Renewing Ontario's Electricity Distribution Sector: Putting the customer First – The Report of the Ontario Distribution Sector Review Panel December 2012 – footnote 23, p11*

It is of some concern to Advisian that the Ontario jurisdiction has decided to segregate this data in its assessment due to unusual factors[51], but unbridled use has been made of it by Economic Insights.

A similar lack of overlap between the Australian, New Zealand and Ontario DNSPs exists when line lengths are considered. This is shown in Figure 4-4. With the exception of Citipower and ActewAGL, only three of the overseas DNSPs overlap with the Australian DNSPs in this parameter. In addition, 39 of the 57[52] (68%) overseas DNSPs have lower line lengths than Citipower, the Australian DNSP with the shortest line length.

In Advisian's opinion, this lack of overlap between the Australian, New Zealand and Ontario DNSPs gives further rise to a need for caution in direct application of the modelling results. This is because the size of the Australian businesses means that they are largely outside the size range of DNSPs covered by the sample (on either customer number or line length measures of scale). Again we note the magnitude of the changes that the AER has proposed for the NSW DNSPs in the Draft Decision and sensitivity of the AER's assessment to how well the Australian DNSPs 'fit' statistically within the wider group of New Zealand, Ontario and Australian DNSPs.

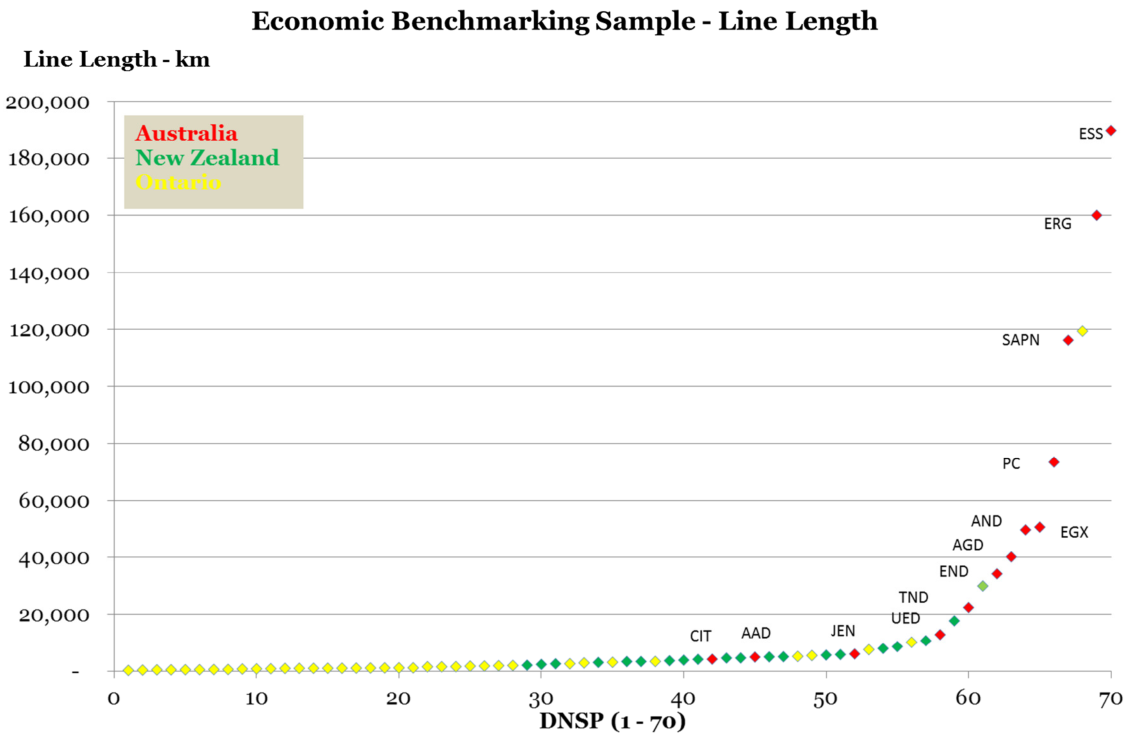

Figure 4-4 Line length for combined Australian and international DNSPs
Source: Advisian Analysis

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[51] We note that the Ontario assessment was not a productivity benchmarking study, but an analysis of DNSP costs.

[52] *Adjusting for the differences between Advisian's data set, and that used by Economic Insights*

The combination of customer numbers and line length gives rise to the AER's primary measure of customer density (customers per line km)[53] that has been used in applying its analysis and judgment (For example, Figure A.7 and A-8 of the relevant Attachment 7 to the AER's Draft Decision[54]). The distribution of Australian DNSPs within the international benchmarking group is shown in Figure 4-5.

Whilst, reviewing this measure, the Australian DNSPs are distributed throughout the benchmarking data set, as visible in figure 4-5 three distinct categories emerge:

- DNSPs with a low customer density (up to 20 customers / km) – Essential, Ergon, Powercor, SAPN, Ausnet Services and TasNetworks. On this measure, these DNSPs generally share customer density characteristics with New Zealand DNSPs.
- DNSPs with a medium customer density (20 – 40 customers/km) – Energex, Endeavour, ActewAGL and Ausgrid. On this measure, these DNSPs share customer density characteristics with a mix of NZ and Ontario DNSPs. There are no Australian "frontier" companies in this group. On this basis, particularly in relation to Endeavour and Ausgrid, Advisian questions whether the cohort distributors can be considered "comparable" within the meaning of the AEMC's guidance in its rule change determination.
- DNSPs with a high customer density (50+ customers/km) – Jemena, United Energy and Citipower. On this measure, these DNSPs share customer density characteristics with Ontario DNSPs.

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[53] We note that the AER's 'customer density' variable (customers per line km) is a linear measure that is often termed 'connection density' rather than 'customer density' (customers per square km). Connection density is a measure of the average distance between customer connections to a distribution line across a network. The geographical dispersion of customers across a DNSP's service area (customers per square km) is a significantly different spatial measure that is weakly correlated connection density. For clarity, Advisian has generally adopted the terms 'linear density' for customers/km and 'spatial density' for customers/km^2.

[54] AER Draft Decision, Attachment 7: Operating Expenditure, November 2014, (Ausgrid pp. 7-66 to 7-67), (Endeavour pp. 7-66 to 7-67) (Essential pp. 7-66 to 7-67)

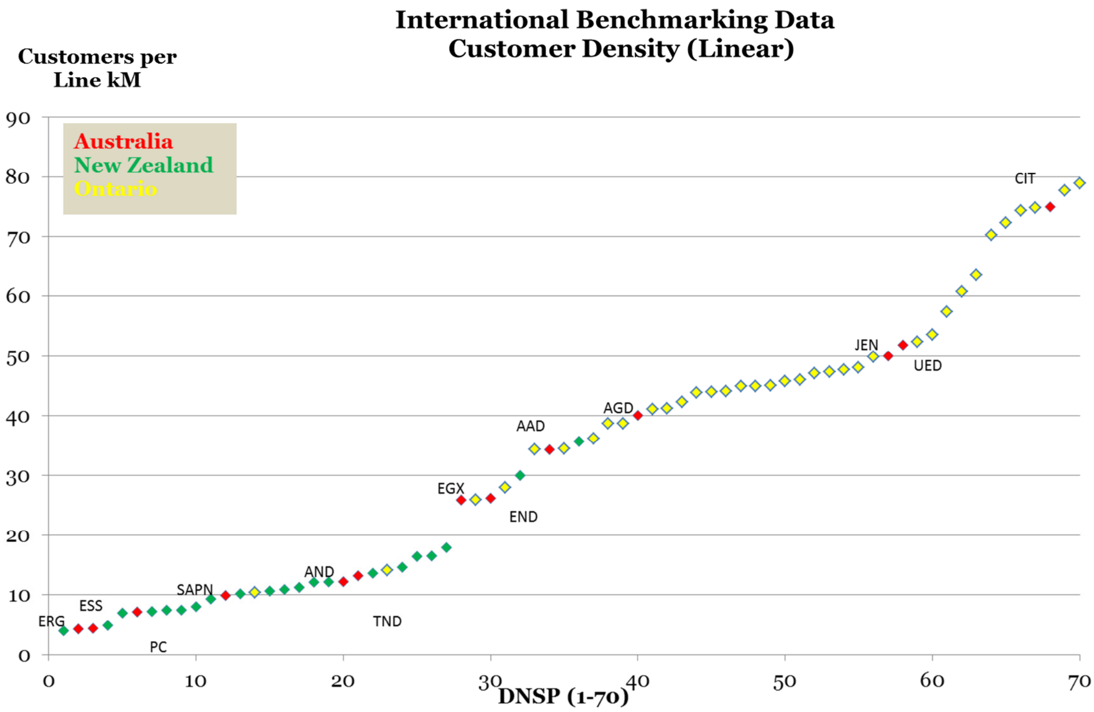

Figure 4-5 Customers per line km for combined Australian and international DNSPs
Source: Advisian Analysis

The third exogenous variable in the SFA CD, LSE TLG and LSE CD models is the share of underground construction as a proportion of total lines. Figure 4-6 compares the Australian and international DNSPs on this measure.

Again, the Australian DNSPs are distributed throughout the benchmarking data set and three distinct categories emerge:

- DNSPs with a low proportion of underground (up to 20%) – again Essential, Ergon, Powercor, SAPN, Ausnet and TasNetworks. On this measure, these DNSPs share UG proportionality characteristics with a mix of New Zealand and Ontario DNSPs;
- DNSPs with a medium proportion of underground (20 – 40%) – Energex, Endeavour and Ausgrid, but joined by United Energy and Jemena. On this measure, these DNSPs share UG proportionality characteristics with a mix of NZ and Ontario DNSPs; and,
- DNSPs with a high proportion of underground (around 40%) – ActewAGL and Citipower. On this measure, these DNSPs share UG proportionality characteristics predominantly with Ontario DNSPs.

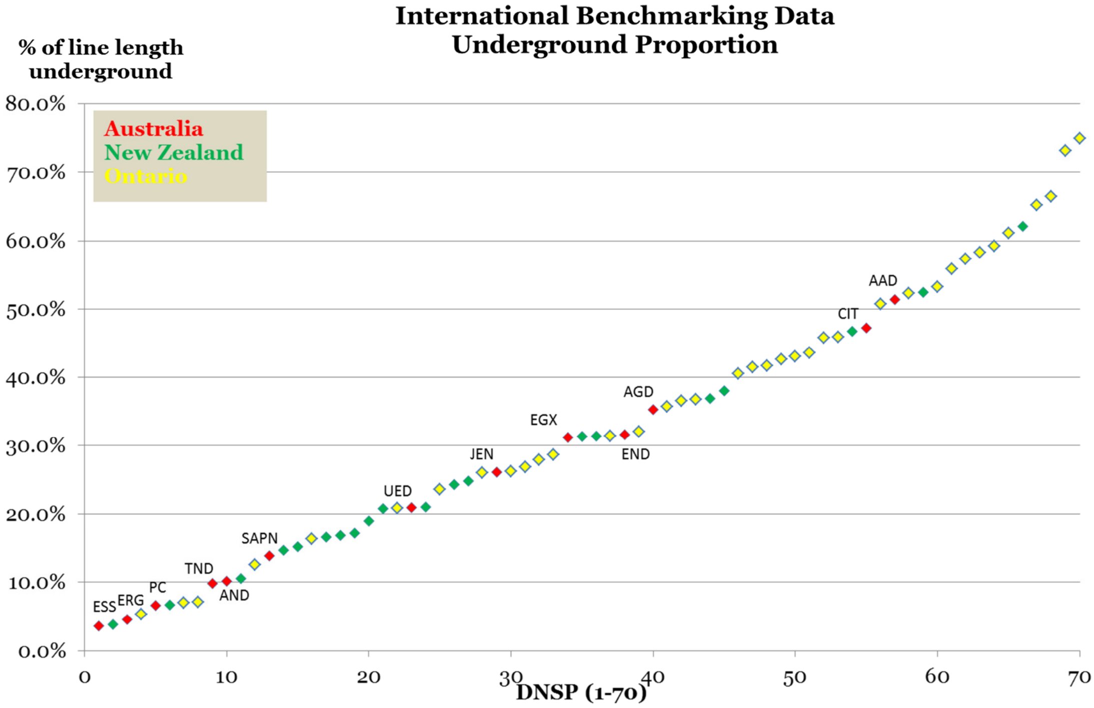

Figure 4-6 Underground proportion of network for combined Australian and international DNSPs

Source: Advisian Analysis

On the two measures implicit in the benchmarking models, there is considerable homogeneity in the 'low density' low UG proportion. Similarly, the DNSPs in the two 'mid' groups are largely the same, however these businesses have different proportionality of underground construction at different voltages and construction types[55] (leading to further difference in cost drivers). AAD slips into the 'high' group on the underground proportion measure, Jemena and United Energy slip back to join Ausgrid, Endeavour and Energex the 'mid' group on this measure.

In Advisian's view, this analysis of the AER's Opex benchmarking approach gives rise to two concerns:

1) Firstly, given that the SFA CD model is a 'one size fits all' approach, we are concerned about the lack of homogeneity between DNSPs on the factors that have been determined to be the most critical attribute in determining opex efficiency. Advisian would have expected the benchmarking analysis to include some 'class' analysis between the DNSPs in the sample that maximised homogeneity within the classes, and maximised heterogeneity between classes[56], thereby increasing the likelihood that cohort DNSPs are truly *comparable*.

2) Secondly, the DNSPs in the medium customer density group have generally ranked poorly on efficiency, with three of the four assigned 'scores' of 60% or less on the SFA CD ranking. In

[55] *For example multiple feeders running along the same route in concrete ducts in CBD/Urban environments versus direct buried cables in suburban areas.*

[56] i.e. DNSPs are compared against the group of similar (comparable) DNSPs such as rural to rural, urban to urban, mixed to mixed.

Advisian's opinion, this in itself is cause to seek further explanation. It is conceivable that a contributor to Ausgrid and Endeavour's poor Opex productivity ranking is the lack of model fit in this group, combined with over emphasis on the underground proportion measure, without identifying differences in proportion of high voltage underground assets.

Where there are significant concerns in relation to the comparability of DNSPs we consider that benchmarking results should be considered as informative rather than definitive, with more substantive weight placed on the revealed costs and network performance of the NSW DNSPs. We discuss the appropriateness (or otherwise) of alternative approaches to account for these issues in Section 4.3

4.2 Linear v Spatial Density

The AER's consultant does not appear to have appropriately considered spatial density (i.e. customers/sq. km) as an alternative to linear density (i.e. customers / km) in developing their benchmarks. Whilst this may be due to data limitations, particularly in relation to New Zealand DNSPs, the AER has expressed the view that:

> *"We are satisfied that it is not necessary to provide an operating adjustment for customer density. An adjustment for customer density does not satisfy operating environment adjustment criterion three. On the basis of second stage regression analysis of Opex MPFP results, we are satisfied that output variable sufficiently account for the effects of customer density."*[57]

AER goes on to state:

> *"The use of service territory as a density measure has proven problematic. This is due to the difficulty in accurately measuring service territory items such as lakes, national parks and unpopulated areas, as the networks do not incur costs for areas that are unserviced, customers per square kilometre of service area is not a useful measure for Opex for service comparisons."*[58]
>
> *"Because the MTFP and Opex cost function models use customer numbers. Line length and demand as outputs (like the MPFP model) we are satisfied that they will also account for customer density. Density measures are ratios of customer numbers, energy throughput, and demand to line length."*[59]

Advisian does not agree with the AER's conclusions on this matter for the reasons explained below. The issue that distinguishes Australia from many overseas comparisons is the large variation in spatial customer density between the 13 Australian DNSPs, which ranges from 0.4 customers/km^2 (Ergon) to 2050 customers/km^2 (Citipower), a ratio of 1:5125. This ratio is significantly greater than the linear density ratio of 4.3 customers / km (Ergon) to 75 Customers / km (Citipower), a ratio of only 1:17.4.

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[57] AER, *Draft Decision Distribution Determination 2014-19 Attachment 7: Operating Expenditure*, November 2014, p.*7-133*

[58] ibid, p.*7-135*

[59] ibid, p.*7-136*

Figure 4-7 shows the spatial density of the DNSPs included in the benchmarking analysis.

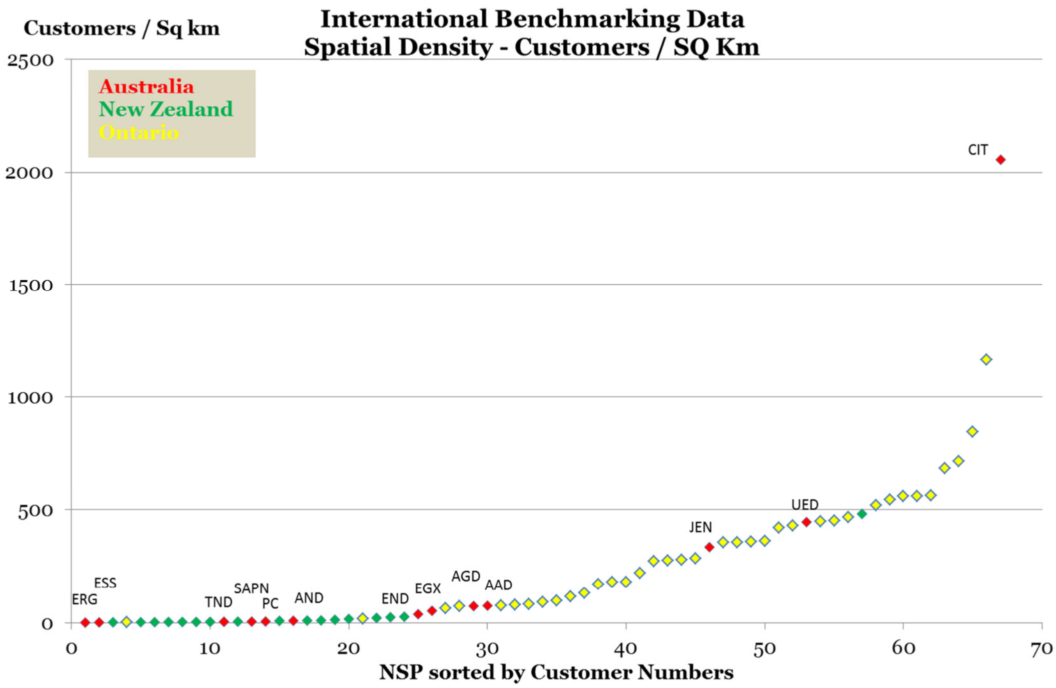

Figure 4-7 Spatial density for combined Australian and international DNSPs
Source: Advisian Analysis

In comparison, the New Zealand DNSPs generally serve low density areas of population that is more comparable to the Australian rural distributors, whilst the Ontario DNSPs generally serve areas that are much more aligned on average to the higher customer densities encountered in the Victorian urban DNSPs. In addition, comparisons within the New Zealand or Ontario data sets are more appropriate due to the much greater homogeneity of environmental factors and common jurisdictional requirements between the businesses.[60]

This differs considerably from the findings from a London Economics and PowerNex Associates econometric study that was completed for Hydro One Networks in Ontario in response to a request from the Ontario Energy Board to "*investigate the relationship between customer density and distribution service costs*"[61]. The London Economics/PowerNex Associates analysis considered five independent variables (Customer Density[62], Number of Customers, Energy Density, Time/Trend Variable) to find that:

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[60] Both Ontario (Ontario Govt.) and New Zealand (NZ Govt.) are subject to a single level of common jurisdictional oversight for electricity distribution networks. Within the NEM, there are six separate jurisdictions (NSW, Qld, Vic, SA, Tas, ACT), each with differing jurisdictional legislative obligations, licensing requirements and technical standards. This is in addition to an independent federal economic regulator.

[61] London Economics, PowerNex Associates, *Density Study Results Stakeholder Consultation – Prepared for Hydro One Networks Inc.* October 19 2011, p.3.

[62] Both Linear and Spatial density measures were separately considered

a) Spatial customer density was a significant driver of operating (and capital) expenditure, with an estimated regression co-efficient in the order of -0.100 for opex; and,
b) Linear customer density was a separately significant driver of operating (and capital) expenditure, with an estimated regression co-efficient in the order of -0.299; [63]

Whilst these coefficients are not directly comparable to the AER/Economic Insights figures (due to differences in statistical methodologies), the analysis does establish that:

a) both linear and spatial customer density are significant opex drivers for Ontario DNSPs; and,
b) linear density does notionally have a stronger explanatory power for opex - as evidenced by the higher (-0.299) coefficient when compared to spatial density (-0.100). However, whereas the linear density ratio in Australia is only 1:17.4, the spatial density ratio is 1:5125 meaning that a linear density model alone potentially understates the impact of customer density on Opex.

Advisian is concerned that the AER's preferred model fails to adequately take this finding into account. .

The London Economics/PowerNex Associates analysis was a specific econometric investigation of the relationship between spatial and linear measures of customer density on DNSP opex. It used four models and five years of reported data (2006-2010) to evaluate the differences in Operating, Maintenance and Administrative (OM&A) costs for networks of different spatial customer density. The study found that:

- *"Estimated coefficients for customer density in all four models are statistically significant at the 95 percent confidence interval*
- *More specifically, all four models show a negative relationship between costs and customer density*
- *Based on the results of the fourth model, which considers OM&A and the Capital Proxy, a fivefold increase in customer density would* **(only)***lead to a 150 percent increase in cost*
  - *For example, an increase from 5 customers per km² to 25 customers per km² or from 25 to 125 customers per km²"* [64]

The results are illustrated in Figure 4-8, which clearly show the much greater spread of both OM&A and replacement Capex at lower customer densities (below about 100 customers/km²), and far greater consistency in costs for higher density areas (>100 customers/km²).

[63] Ibid, p.12

[64] *Ibid p. 12*

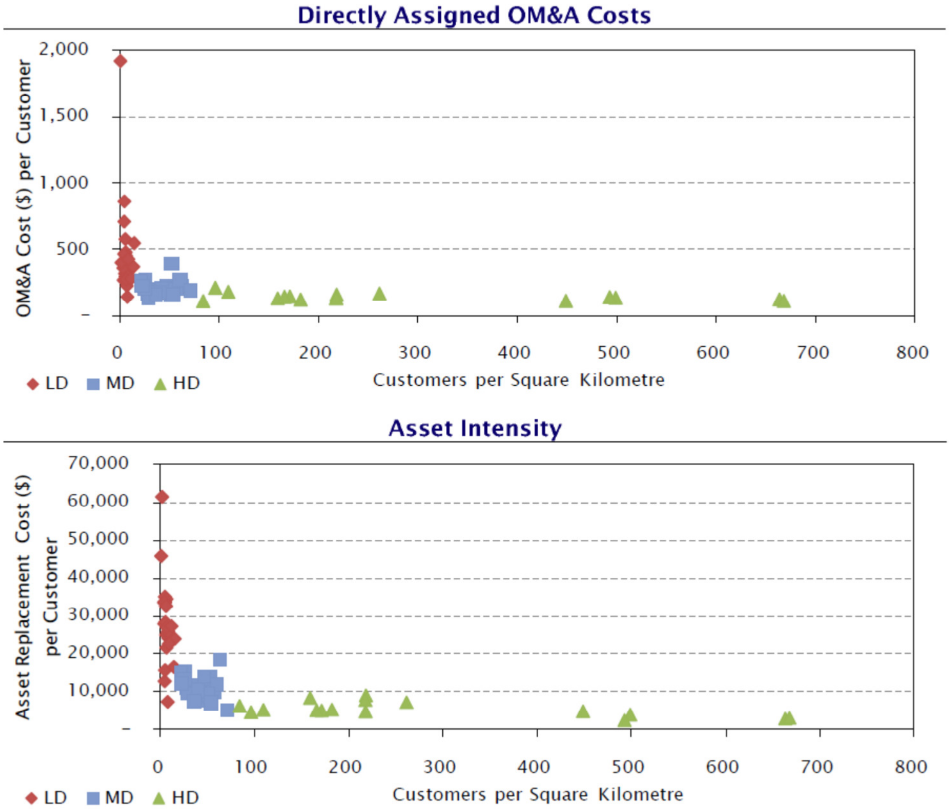

Figure 4-8 Comparison of Cost per Customer to Customers per km²

Source: London Economics & PowerNex Associates[65]

We note that the purpose of these Ontario studies has not been to establish a benchmark operating expenditure but to investigate the relationships between cost drivers and specific variables to better inform regulatory and market structure decisions. This differs from the AER's analysis which simply attempts to establish a universal measure of relative productivity to derive a single efficient opex cost function that is notionally applicable to all DNSPs included in the sample.

Figure 4-9 shows that the spatial density of the urban/suburban Victorian businesses (United, Jemena and Citipower) is above 300 customers/km² in all cases, which is well above the point at which both OM&A and Replacement costs per customer were found to 'level' out for the Ontario businesses (the 'High Density' DNSPs in Figure 4-8) . In contrast the NSW DNSPs all report lower average spatial densities that are around or below 100 customers/km², which corresponds to the portion of Figure 4-8 dominated by the 'Medium Density' businesses.

Noting the materiality of the findings that spatial density:

a) affects both Opex and Replacement costs within the Ontario businesses; and,
b) the uncertainty in the strength of the relationship (seen by the spread of results in a class in Figure 4-8) increases significantly as spatial density decreases.

[65] *Ibid p.13*

Advisian is concerned that the Economic Insights and AER's analysis has not taken spatial density into account, citing data quality issues (national parks, lakes and unserviced areas). We highlight that much of the additional Opex arising from the presence of these unserviced areas in a service area is due to the fact that these areas disrupt 'point to point' transport. In turn, this means that for maintenance and inspection activities, sparsely populated areas of a distribution network usually require field staff to drive *around* the unpopulated areas to reach assets or customers. This means that the presence of these areas is relevant to the analysis and is discussed further below.

For the purpose of context, Advisian also notes that Ontario is approximately 60% of the area of Queensland, with the largest business, Hydro One serving approximately 75% of the province[66]. This leaves approximately 70 DNSPs serving a relatively compact area that is comparable in size to either Victoria (5 DNSPs) or New Zealand (27 DNSPs). Given that the London Economics/PowerNex Associates study relates to sample areas within the same business, many of the issues relating to the reporting inconsistencies between businesses that are evident in the Australian DNSPs' RIN data do not apply in this case.

As with our prior assessment, four observations are pertinent:

- DNSPs with low spatial densities (up to 10 customers / sq. km) include Essential, Ergon, Powercor, SAPN, Ausnet Services and TasNetworks. On this measure, these DNSPs share spatial density characteristics with New Zealand DNSPs.
- A diverse range of DNSPs with a spatial density between 30 and 100 include Endeavour, Energex, Ausgrid and ActewAGL. On this measure, these DNSPs share spatial density characteristics with a mix of NZ and Ontario DNSPs.
- DNSPs with a high spatial density (300-500)– Jemena and United Energy, shared spatial density characteristics with Ontario DNSPs.
- Citipower[67][68][69] as an outlier, with extremely high spatial density. Compared to the nearest NSW DNSP (Ausgrid), Citipower has a linear density of 75 customers /km to Ausgrid's 40 customers / km (a ratio of 1.875:1) compared to spatial densities of 2055 to 73.4, a ratio of 28:1).

Taking these factors into consideration, Advisian is concerned that the AER's reliance on a linear customer density measure does not adequately reflect the Opex cost drivers that are associated with the differences in spatial density.

To further highlight the potential for error in assuming linear density adequately deals with spatial density issues, as the AER has done, Figure 4-79 shows the relationship between linear density and spatial density for the benchmarking sample. Some New Zealand DNSPs are not shown due to unavailability of data.

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[66] Hydro One, *Annual Report 2013*, p. 17

[67] *The following two references demonstrate previous consultant reports identifying CitiPower as a significant outlier amongst all other DNSP's. Citing that for the purpose of benchmarking CitiPower should be excluded.*

[68] *Nuttall Consulting, Report – Principle Technical Advisor Aurora Electricity Distribution Revenue Review November 2011,p35 " we have excluded CitiPower from this analysis, as we consider that its predominantly CBD/urban network would mean it would not be a suitable comparative DNSP"*

[69] *Ibid p 75, "The table also indicates the much longer asset life of Citipower than those of any of the other DNSPs, supporting our view that Citipower should be excluded from the benchmarking."*

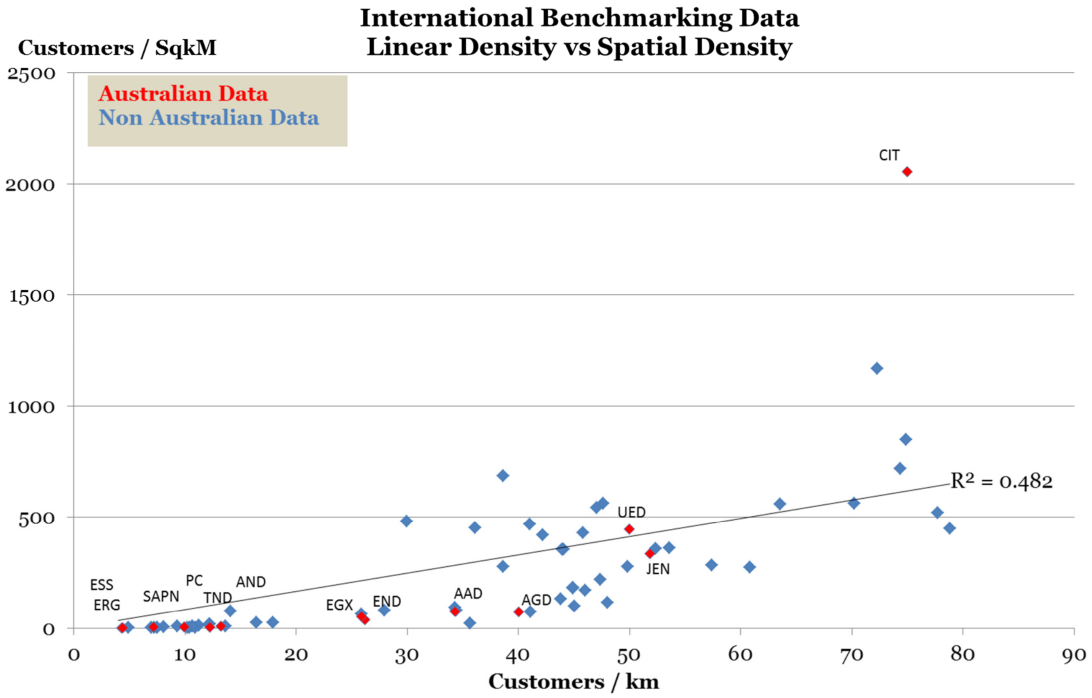

Figure 4-9 Spatial density v Linear Density for combined Australian and international DNSPs
Source: Advisian Analysis

The R^2 between linear density and spatial density is less than 0.5 which indicates that the reliance on linear density alone to act as a proxy for spatial density is relatively weak. An R^2 value of this magnitude means that it is not reasonable to expect linear density to fully explain the effect of spatial density. In this regard, they are two factors that are related - but not interchangeable.

Accepting the AER's concern that spatial measures may be unduly influenced by areas which do not need to be served by electricity distributors, we note that this is equally valid for the international DNSPs and by dismissing spatial density, there is an inherent bias in the analysis towards businesses where the distribution of population and topographical constraints are less of an issue[70]. With this in mind, it is evident from Figure 4-9 that there is greater alignment between the spatial density measure in the international data with the AER's frontier businesses than for the Australian 'mixed' rural and urban DNSPs. In this regard, Energex, Endeavour, ActewAGL and Ausgrid all fall at the lower extreme of businesses with a comparable linear density, whilst United Energy and Jemena are far more typical of the relationship between linear and spatial measures of density in the international data. Similarly the NSW and ACT distributors fall at the point in the sample where there is the greatest disparity in the relationship between linear and spatial density.

Consistent with our earlier approach, the following observations regarding the heterogeneity of the data set are pertinent:

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[70] Notably, the Victorian (and to a lesser extent, South Australian) DNSP's are concentrated across a much smaller total area as Victoria is simply physically much smaller in area than other states. Inclusive of all National Parks and unserviced areas, Victoria (served by five DNSP's) covers a total area that is 9% of the combined area of NSW and Queensland (which is also served by five DNSP's).

- DNSPs with a both a low linear and low spatial density are Essential, Ergon, Powercor, SAPN, Ausnet Services and TasNetworks. On this measure, these DNSPs share density characteristics with a mix of New Zealand and Ontario DNSPs.
- A group in the middle comprising Energex, Endeavour, ActewAGL, Ausgrid, Jemena and United Energy emerges. On this measure, these DNSPs share density characteristics with a mix of New Zealand and Ontario DNSPs.
- Only a single DNSPs has a very high linear and spatial density, notably Citipower, which is clearly an outlier.

Advisian makes the general observation that, with the exception of United Energy, the 'mid' group has generally benchmarked poorly. Our concern again relates to the lack of homogeneity of the DNSPs in the benchmarking sample set. The fact that the models have generally identified Citipower as the most efficient Australian DNSP is of concern given its 'outlier' characteristics on measures such as linear and spatial density.

Advisian concurs with the AER's view that spatial density in itself fails to recognise unserved areas such as lakes, National Parks, waterways and the like. However, we consider that it is a material Opex cost driver for businesses with lower spatial density. Whereas in high density areas (by either spatial or linear measure) point to point transport routes exist[71], the practical reality is that as spatial density decreases, more indirect 'hub and spoke' transport routes become necessary. Power lines generally take direct routes across property, rivers, parkland and other obstacles, whereas roads frequently do not.

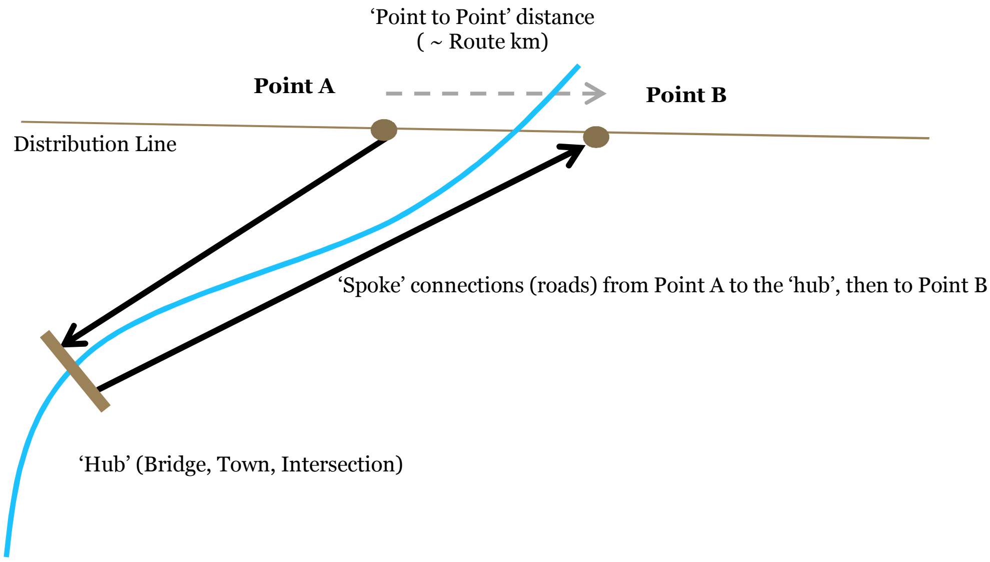

Figure 4-10 Impact of 'Hub & Spoke' v 'Point to Point' transport networks
Source: Advisian

In these cases it is necessary to travel from point A back along a 'spoke' (road) to a 'hub' (regional centre, river crossing, intersection) to travel to another point B on an adjacent 'spoke', effectively travelling two sides of a triangle between point A, point B and the 'hub'. In more densely populated

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[71] Such that in most cases it is possible to travel more or less directly between any two points on the network.

and less topographically diverse areas, more interconnected transport networks mean that the distance travelled would be much closer to the distance between point A and point B.[72] This is illustrated in Figure 4-10.

Recognising that these operational difficulties do exist in practice, the question turns to how they can be taken into account in determining the efficient Opex for the Networks NSW Distributors. In this respect, it is these travel time factors, along with reliability performance requirements that Australian DNSPs consider the number and location of field crews and depots to deploy across their networks.

As the spatial density of a DNSP decreases (or the total service area increases), more depots, equipment and personnel are required to maintain a given level of service performance, with less opportunity to share personnel or specialist equipment between depots (or with other DNSPs[73]) for the resources that are deployed to serve geographically isolated areas. Consequently, the impact of these factors are ultimately reflected in the staffing levels, contracting strategies, business structure, maintenance strategies and accommodation costs revealed in a DNSPs Opex, which will result in less spatially dense businesses appearing less productive than higher density networks across most categories of Opex. We discuss the appropriateness (or otherwise) of alternative approaches to account for these issues in Section 4.3

4.3 Application of Alternative Approaches

Noting the issues that we have raised in the above sections, Advisian considers that there are four approaches that could be adopted to more appropriately account for these issues for the purpose of setting the NSW DNSPs efficient Opex:

1) Adjustment to the benchmarking model specification to take account of spatial density across all DNSPs in the sample;

2) Consideration of DNSPs on a 'class' basis to ensure that the businesses included in the benchmark sample remain *comparable* (as envisioned by the AEMC in its guidance on the use of the AER's analysis in exercising discretion under the rules i.e. *"In addition, the AER can conduct its own analysis, including using objective evidence drawn from history, and the performance and experience of* ***comparable NSPs****."*[74])

3) Applying a specific 'out-of-model' adjustment of the productivity results to account for the additional Opex driven by differences in spatial density in a similar manner to the other specific adjustments applied in the AER's draft decisions;

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[72] In the case of the author's own property, approximately 1.5 route kilometres of line connects two neighboring properties to a common 11kV control point. However, due to property boundaries and rivers, the distance by public road (which the DNSP is forced to use) from one property to the control point is approximately 16kM, even though the route length is less than 2km.

[73] Either through increasing the effective utilisation of internal resources serving the regulated network through the provision of unregulated services to other DNSP's; or, by minimising the volume of internal resources through contracts with third parties that also serve co-located or neighbouring DNSP's.

[74] AEMC, *Rule Determination – National Electricity Amendment (Economic Regulation of Network Service Providers) Rule 2012,*29 November 2012, p. 112. (emphasis added)

4) Reliance on the NSW DNSPs' audited 'revealed' costs for the base year (as adjusted for specific and identifiable adjustments for one-off costs or specific inefficiencies or categorisation issues) on the basis of the AER's statements that:

"*the total Opex in a recent year typically best reflects a service provider's current circumstances*"[75]

"*…we have incentives in place to reward the service provider for making efficiency improvements by allowing it to retain a portion of the efficiency savings it makes. Similarly, we penalise the service provider when it is relatively less efficient. This gives us confidence that the service provider did not spend more in the proposed base year to try to inflate it's Opex forecast for the next regulatory control period*" [76]

and

"*…These regulatory obligations ensure that the financial incentives a service provider faces to reduce its costs are balanced by obligations to deliver services safely and reliably. In general, this gives us confidence that recent historical Opex will be at least enough to achieve the Opex objectives*" [77]

As there is likely to be analytical issues such as defining cross-correlations between spatial density, linear density and other variables in the benchmarking models that are difficult to separate (and arguably would then fail to unequivocally satisfy the AER's criterion of '*is it accounted for elsewhere*'[78]), and given the limitations of the statistical methods and datasets that underpin the results, Advisian is of the view that is not apparent how this issue can be directly accounted for in the AER's analytical models on the basis that:

- The inclusion of additional variables into the model would absorb degrees of freedom in the model and with the potential to reduce the statistical validity of the approach. Advisian does not offer an expert opinion on these matters, however, we understand that the issue of model specification adjustments will be considered separately by the NSW DNSPs' statistical and econometric experts;

- The analysis of DNSPs by 'class' would reduce the volume of comparator businesses, and the Economic Insights model was stated to become unstable with too few DNSPs included[79]. Therefore it is unlikely that a stable model could be obtained for the 'classes' of networks that we have identified;

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[75] AER, *Draft Decision Ausgrid Distribution Determination 2014-19 – Attachment 7: Operating Expenditure*, November 2014, p. 7-14

[76] ibid

[77] ibid

[78] ibid, p. 7-92

[79] Economic Insights, *Economic Benchmarking Assessment of Operating Expenditure of NSW and ACT Electricity DNSP's*, 17 November 2014, p. 33.

- The application of a specific 'out-of-model' adjustment for spatial density factors is problematic because, assuming all other factors are equal, it simply accounts for a proportion of the difference between productivity scores for different DNSPs.

  As the impact of spatial density is embedded in the reported historical Opex for the business, the inherent difference in productivity would manifest itself as a consistent difference in measured productivity between networks over time (which can in fact be seen in the similar relative trends in MTFP indexes in the Economic Insights report[80] and reproduced in the AER's annual benchmarking report[81]). However these differences, regardless of the underlying reasons, implicitly form part of the AER's interpretation of 'inefficiency' based on the SFA CD results unless a specific 'out-of-model' adjustment has been made by the AER.

- The use of the NSW DNSPs' 'revealed' audited base year costs, along with the regulatory proposal, detailed RIN responses and engagement with the business during the preparation of the AER's decision represent the best available information for the Opex that was required to operate the NSW DNSPs .

However, the AER has considered this information to be of less significance in making its decision than the Economic Insights benchmarking models, which are based on a specification of network information that has been available to the AER at the time of each of its previous DNSP determinations[82] and subsequently does not account for the large amount of additional RIN information collected by the AER. Furthermore, the productivity scores have been averaged over an extended period which included the Global Financial Crisis, Australian mining boom, substantial volatility in AUD foreign exchange rates and significant investments by some (Qld, NSW, ACT), but not all networks due to greater network specific augmentation and security of supply requirements[83]. Finally, the averaging process adopted by Economic Insights implicitly fails to account for the material decline in the productivity of the frontier businesses over the analysis period.

Should it be accepted that the issue of spatial density (or any other factor) *'is outside the service provider's control'* and that it *'is material'*[84], then the fact that it is difficult to account for with the available data for the Australian and international comparators does not diminish the significance of the issue. Rather Advisian considers that this should lead the AER to recognise that differences in the assessed productivity simply represent an indicative measure of relative differences based on the particular specification that has been adopted. As a result of this finding, and noting the materiality of the adjustments to the NSW DNSPs' Opex, Advisian would expect that greater weight would have

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[80] ibid, figure 3.1 and figure 3.2, pp.17-18.

[81] AER, *Electricity Distribution Network Service Providers – Annual Benchmarking Report*, November 2014, figure 17 and figure 18, pp. 33-34

[82] *Line Length, Customer Numbers, Network Maximum Demand, Proportion Underground and Total Opex have historically been available from annual regulatory accounts and reliability reporting information. These factors have been published in summary form by the AER in its annual State of the Energy Market reports since 2007.*

[83] *IPART, Design, reliability and performance licence conditions for distribution network service providers date 1 December 2007*

[84] AER, *Draft Decision Ausgrid Distribution Determination 2014-19 – Attachment 7: Operating Expenditure*, November 2014, p.7-105 (these represent the AER's other two criteria for specific Opex adjustment)

been placed on testing the sensitivity of results to alternative model specifications[85] or otherwise the regulator's effort directed to the more detailed assessment of the recent, audited, total historical Opex that has been revealed by the businesses, in recognition that "*the total Opex in a recent year typically best reflects a service provider's current circumstances*"[86][87][88].

4.4 Conclusion – Benchmarking Approach

In addressing Advisian's concern that the AER's reliance on a linear customer density measure does not adequately reflect the Opex cost drivers that are associated with the differences in spatial density, Advisian considers that the fourth option (use of the DNSPs revealed base year as the starting point) represents the most appropriate and robust means of accounting for the difference in spatial density and all other network specific factors. This removes the substantial regulatory risk that the AER has introduced by incorrectly attributing inherent productivity differences to inefficiency in Opex expenditure. We note that if this is not addressed in the final decision, Advisian is concerned that it will lead to material under-expenditure on operating and maintaining the 'non-frontier' networks which is not in the long term interest of the NSW DNSP's customers[89]; does not promote efficient investment or operations in the NEM or the NSW DNSPs[90]; and, does not allow the NSW DNSPs to recover the efficient cost of achieving the operating expenditure objectives[91] for its networks.

Notwithstanding this, we note that the AER's preference in the draft decision has been to:

- rely on the results of Economic Insights benchmarking models for the purpose of deriving productivity measures;
- infer that the relative productivity measure is an appropriate basis for setting efficient base operating expenditure; and,
- make specific percentage adjustments to the revised Opex that are required for factors that are not considered in the model.

Therefore, whilst the adoption of the revealed base year (inclusive of any specific adjustments applied by the AER) as the starting point would implicitly include all of the issues that require specific adjustments, the remainder of this report focuses on identifying the most material issues that affect the AER's assessment of the NSW DNSPs' base Opex, or the productivity results of the frontier businesses. In Advisian's opinion, these factors must be transparently and meaningfully taken into

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[85] Advisian notes that consistency of results across a wide range of different model specifications using a single statistical methodology would provide a more compelling justification for the AER's strong conclusions on the relative Opex productivity of businesses than results obtained by testing similar model specifications across a wide range of statistical methods.

[86] AER, *Draft Decision Ausgrid Distribution Determination 2014-19 – Attachment 7: Operating Expenditure*, November 2014, p. 7-14

[87] AER, *Draft decision Endeavour Energy distribution determination 2014–19 Attachment 7: Operating expenditure November 2014*, p. 7-13

[88] AER, *Draft decision Essential Energy distribution determination 2015–16 to 2018–19 Attachment 7: Operating expenditure November 2014*, p. 7-13

[89] *In accordance with the National Electricity Objective*

[90] *In accordance with the National Electricity Objective*

[91] *In accordance with Opex Criteria under the NER*

account to support a conclusion of the magnitude that has been applied by the AER in its draft decision.

5 Asset Types and Volumes

This section summarises the differences in the asset base that must be maintained by the NSW DNSPs in comparison to the 'frontier' DNSPs. We first consider the key asset classes of distribution lines and transformers before investigating differences in the scope of distribution services between DNSPs. Finally we consider the adjustments that must be made to the benchmarking analysis to correct for the issues that we have identified.

As outlined previously, the Economic Insights model relies on three primary parameters to explain the relative operating efficiency of the DNSPs:

- Customer Numbers (and Ratcheted Maximum Demand which is highly correlated with Customer Numbers);
- Line Length; and,
- Underground Percentage.

Given that no "class" analysis has been used in the benchmarking and a composite score against a combination of urban and rural distributors has been used in the formulation of the efficiency frontier, Advisian has examined the mix of asset types that make up the primary model parameters.

5.1 Line and Cable Lengths

On a "per customer" basis, the relative length of line by construction type is shown in Figure 5-1.

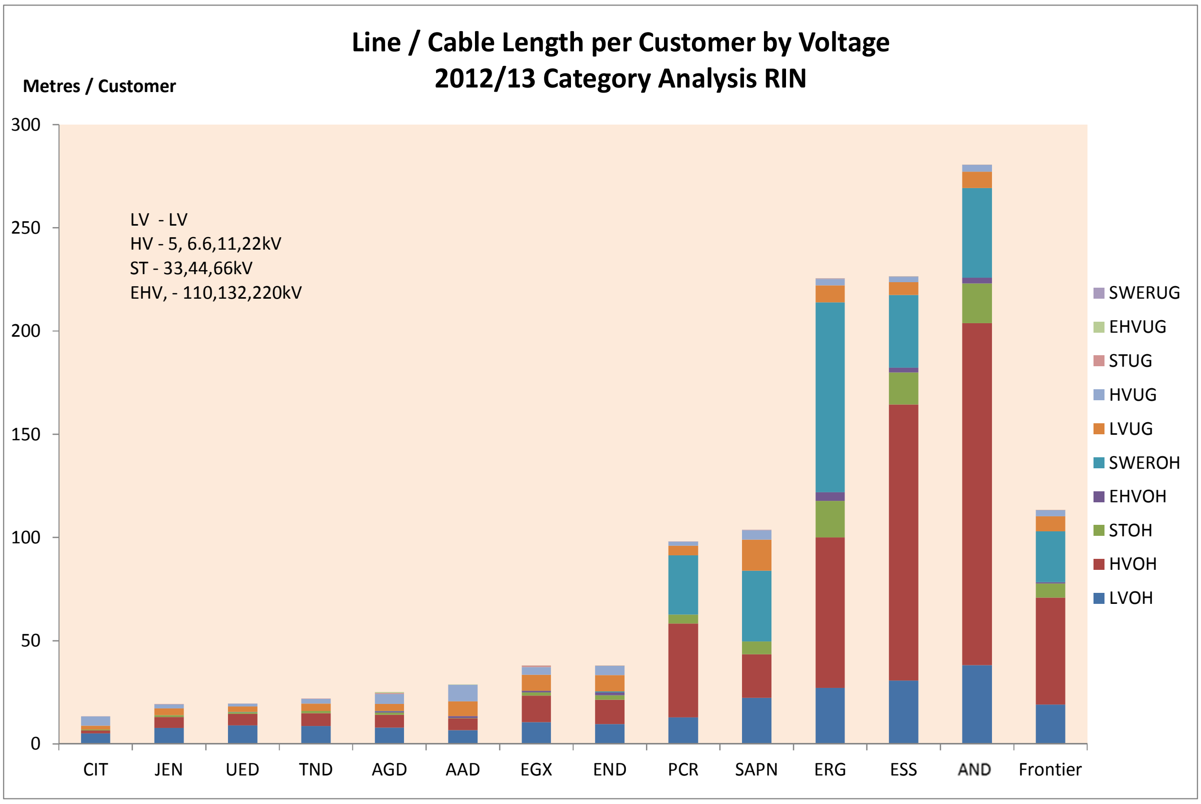

Figure 5-1 Benchmarked DNSPs – Line Length / Customer
Source: Advisian Analysis

Inspection of Figure 5-1 demonstrates the pitfalls of using a single model. The "frontier" DNSP, is comprised on (based on a customer number weighting methodology):

- 9.9% Citipower (CIT)
- 23.1% Powercor (PCR)
- 26% SA Power Networks (SAPN)
- 20.9% Ausnet (AND)
- 20.1% United Energy (UED)

It is readily observable that whilst Powercor and SA Power Networks share some homogeneity with the "frontier" network (bearing in mind they make up almost 50% of it), homogeneity with Ausgrid, Endeavour and Essential is lacking.

Advisian has also examined the case of "Non Rural" distributors in more detail in Figure 5-2.

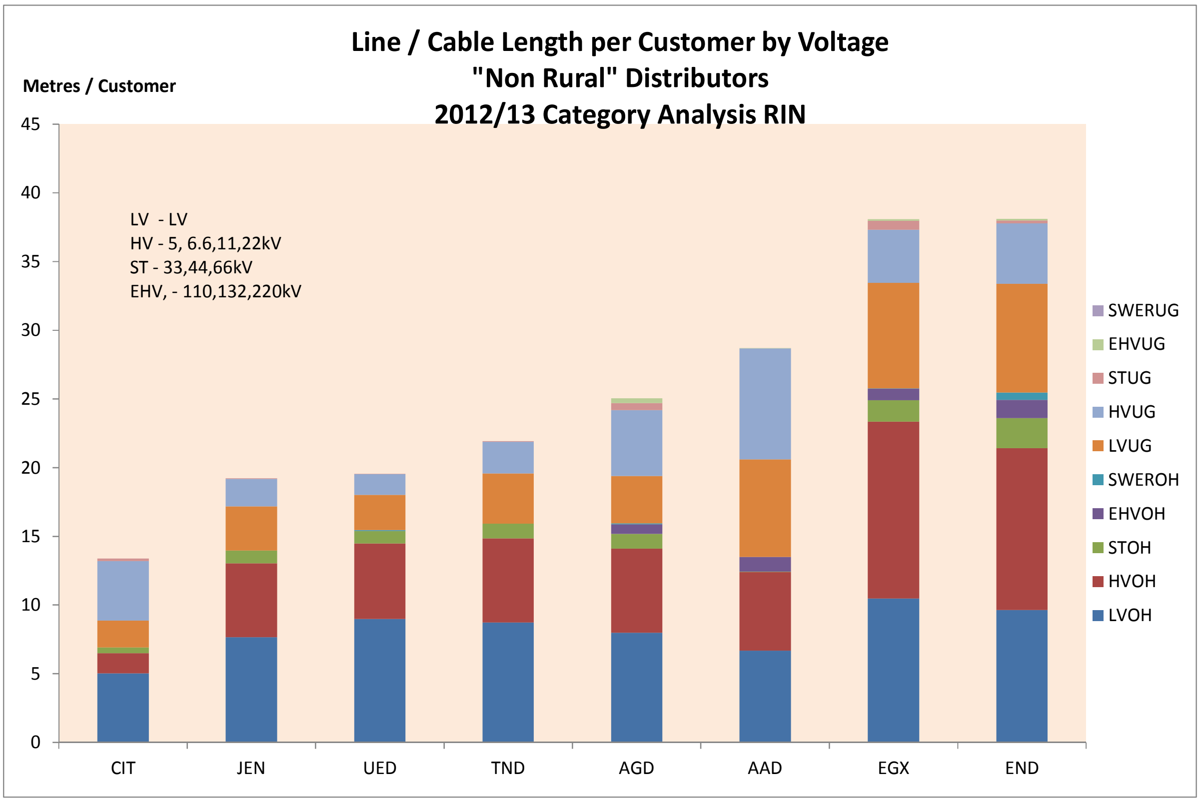

Figure 5-2 Non Rural Distributors – Line Length / Customer
Source: Advisian Analysis

Based on the comparison of line assets illustrated in Figure 5-2, Ausgrid operates and maintains 25.1 meters of line / cable per customer compared to CitiPower's 13.4 metres / customer, an increase of 87%. After adjusting for the relative underground percentages (Citipower 48%, Ausgrid 36%) it is our interpretation of the SFA model coefficients, that Ausgrid would be "allowed" 12.6% more Opex (on a per customer basis) for this 87% increase in line length per customer. Put another way, on the margin and all other things being equal, Ausgrid would be expected to operate and maintain its lines on a $/metre basis at 60% of the equivalent Citipower rate (1.126/1.187). In the case of Endeavour, the equivalent rate drops to 44%. Advisian is of the opinion that this is not an intuitively credible result.

Furthermore, in respect to Opex, Advisian notes that a significant proportion of line Opex is driven by the number of poles that must be inspected and maintained, as these represent the points on the network that are physically visited during an inspection cycle. Figure 5-3 shows the number of poles per customer.

Significantly, the urban distributors within the 'frontier' (United and Citipower) maintain a substantially lower number of poles per customer than either Ausgrid or Endeavour and the predominately rural distributors (SA Power Networks, Ausnet Services and Powercor) all maintain a substantially lower number of poles per customer than Essential. In this regard the frontier businesses are all at an inherent advantage to the NSW DNSPs in the assessment, purely from an asset volume perspective that does not arise from operational efficiencies, but from exogenous factors.

Therefore Advisian is of the opinion that the AER's reliance on 'line km' measures as a proxy for the volume of assets effectively ignores the cost of maintaining a larger number of assets from a maintenance perspective. As the AER's partial factor benchmarks are largely based on 'per customer' or equivalent linear density measures, Advisian is concerned that the AER has not taken (and its benchmarking model is not designed to take) into account, the additional legacy asset burden on the NSW DNSPs in relation to the volume of poles per customer (among other factors).

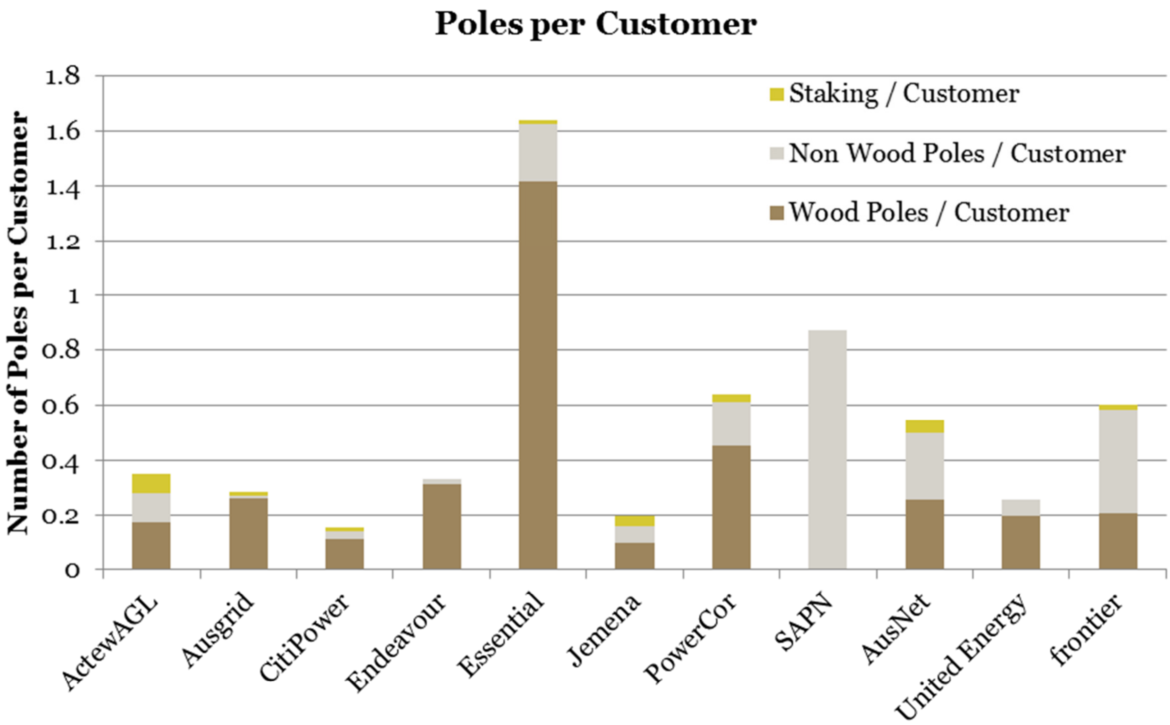

Figure 5-3 Number of Poles per Customer
Source: Advisian Analysis

Advisian also notes that a key contributor to the "frontier company", SAPN, has no wood poles. We have not completed a detailed study on the relative Opex costs of Stobie[92] poles vs wood poles, but we are of the view that there could be a material difference over a sustained period. The decay mechanisms (white ants and rot versus corrosion) are quite different, and we would expect quite different inspection/ maintenance regimes.

5.2 Installed Transformer Capacity

The four benchmarking models used by the AER and its consultant have incorporated 'Ratcheted Maximum Demand' as a demand variable that was adopted as an alternative to, and considered to act as a proxy for installed system capacity. Economic Insights explains in its report that the intention in adopting this variable was:

- Firstly, to address the suggestion of user groups that the use of maximum demand represented a better measure than installed capacity as it only gives credit for network capacity that is actually used[93]; and,
- Secondly that the use of 'ratcheted maximum demand' was intended to address the issue that the use of the observed maximum demand would *'fail to give the DNSP credit for capacity it had been required to provide to meet previous maximum demand which may have been higher than those currently observed'*[94].

Advisian notes that the nature of electricity distribution networks is such that augmentation is required to be planned and investment made to deliver a project in time to meet a forecast peak demand at a particular point in the network (i.e. at a spatial level), to accommodate different load types at different points in the network[95], as well as additional capacity being installed to provide system security[96] and to accommodate forecast growth. We note that none of these factors are recognised where either maximum demand or ratcheted maximum demand is used in place of installed capacity for the purpose of setting efficient Opex.

As shown in Figure 4-2 and discussed in section 4.1, Advisian believe that the ratcheted maximum demand variable is highly correlated with customer numbers and therefore could notionally be removed from the model with limited impact on the results (leaving the resultant model specification driven almost entirely by customer numbers)

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[92] *A Stobie pole is a combination of steel and concrete used extensively in South Australia.*

[93] Economic Insights, *Economic Benchmarking Assessment of Operating Expenditure for NSW and ACT Electricity DNSP's*, 17 November 2014, p.11.

[94] ibid

[95] For example, commercial loads are typically daytime peaking, whilst residential loads are typically evening peaking. Significant utilisation benefits exist in areas, such as inner city suburbs, where the same network assets serve both commercial and residential loads. This is an exogenous factor that inherently advantages networks where customers are spatially located in closer proximity and disadvantages areas such as the ACT where there are distinct geographically separated commercial and residential precincts.

[96] Significant recent investment in additional capacity for system security and reliability was required by NSW DNSPs in accordance with *IPART, Design, reliability and performance licence conditions for distribution network service providers date 1 December 2007.* In time this additional installed capacity may be utilised, however will not currently be accounted for by a maximum demand or ratcheted maximum demand specification.

Advisian has previously identified a major issue in NSW and Queensland relating to scope of activities and legacy design issues which results in a significant expansion of transformer capacity in those states on a relative basis. There is also a related increase in sub-transmission lines and cables. The issue arises from NSW DNSPs taking bulk supply at 132kV or 110kV, and then transforming it to a 33kV (or 66kV) sub-transmission voltage before a final transformation to high voltage distribution level. This issue arose as new networks transporting coal fields based power stations were interfaced to legacy networks, largely built to take electricity from metropolitan power stations (such as Bunnerong, White Bay, and Pyrmont in Sydney). As a general principle the Victorian and South Australian DNSPs that form the 'frontier DNSP' transform from 66kV to their relevant high voltage (22 or 11kV). In our view, this issue is central to the "scope" of the businesses. In order to assess the relevance of this issue on the benchmark distributors from Ontario and New Zealand, we have sought to provide a comparative analysis of "zone" substation transformer capacity per customer. This includes both stages of transformation where relevant.

The amount of transformer capacity installed by each Australian and New Zealand DNSP, on a kVA per customer basis is shown in Figure 5-4.

Clearly, NSW and Qld distributors have high installed capacities both in comparison to their Victorian and South Australia counterparts, and in comparison to New Zealand. There is a high correlation with how Australian DNSPs have ranked in the AER's benchmarking with those having high capacities generally benchmarking poorly, whilst those with low capacities have benchmarked well.

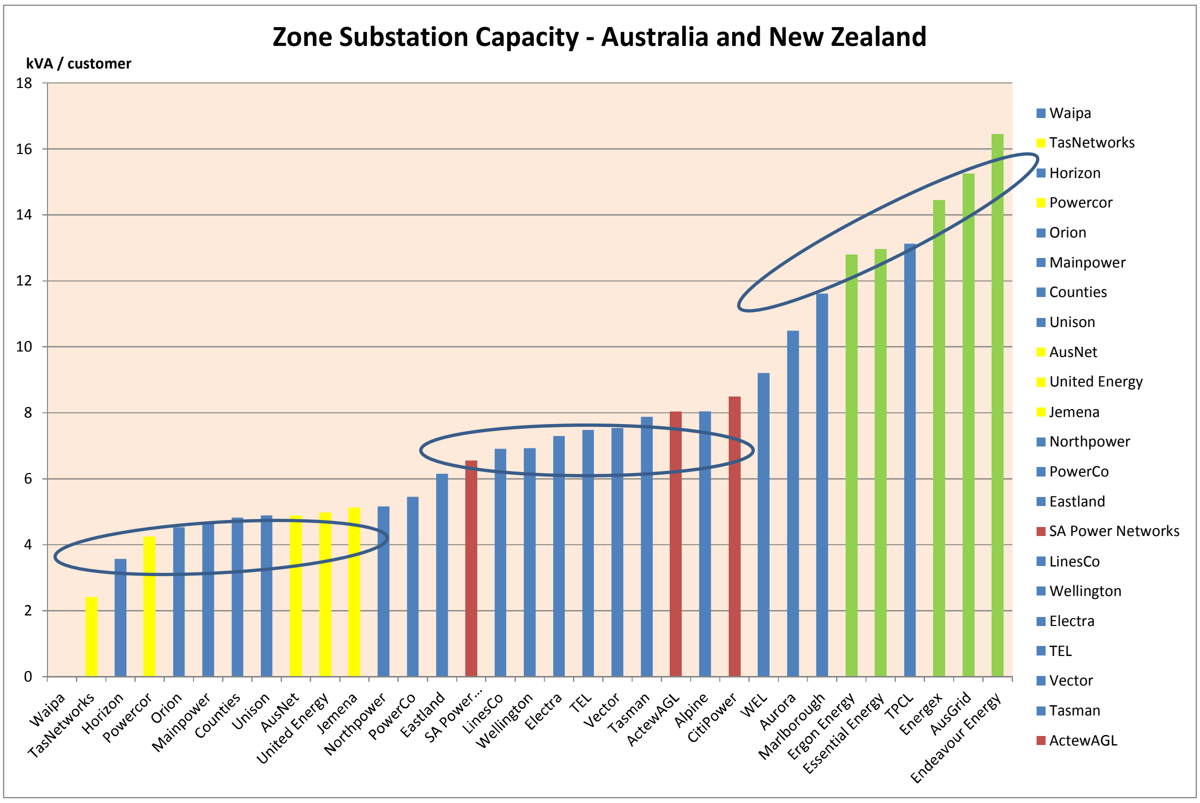

Figure 5-4 Australian DNSPs Installed Capacity per Customer

Source: Advisian Analysis

This simply reflects the SFA model's reliance on customer numbers rather than asset volumes as the key explanatory driver for Economic Insight's productivity measure. Effectively the Economic Insights SFA model establishes that businesses that are able to serve their customers with fewer assets are more productive. This is a relatively straightforward conclusion that does not require complex statistical techniques to prove. **What the SFA model does not establish (and its specification is not intended to establish) is whether the DNSPs Opex is efficient for the actual asset base and customer base that exists for each network, as it stands today.**

Whilst Advisian notes that customer numbers is not a function that is within the control of the business, we also note that the volume of assets to be maintained is largely a result of legacy decisions that cannot be changed by management in the immediate term (or even the long term without substantial additional capital investment). To establish whether or not each historical decision that has contributed to the current network was efficient would necessarily require an ex-post review of all investment, based only on the information (and uncertainty) that was available at the time of investment commitment. Even the choice of the high voltage distribution voltage is critical to this issue. In hindsight, 22kV systems as commonly used in Victoria are highly likely to be more productive than 11kV which is commonly used in NSW. In simple terms, 22kV should provide twice the capacity at about the same cost as an 11kV system, substantially reducing the assets (and therefore Opex needs) on a per customer basis. .

Notwithstanding the complexity (and likely impossibility, given the comprehensive data requirements) of completing such a comprehensive historical analysis in an objective manner, what is clear is that, whilst the legacy issues give rise to increased scope in NSW and Qld, there is also evidence of reduced scope in Victoria.

5.3 Scope of Comparable Network Services

In this regard, a material proportion of energy in Victoria passes directly from the TNSP's system into the DNSP networks at high voltage distribution levels (22kV). This is highlighted in the following extracts from the *Transmission Connection Planning Report 2013* which is produced jointly by the Victorian electricity distribution businesses:

> "*RICHMOND TERMINAL STATION 22 kV (RTS 22 kV)*
>
> *RTS 22 kV is a summer critical station equipped with two 165 MVA 220/22 kV transformers, providing supply to CitiPower's distribution network. The terminal station's supply area includes inner suburban areas in Richmond and Prahran and Melbourne City's Russell Place and surrounding areas. The station also provides supply to City Link and public transport railway substations east of the Central Business District. Due to uneven load sharing between the two 22 kV buses at RTS, the N rating is only slightly higher than the N-1 rating. The N-1 ratings are restricted by over-voltage limits on transformer tapping. A line drop compensator however, limits the overall 22 kV transformation output to 141 MVA for both summer and winter.*"[97]
>
> "*WEST MELBOURNE TERMINAL STATION 22 kV (WMTS 22 kV)*

[97] Jemena, Citipower, Powercor, SP Ausnet, United Energy, *Transmission Connection Planning Report 2013*

WMTS 22 kV is a summer critical station consisting of two 165 MVA 220/22 kV transformers, which supply CitiPower's distribution network. The terminal station provides major 22 kV supply to the West Melbourne area including Melbourne Docks, Docklands Areas, North Melbourne (including a railway substation), Parkville and Carlton, and the northern and western inner Central Business District and surrounding areas." [98]

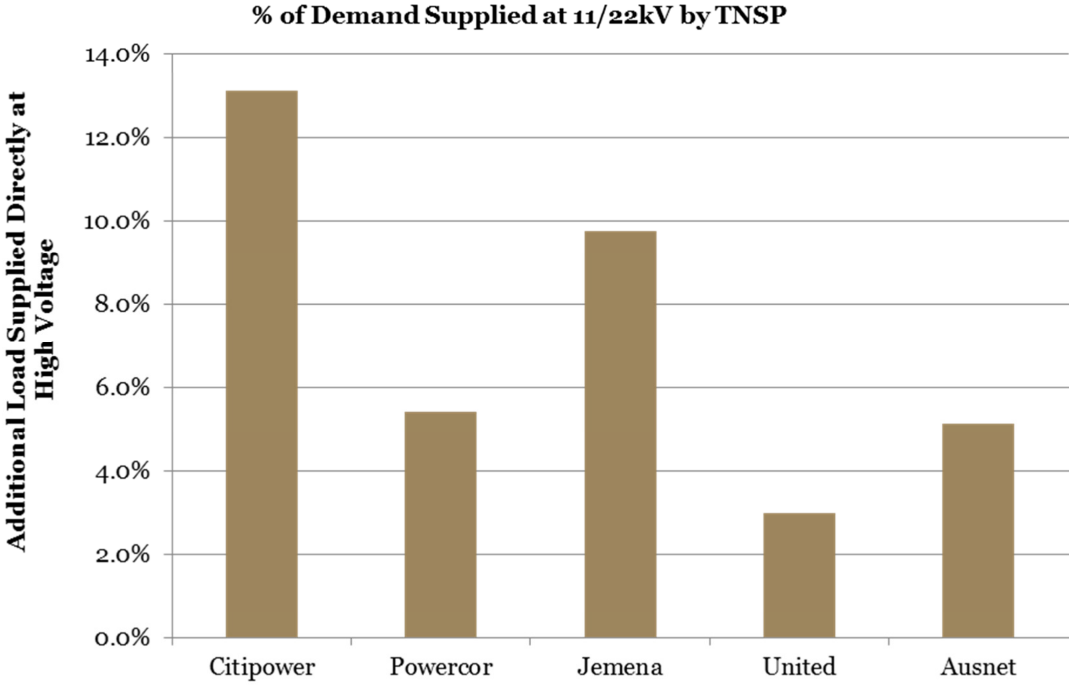

Figure 5-5 Percentage of Demand Supplied at 11/22kV from the TNSP
Source: Advisian Analysis

In all, Advisian has identified 11 instances where supply is taken directly into the high voltage distribution network. Whilst Advisian concurs that such an approach makes sound technical and economic sense, the magnitude of these supply arrangements materially impact the scope of activities of a number of DNSPs that form the "frontier" DNSP which is not reflected in the benchmarking models. Essentially this is an endogenous factor that favours four of the five DNSPs that form the 'frontier' DNSP. Figure 5-5 demonstrates the proportion of demand that Advisian has estimated is taken in this way by the Victorian DNSPs.

This decrease in the scope of the 5 Victorian DNSPs directly impacts all DNSPs to the extent that the reference point against which it has been judged by the AER does not incorporate 'full scope' DNSPs[99].

A similar issue arises in relation to the Ontario distributors. Whilst Advisian has not been able to source data on which to provide quantitative analysis, we note the following in the Ontario Distribution Sector Review Panel report:

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[98] ibid

[99] The Victorian DNSP's do not transform all of the energy supplied from the transmission system.

"Even though the operating costs of small LDC's (local distribution companies) are generally higher, they would be even greater if they incorporated the full cost of distributing low-voltage power to customers.

- *Some LDC's… …buy high-voltage power from Hydro One Networks, then run it through their own transformer stations to step down or reduce the voltage of electricity before sending it to consumers*
- *Some Large LDC's and most small and mid-sized LDC's buy their power from Hydro One Networks but at a lower voltage after it has already been stepped down because they have no transformer stations themselves.*
- *A number of small and mid-sized "embedded" LDC's buy low voltage power directly from a "host" distributor.*

These are critical distinctions, as the small and mid-sized LDC's are charged for the use of the transformer stations and other distribution assets required to serve their customers. LDC's do not typically reflect these charges in their operating and capital costs reported to the OEB (Ontario Energy Board), leading to an understated OM&A totals…" [100]

The extent to which this scope variation occurs within the Ontario benchmark distributors influences the benchmarking models and is ultimately a matter for econometric specialists. However, Advisian would expect that it certainly does not enhance the robustness of the model. We are concerned that much of this effect for the Ontario DNSPs has implicitly been attributed to the Ontario 'dummy variable' that has been employed by Economic Insights. The same issues are expected to be implicit in the New Zealand data, partly explaining the degree of variation.

5.4 Adjustments to the Benchmarking Results

Economic Insights in preparing its MTFP analysis, where sub-transmission transformer capacity has been excluded from the capacity measure for capital inputs quantities, states that:

"Those DNSP's with more complex system structures because they have inherited more 'upstream' distribution boundaries will be at a disadvantage relative to DNSP's with simpler structures and a more 'downstream' boundary. Excluding the first stage of two stage transformation at the zone substation level for those DNSP's with more complex system structures allows more like-with-like comparisons to be made across DNSP's"[101]

With regard to DNSP operating factors, Economic Insights also states that:

"…distribution network complexity is also likely to be a factor influencing efficiency levels which is largely beyond current management control in the short term. Those DNSP's that have inherited a more 'upstream' boundary with the transmission network, and hence, may have more sub-transmission and possibly two-stage transformation at the zone substation level may

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[100] Ontario Distribution Sector Review Panel, *Renewing Ontario's Electricity Distribution Sector: Putting the Consumer First*, December 2012,

[101] Economic Insights, *Economic Benchmarking Assessment of Operating Expenditure for NSW and ACT Electricity DNSP's*, 17 November 2014, p.13.

require more inputs to produce the same amount of (measured) output than DNSP's with more 'downstream' boundaries and single stage transformation"[102]

Following it's adjustments to the MTFP model, Economic Insights reports that the effect of excluding the first stage of two stage transformation is a 6 percent increase in MTFP levels for Energex and Endeavour, with smaller figures reported for Ausgrid, Ergon and Essential. The AER has subsequently made "out of model" adjustments of:

- Ausgrid 5.5%
- Endeavour Energy 5.0%
- Essential Energy 2.5%

In calculating these adjustments, the AER has relied on a total of both underground and overhead sub transmission line length as a proportion of total line length on the basis that:

"The most robust and consistent data set that we have for the above measures is line length. We selected the data set because we have information to compare the volume of sub-transmission assets and the operating costs of sub-transmission assets by line length. This was not the case for other data sets."[103]

The proportionality of underground and overhead sub-transmission underground lines as a cost driver has not even been considered in determining this factor.

The mere existence or non-existence of data is not a sound basis for making such a calculation. Advisian is not in a position to quantify the extent of the adjustments that should be made, either ex-ante to the benchmarking model or ex-post to the results.

We do note however that such adjustments are implicitly included in the base Opex values submitted by the NSW DNSPs in the first place. We also note that the Econometric Model of Network Services Opex: Results Using Transnational Data prepared by PEGR concluded that:

"at sample mean values of the business condition variables, the elasticities of cost with respect to customers, route miles and substation capacity are 0.589, 0.117 and 0.241%[104] *respectively".*

Notwithstanding that the AER has chosen not to utilise this study, the results adds further uncertainty to the adequacy of model specification applied by Economic Insights.

In Advisian's opinion, neither ex-ante adjustments to the benchmarking models provided by Economic Insights (in relation to Opex efficiency) nor the ex-post adjustments made outside the models by the AER have adequately dealt with what are clear variations in the scope of activities of both the Australian and international distributors.

This leads to a consistent conclusion that the approach taken by the AER is not of sufficient robustness to reasonably make Opex reductions of the magnitude that has been applied in the draft decision, whilst still permitting the NSW DNSPs to meet their obligations to operate a safe and reliable network.

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[102] Ibid, p. 14

[103] *Endeavour Energy Draft Decision Attachment 7: 7-131*

[104] *With a p value of0.049, reflective of slightly above a 95% confidence interval. (Table 2) OPCIT*

5.5 The Impact of SWER on Circuit Length

The AER's preferred SFA CD model specification is reliant almost exclusively on the circuit length as the primary differentiator between urban and rural networks. With the exception of the Underground percentage variable, no differentiation is made between line types (including different construction types and voltages), ratings or costs.

Single Wire Earth Return (SWER) technology is extensively applied in both Australia and New Zealand to supply remote locations. It is unlikely to occur in significant volumes in Ontario. It is characterised by a single (usually steel) wire with long spans between poles (typically 200 – 300m) and a single insulator to carry the conductor. As such, it is a low capital cost technology.

Notwithstanding inspection costs, 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. This is partially offset by more expansive earthing requirements at each customer offtake point.

In Advisian's opinion, SWER represents a significant source of heterogeneity both within the Australian DNSPs and across the international benchmarking set. Its impact does not appear to have been tested or considered by Economic Insights.

Figure 5-6shows the relative portion of Overhead, Underground and SWER circuits. In our previous discussion in section 4.2, Advisian has identified a "cluster" of DNSPs characterised by low linear and spatial density. These organisations are also characterised by relatively high proportions of SWER. Significantly, the three largest contributors to the "frontier" DNSP (Powercor, SAPN and Ausnet Services[105]) have significant SWER networks.

Of the NSW DNSPs, Essential Energy has a significant SWER network, but at around half the penetration of Powercor and SAPN – the major contributors to the "efficient" DNSP. The inclusion of Ausnet Services' SWER component means that around 70% of the "efficient" score is driven by networks with high SWER proportions. In comparison, Ausgrid and Endeavour Energy have very minor SWER networks.

Notwithstanding significant concerns in relation to "ceteris paribus"[106] assumptions, Advisian is of the opinion that inclusion of SWER on a 1 to 1 basis in circuit length may have resulted in a significant understatement of the cost impact of more conventional lines in the benchmarking model, to the detriment (in efficiency terms) of both Ausgrid and Endeavour Energy, and to a lesser extent, Essential Energy. Whilst acknowledging Citipower and United Energy also make up part of the "efficient" score, the three rural providers have a much greater impact on the result.

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[105] *Together, these businesses account for around 70% of the notional frontier business*

[106] *All other things being equal*

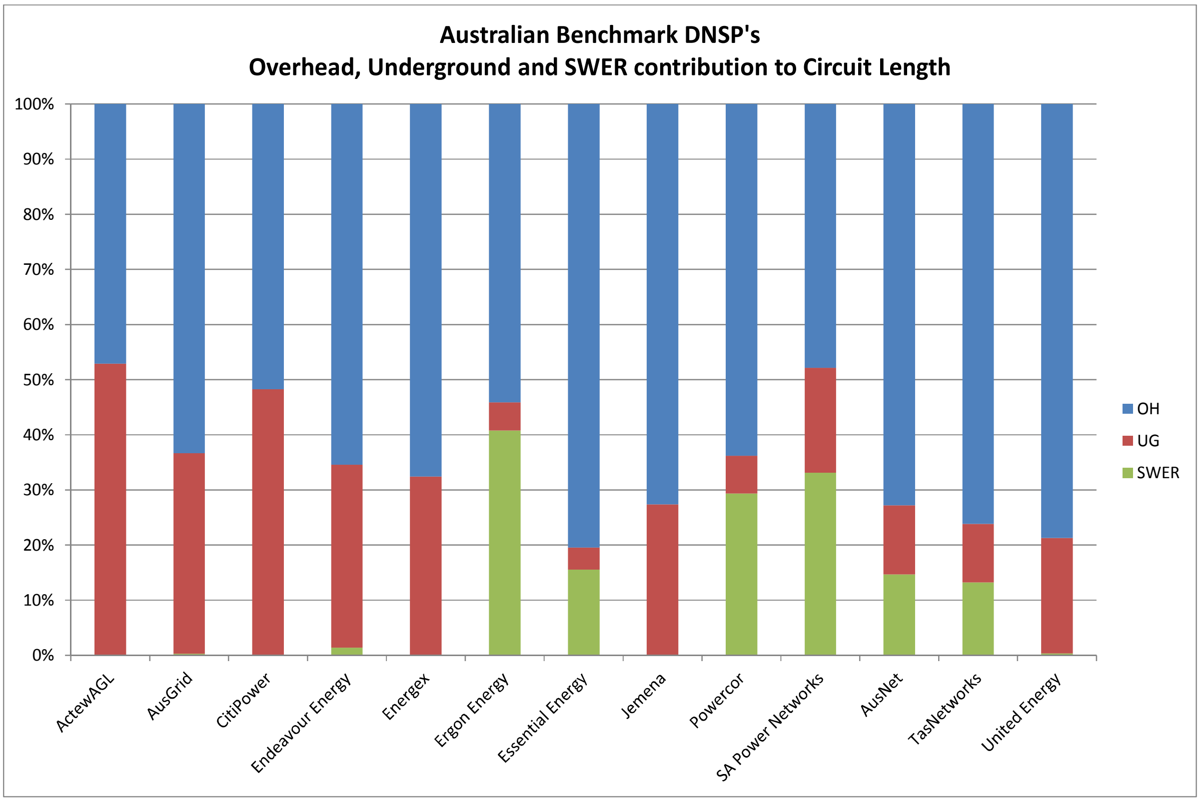

Figure 5-6 Percentage of SWER, Underground and non SWER overhead Networks)
Source: Advisian Analysis

In order to test the materiality of this issue, Advisian has "tested" the impact of a 50% weighting on the SWER lengths for the benchmark businesses. This is summarised in Table 5-1 below.

Table 5-1 Impact of Suggested SWER Adjustment to Circuit Length.

	SWER km	Adjustment to circuit length
Ausgrid	125	-62.5
Endeavour Energy	485	-243
Essential Energy	29,766	-14,883
SA Power Networks	29,144	-14,572
Ausnet	6,459	-3,229
Citipower	0	-
Jemena	0	-
Powercor	21744	-10,872
United Energy	41	-21

Source: Advisian Analysis of EB RIN

The impact of this adjustment would ideally be quantified on the basis of a revised econometric model, incorporating other adjustments. However, for the purpose of this report, it can be estimated through the application of the SFA CD co-efficient whereby a 1 percent reduction in circuit length, will lead to a 0.106 percent reduction in Opex[107]. In this case, the application of a 50% reduction in the impact of SWER on circuit length[108] improved the relative efficiency of the NSW DNSPs as per table in comparison to the "efficient" company.

Table 5-2 - SWER Adjusted Relative Efficiency

Networks NSW DNSP	SWER adjusted relative efficiency
Ausgrid	0.97%
Endeavour Energy	0.91%
Essential Energy	0.16%

Whilst Advisian does not advocate this approach due to our other more material concerns regarding the reasonableness of the SFA model, we note that it highlights the failure of the benchmarking model to account for significant differences between DNSPs that under the current approach are simply categorised as 'inefficiency'.

5.6 Conclusion – Asset Mix

On the basis of the facts presented above, Advisian is of the opinion that the benchmarking approach used to determine the frontier businesses does not (and the preferred model specification cannot) appropriately account for the differences in the volume and complexity of assets that the businesses must operate and maintain. Whilst the modelling approach taken by Economic Insights may be appropriate for assessing the relative productivity of the businesses (which simply demonstrates that DNSPs that can meet the historical maximum demand with fewer assets, generally do so at lower cost per customer), it is not a reasonable basis for setting efficient Opex because it does not account for the exogenous factors that have led to the need for historical investments in, and configuration of the existing asset base.

As a result we consider that the AER's benchmarking approach is not sufficiently developed, proven or robust to support the scale of Opex adjustments that have been proposed in the draft decision. We are also highly concerned that the AER and Economic Insights have knowingly designed the model in a way that systemically discriminates against DNSPs with a high installed capacity, regardless of whether or not this capacity:

- was installed as the most efficient option in response to jurisdictional planning requirements (as was the case for much of the recent NSW, Qld and ACT investment);

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[107] Economic Insights, *Economic Benchmarking Assessment of Operating Expenditure for NSW and ACT Electricity DNSP's*, 17 November 2014, p.33.

[108] This 50% factor reflects that typical SWER spans are in the order of 200m in comparison to typical single/multiphase line construction with spans in the order of 50-100m and that SWER requires a single conductor rather than the two, three or four necessary for conventional construction. As a result SWER lines typically comprise less than half the poles and less than half the conductor required for a km of conventional construction.

- was installed in response to market driven augmentation signals, including the best available forecasts, as reviewed by the AER, at the time of the last regulatory determinations[109];
- is, or was, required to maintain security of supply to customers, or otherwise maintain system security; or,
- is required to accommodate an intermediate sub-transmission transformation step due to the configuration, supply voltages and location of available capacity from the upstream transmission network (this issue is discussed in more detail in section 5.2)

Whilst we understand the AER's desire to ensure that its benchmarking analysis aligns with demand side (customer) outcomes, we also note that this has subsequently resulted in a model specification that does not, and was never designed to reflect the underlying Opex cost drivers of Australian electricity distribution networks, which primarily relate to the volume, configuration and geographical distribution of assets.

To enable the AER's preferred model to be used as a basis for determining efficient Opex, as distinct from relative productivity, Advisian considers that changes must be made to better reflect differences in the volume and nature of the assets that must be operated and maintained. We have identified three principal factors that are highly material to determining the efficient Opex requirements for a DNSP but are not appropriately taken into account in the model for the purpose of determining efficient Opex.

1) The use of total installed zone and distribution transformer capacity rather than ratcheted maximum demand to recognise differences in security requirements, utilisation and load distribution across the network;

2) The relativity between route length and circuit length as well as a correction of rural distributors to account for the lower Opex required to maintain SWER line in comparison to conventional three phase distribution lines[110];

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[109] For example the AERs Final Decision for the NSW DNSP's for the 2009/10-13/14 period (page xxii) states that

> *"The AER stated that Country Energy and EnergyAustralia's maximum demand forecasts set out in their regulatory proposals, provided a realistic expectation of the demand forecast required to achieve the Capex and Opex objectives in the transitional chapter 6 rules. Integral Energy's revised maximum demand forecast, submitted on 29 August 2008, provided a realistic expectation of forecast demand, as required to achieve the Capex and Opex objectives in the transitional chapter 6 rules."*

> And pages xxiv to xxv

> *"The AER considers the revised global maximum demand forecasts provided by Country Energy in its revised regulatory proposal are reasonable, but notes that the forecasts have limited application for the AER's assessment of the revised Capex proposal as they were not prepared on a spatial basis…*

> *…The AER considers that the revised global maximum demand forecasts provided by EnergyAustralia in its revised regulatory proposal are reasonable, but notes that the forecasts have limited application for the AER's assessment of the revised Capex proposal as they were not prepared on a spatial basis…*

> *… Integral Energy did not provide a revised maximum demand forecast in its revised regulatory proposal. Integral Energy provided a revised Capex proposal given the worsening global financial crisis was likely to reduce its required growth Capex for the next regulatory control period. The AER's consideration of the adjustments made to Integral Energy's Capex proposal to account for changes in maximum demand resulting from the worsening global financial crisis…"*

[110] Single Wire Earth Return (SWER) line consists of widely spaced poles with a single high tension conductor strung between and was historically used as an inexpensive means to electrify rural areas. In comparison to conventional three phase 11kV or 22kV

3) The recognition of the impact of spatial density (customers per km^2) as distinct from linear density (customers per km) on the nature and configuration of electricity distribution networks, and consequently on the efficient Opex requirements for a distribution network.

Our reasons for points 1) and 2) have been discussed in more detail in section 5.2 and 5.5, whilst point 3) has previously been discussed as a separate issue in section 4.2.

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distribution lines, SWER lines typically require less than half the poles due to average spans in the order of 200m in length and one quarter of the total conductor length. From an Opex perspective, this translates to approximately half the pole inspections and minimal maintenance of pole top structures. However there is generally no Opex benefit for 'per km' line inspections.

6 Reliability

Advisian notes that reliability has not been considered in any of the SFA CD, LSE TLG or LSE CD models. The Opex MPFP model deducts a proportion of Opex on the basis of absolute reliability (SAIDI).

In Advisian's experience, the underlying reliability of a network is largely a function of the physical design of the network taking into account such factors as the number and distribution of zone substations, length and interconnection of high voltage feeders, degree of undergrounding, depot locations coupled with the effectiveness of vegetation management and other maintenance strategies.

These particularly impact SAIFI (the frequency of outages). CAIDI (the duration of outages for each customer) reflects the duration of outages. CAIDI captures an organisations ability to respond and implement repairs or switching when faults do occur. The combination of SAIFI and CAIDI, i.e. the number of outages and the time to respond, reflects in SAIDI – the overall outage time customers experience on average. SAIDI ultimately reflects the unserved energy which, when multiplied by the Value of Customer Reliability, gives the cost to the community of outages.

Recognising that the NSW DNSPs networks are dispersed over a much larger area per customer than the (predominately Victorian) distributors that record lower costs on these measures, Advisian notes that the AER makes the following statements in the Annual Benchmarking Report in relation to reliability performance:

> *"We would expect those distributors with greater route line lengths to incur higher minutes off supply per customer, as they may need to travel further distances when responding to outages"*[111]

and:

> *"We would expect those distributors with greater line length to spend less per km and exhibit longer outage durations"*[112]

In making these observations, the AER has identified the fundamental impact that the geographical dispersion of assets has on a DNSP's Opex, Capex and relative reliability performance. This requires trade-offs between expenditure and service performance that are unique between businesses (due to the differing Opex[113] and Capex[114] responses, inherent acceptance of risk[115] or relaxation of service performance). The diversity of geographical factors that have led to the legacy Capex, Opex and service standard trade-off decisions that have been taken is such that the businesses will each operate

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[111] ibid, p. 45

[112] ibid, p. 46

[113] Opex responses include*:* frequency and intensity of asset inspections & maintenance, selection of vegetation management strategy, staffing levels, location and number of depots

[114] Capex responses include: asset replacement, network technologies (sectionalisers, reclosers etc.), inherent redundancy, load transfers in more densely populated 'meshed' areas, spreader bars.

[115] For example the scale of the recent settlement of bushfire liabilities in Victoria and the findings of the WA wood poles inquiry demonstrate that DNSP's historical acceptance of risk has been undervalued in some jurisdictions.

at a different absolute 'MTFP' level against any individual specification. This simply evidences that each of the NEM DNSPs operates their business differently.

6.1 Reliability Trends

Advisian has reviewed SAIDI and SAIFI, and by implication CAIDI, over the 8 year period 2006 – 2013 provided in the Economic Benchmarking RINs. For the purpose of this analysis and consistent with the AER's approach to schemes such as the Service Target Performance Incentive Scheme (STPIS), the impacts of Major Event Days and other excluded events have been omitted from the measure.

Figure 6-1 shows unplanned SAIDI for the NSW DNSPs and the 5 "efficient frontier" DNSPs over the 8 year period.

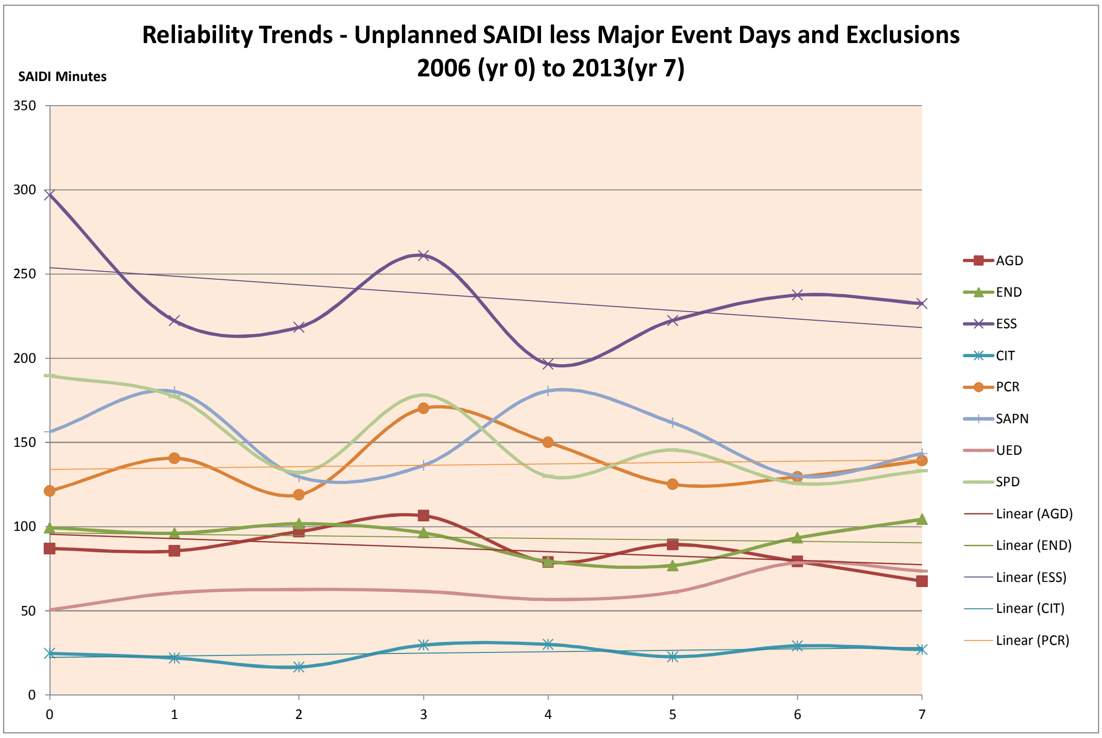

Figure 6-1 Reliability Trends – Annual Unplanned SAIDI 2006 to 2013
Source: Advisian Analysis of EB RIN

In order to determine a trend in reliability for each DNSP, a trend line has been used to calculate a starting point (Year 0 – 2006) and ending position (year 7 – 2013). The resultant change in SAIDI over the period is shown in Figure 6-2.

On this "integrated" SAIDI measure, Ausgrid, Endeavour and Essential have improved reliability over the period by 19%, 6% and 14% respectively whilst the reliability of Citipower and United Energy networks appear to have deteriorated significantly.

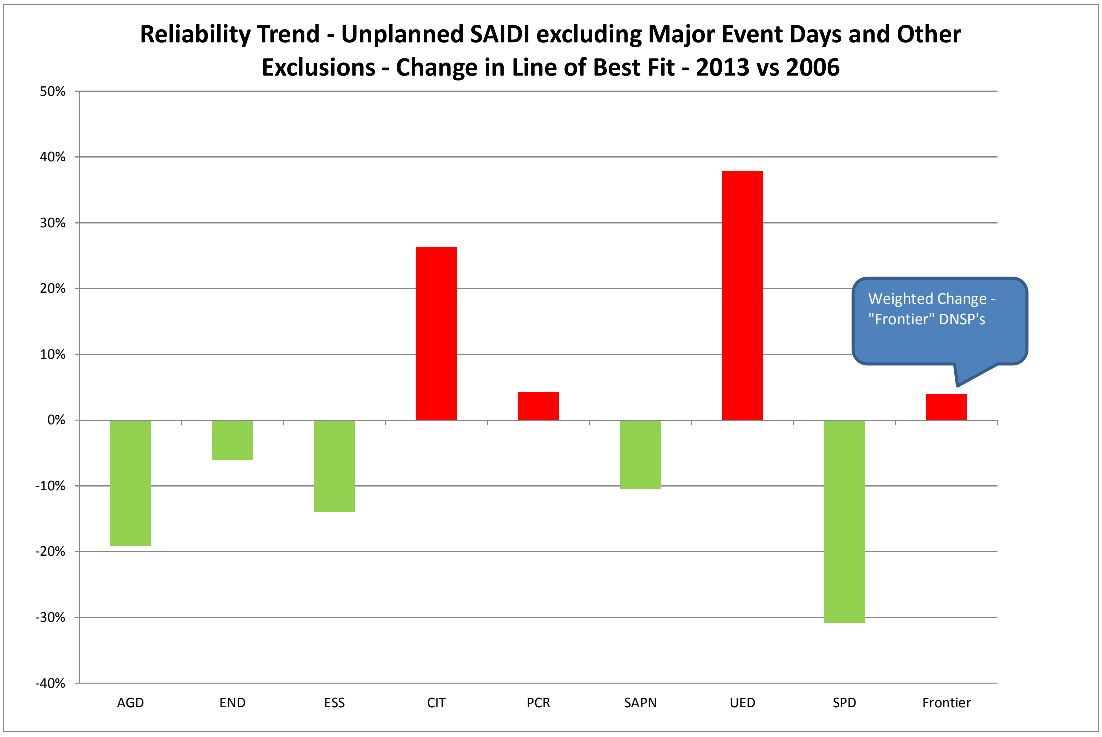

Figure 6-2 Reliability Trends – Change in Unplanned SAIDI 2006 to 2013
Source: Advisian Analysis of EB RIN

When the analysis is repeated for SAIFI, the results are inconsistent with the SAIDI measures above. Figure 6-3 shows that SAIFI has improved significantly for most of the 'frontier' companies whilst United Energy has remained stable.

In addition to the effectiveness of Opex programs such as vegetation and equipment maintenance, SAIFI can be positively impacted by replacement and augmentation Capex programs. Clearly, the vast majority of DNSPs have been effective in achieving SAIFI improvements.

However, performance on the CAIDI measure has not been so clear cut. The implied CAIDI (calculated by dividing SAIDI by SAIFI) is shown in Figure 6-4.

CAIDI appears to have deteriorated significantly for the majority of efficient frontier DNSPs whilst Ausnet Services has achieved slight improvements in response times. In Advisian's view, deteriorating CAIDI is more likely to be Opex related than Capex related as deterioration of CAIDI performance typically reflects under resourcing to respond to outages and other factors such as rationalisation of depots resulting in longer response times. Whereas all of the NSW DNSPs and a number of the 'frontier' DNSPs have been able to achieve a SAIFI / CAIDI trade off to maintain or improve SAIDI, Citipower and United Energy do not, on the basis of the data presented, yet appear to have achieved this balance.

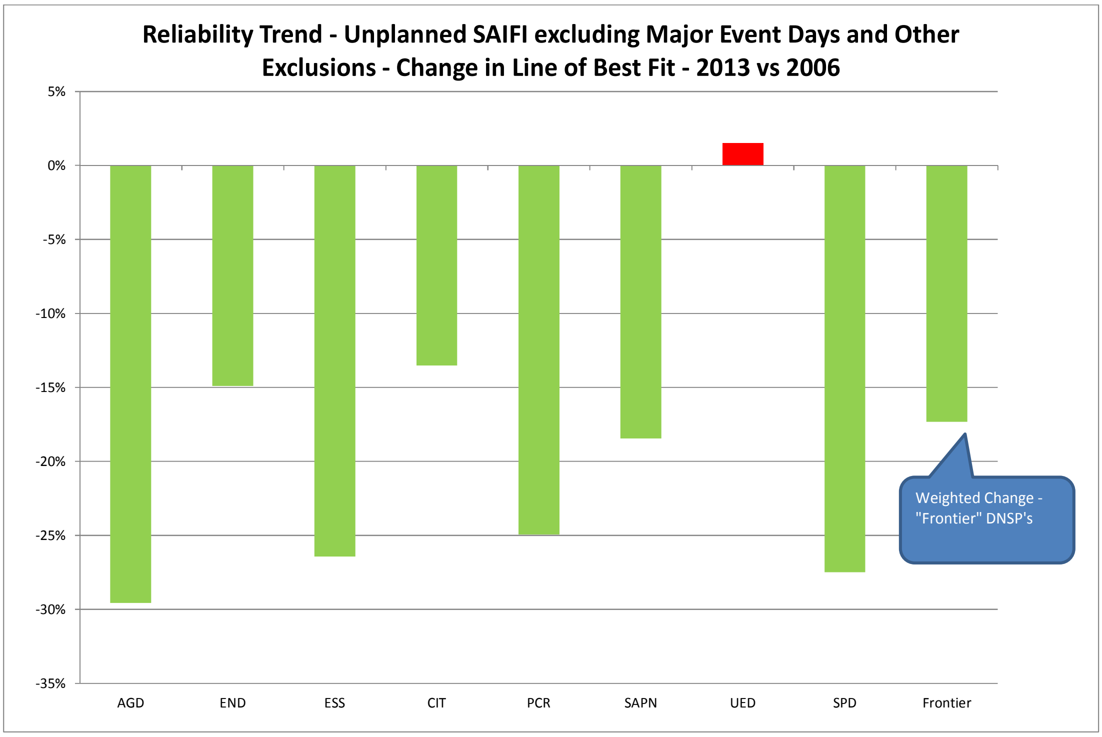

Figure 6-3 Reliability Trends – Change in Unplanned SAIFI 2006 to 2013
Source: Advisian Analysis of EB RIN

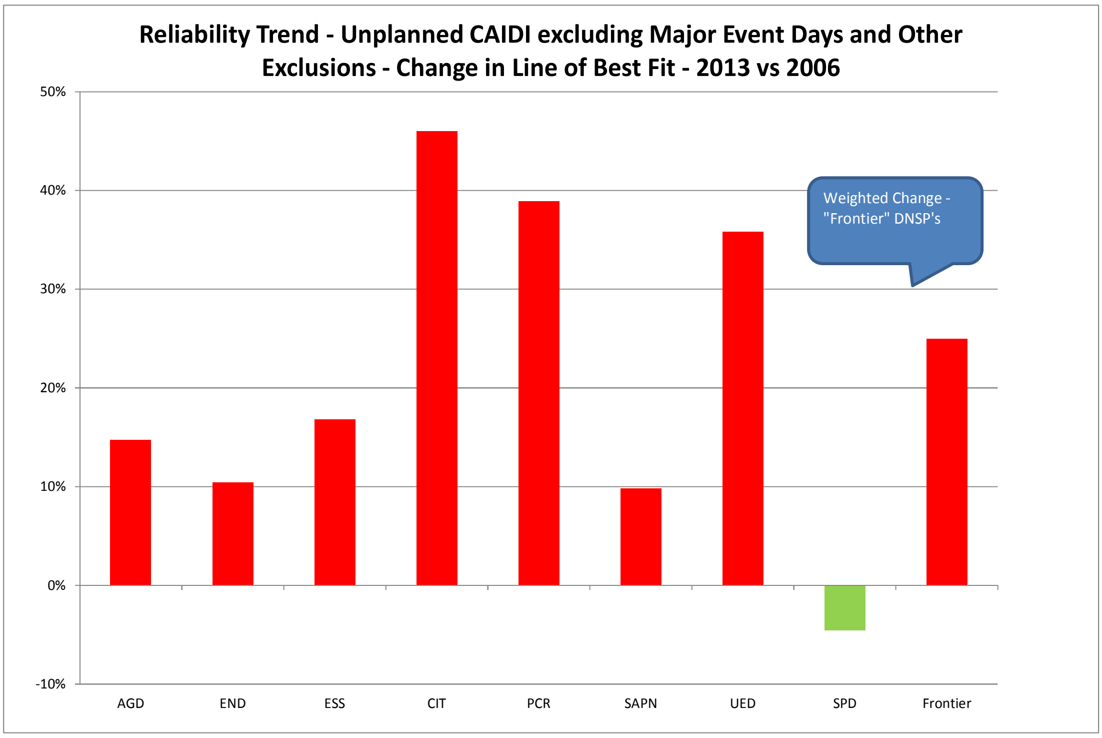

Figure 6-4 Reliability Trends – Change in Unplanned CAIDI 2006 to 2013
Source: Advisian Analysis of EB RIN

6.2 Conclusion - Reliability

In Advisian's opinion three conclusions can be drawn as follows:

- Firstly, that the "ceteris paribus" assumption of constant reliability implicit in the benchmark model does not hold, and some adjustment is necessary to reflect changes in reliability, an issue not dealt with at all in the preferred SFA model.
- Secondly, the Economic Insights reliance on analysis period averages for its benchmarking models means that the effect of declining reliability performance on opex over the analysis period is not captured in its models (which by implication assumes that opex is driven by absolute SAIDI). In practice the relationship between opex and reliability is driven by a combination of the absolute level that has historically been achieved, the specific network environment and the change in SAIDI over the analysis period.
- Thirdly, the trade-off between SAIFI and CAIDI to achieve a SAIDI target highlights that reliability can be achieved by a combination of Opex and Capex programs. No attempt has been made in the AER's benchmarking to "normalise" the approaches taken by DNSPs in this regard. This gives rise to the potential for what otherwise may be a sensible and efficient Opex / Capex trade off being judged as an Opex efficiency / inefficiency.

In Advisian's opinion, this further highlights the inadequacy of the analysis that has been completed in the context of its application to Opex reductions of the magnitude proposed, whilst still ensuring that the NSW DNSPs are able to operate a safe and reliable network.

7 Vegetation Management

A key plank of the AER's approach to validate the findings of the Economic Insight's benchmarking report has been to analyse data from the Category Analysis / Benchmarking RIN's in detail. Vegetation Management is one of these areas. Understanding the AER's analysis in relation to the NSW DNSPs is, to say the least, "challenging".

In Section A.1 "AER findings and estimates of efficient base year Opex" of Attachment 7 of the Draft Decision relating to Essential Energy, the AER included a subsection "Vegetation management – Essential Energy". This section concluded:

> *We are satisfied, on the basis of our detailed review, that vegetation management practices contributed to Essential Energy's high Opex in the 2012 -13 base year. This level of expenditure is unlikely to be representative of the efficient and prudent base Opex in future years. We discuss our vegetation management review findings in detail in Section A.4.3.*

Confusingly, "Essential's" clauses are included in the equivalent sections of the Ausgrid and Endeavour Energy draft determination documents, both in the introduction and in the detailed analysis in Section A.4.3 of each document.

7.1 Review of AER Assessment

Advisian has therefore focused its analysis on the AER's assessment of Essential Energy's Vegetation Practices. The AER's primary evaluation has been based on examining vegetation management (spend) per km of overhead route length. Their rationale for this was:

> *"We chose vegetation management per km of overhead route length because the length of overhead lines is more likely to drive vegetation management costs than customer numbers. We used overhead route line length[116] rather than maintenance span or circuit length.*
>
> *Ideally, we would use maintenance span length. Maintenance span length measures the length of service provider's power lines that have undergone vegetation management in the preceding 12 months. However, service provider's estimation assumptions seem to influence the data on maintenance spans. For some service providers maintenance spans are only a small part of overhead line route, while for others they make up the vast majority of the overhead line length. Therefore, we consider overhead route line length is a better measure of the area of network that requires vegetation management."[117]*

Advisian is concerned that the AER's rejection of the vegetation information provided by the DNSPs in favour of Overhead (OH) route length fails to recognise that the primary driver of vegetation management expense is in fact, vegetation. This is because the proportion of overhead route length will vary considerably depending on whether a distribution line is crossing an open field/urban area (very few vegetation management spans) or through a 'leafy' suburban environment or national park

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[116] Advisian notes that the AER's calculation of overhead route length is incorrect.

[117] AER, *Draft Decision Essential Energy Distribution Determination 2014-19 – Attachment 7: Operating Expenditure*, November 2014, p. 7-84

(majority vegetation management spans). The use of overhead route length as a proxy for the volume of vegetation management requirements fails to recognise that the nature of the prevailing vegetation varies considerably between Australian DNSPs. The AER has qualitatively recognised this, as evidenced by Figure 7-1 taken from the Draft Decision, but failed to quantify its impact. Whilst Advisian shares the AER's concern over the consistency of the Vegetation Span[118] data in the Benchmarking RIN's, we note that it is not logical to simply ignore it in a detailed assessment of vegetation management costs.

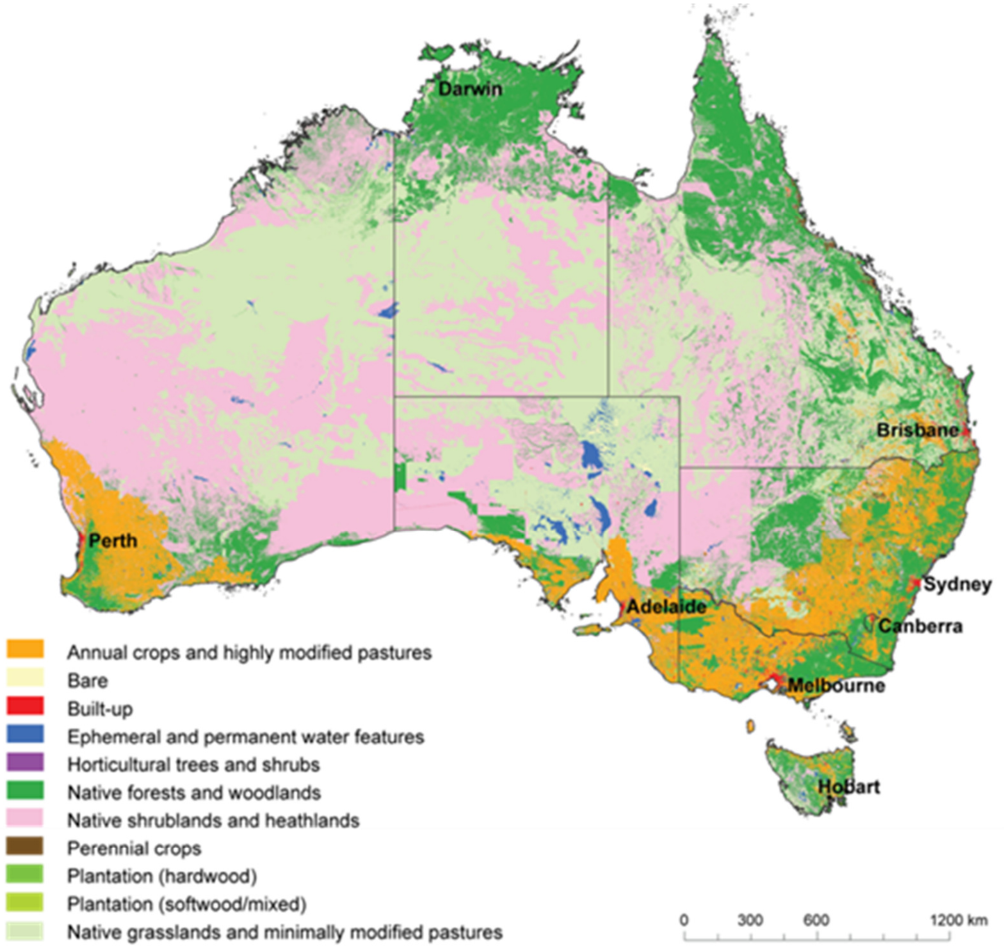

Figure 7-1 Australian Vegetation

Source: *Essential Draft Decision Attachment 7 – Figure A-27 Extent of all forms of vegetation across Australia, 2009*

Figure 7-3 shows the vegetation spans as a percentage of total spans from the 'Operating Environment' tab of the economic benchmarking RINs. On inspection of the initial data, Advisian had concerns with some data points (specifically Endeavour, Citipower and TasNetworks).

[118] A vegetation span is a span on a distribution line where vegetation must be maintained.

In association with this engagement, Advisian notes that Endeavour has revised their percentage down from 100% (which was clearly erroneous) to a figure of 61%, therefore we have used this figure for our analysis. TasNetworks and Energex reported only one year of Vegetation span data, whilst all others reported 3 or more years. Coastal distributors (ActewAGL[119], Ausgrid, Endeavour, Jemena, and Ausnet Services) all report values in excess of 50%. The two hybrid coastal / inland distributors Ergon and Essential are around 30%. Powercor and SA Power Networks, with service territories overlapping large areas of cropping and modified pasture report ratios of approximately 10%. Citipower and United Energy report low values, which appears to be consistent with their shared responsibility and inner urban service territory. The value for TasNetworks does not seem consistent with the vegetation map.

Notwithstanding these caveats, Advisian is of the view that the reported Vegetation Span to Total Span ratios are sufficiently robust to use to inform the analysis.

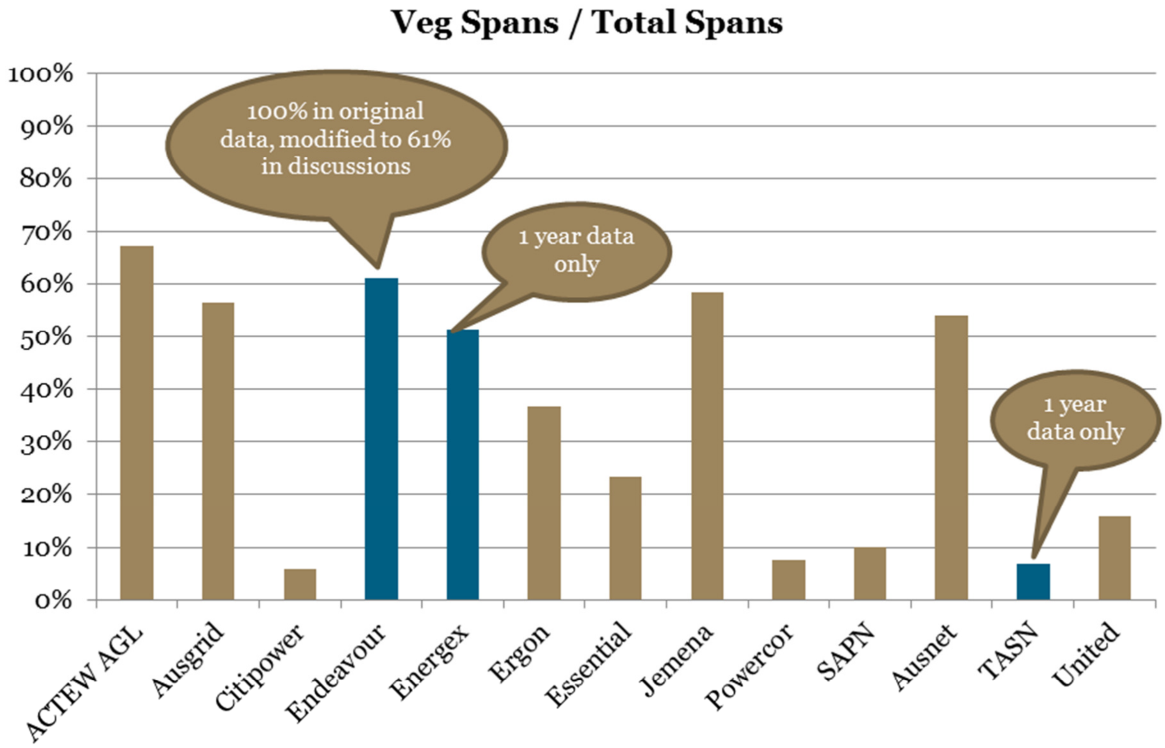

Figure 7-2 Ratio of Vegetation Spans to Total Spans
Source: *Advisian Analysis*

7.2 Differences in DNSP Responsibility

Advisian is also of the opinion that the AER has failed to recognise that the responsibility for vegetation management varies between DNSPs. Whereas NSW DNSPs are generally responsible for

[119] Advisian notes that whilst ActewAGL is not technically 'coastal', Figure 7-1 illustrates that the vegetation in its network is more comparable to the coastal areas for other DNSP's.

all vegetation management near power lines in the public domain, some adjustments are necessary in other jurisdictions. In particular, there are 2 relevant provisions in the Electricity Safety Act (Vic) 1998[120]. These are:

84C Requirement to keep trees clear of electric lines—Councils[121]

A Council responsible for the management of public land in an area of land declared under section 81 is responsible for the keeping of the whole or any part of a tree situated on that land clear of an electric line that is not a private electric line.

81 Declared area in urban area[122]

(1) The Governor in Council, by Order published in the Government Gazette, may declare an area of land in an urban area for the purposes of this Part.

S. 81(2) amended by No. 39/2005 s. 48(Sch. 1 item 2).

(2) An Order under subsection (1) must contain a description sufficient to identify the land concerned which may include a description by reference to a map held by Energy Safe Victoria

Evidence from the Victorian Royal Bushfire Commission[123] shows that almost 90% of local councils in Victoria have some responsibility for the vegetation management of power lines. Although the line length in some rural areas that councils are responsible for may be small, the proportion of line length under control of the councils is considered material to the benchmarking undertaken by the AER, particularly for the more urban DNSPs.

From our review of the AER's Draft Decision, the Annual Benchmarking Report and the Economic Insights report, it is not apparent how these Victorian factors have been taken into account in either the benchmarking, or the Category Analysis that the AER has presented.

7.3 Analytical Inconsistencies

In addition to dismissing the above data and policy matters, Advisian is of the opinion that some numerical deficiencies exist in the analysis. In determining overhead route length for comparison purposes, the AER calculated overhead route length by deducting underground circuit length from total route length on a 1 for 1 basis. The balance was then used as the overhead route length. This is numerically incorrect as underground circuits often share the same route.

Given that there are significant variations between DNSPs in the ratio of circuit km to route km (in the range 1.03 to 1.72) Advisian is of the view that the AER's approach has the potential to materially distort the results. Advisian's preferred approach, in the absence of other information, is to apportion route kilometres in direct proportion to circuit kilometres. In summary:

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[120] *Electricity Safety Act 1998*

[121] *Ibid p75*

[122] *Ibid p63-64*

[123] *http://www.royalcommission.vic.gov.au/getdoc/971e090c-3a46-4618-91df-519a884233d0/RESP.4000.012.0001.pdf*

- **'Vegetation Circuit km'** is calculated by multiplying overhead circuit length by the ratio of vegetation spans to total spans to calculate 'Vegetation Circuit km')
- '**Vegetation Route km'** is calculated by apportioning route length by the ratio of overhead to underground (assumes the same circuits / route for each) and multiplying overhead route length by the ratio of vegetation spans to total spans to calculate 'Vegetation Route km')

To illustrate the impact of these adjustments, Advisian notes that the AER's assessment of the relative efficiency of vegetation spend is based largely on Figure 7-3 below, which shows vegetation spend per circuit km over the five year period.

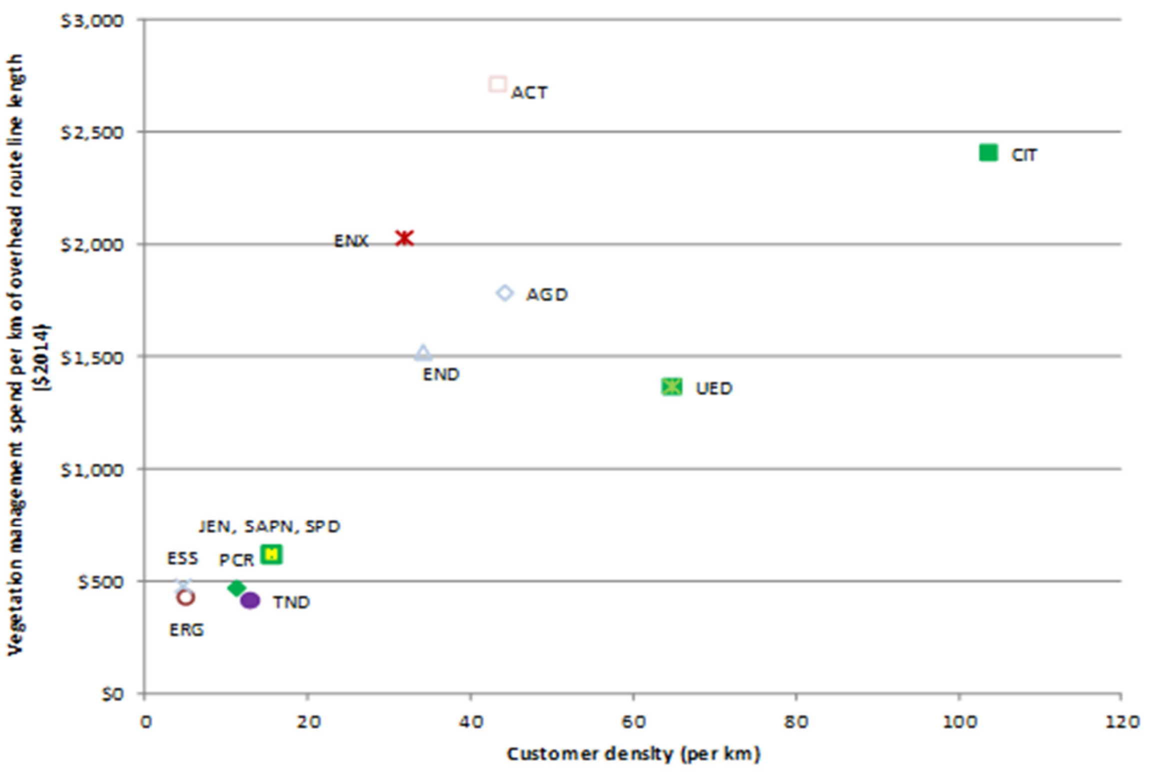

Figure 7-3 AER assessment of vegetation spend per overhead circuit km
Source: AER[124]

7.4 Corrected Analysis

If the data relating to Vegetation Spans is included, the resultant average annual spend per Vegetation Circuit km is shown in Figure 7-4 and Figure 7-5. (Figure 7-5 is a repeat of Figure 7-4with a truncated axis).

[124] Essential Draft Decision Attachment 7 Figure A-18

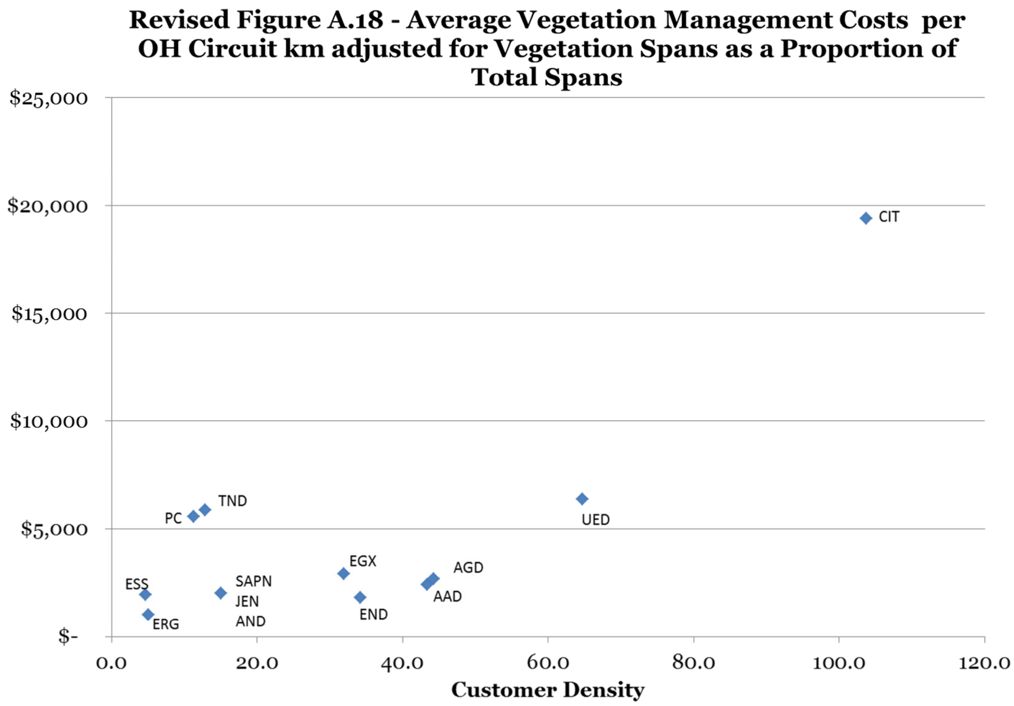

Figure 7-4 Average Vegetation Management Costs per OH Vegetation Circuit km
Source: Advisian Analysis

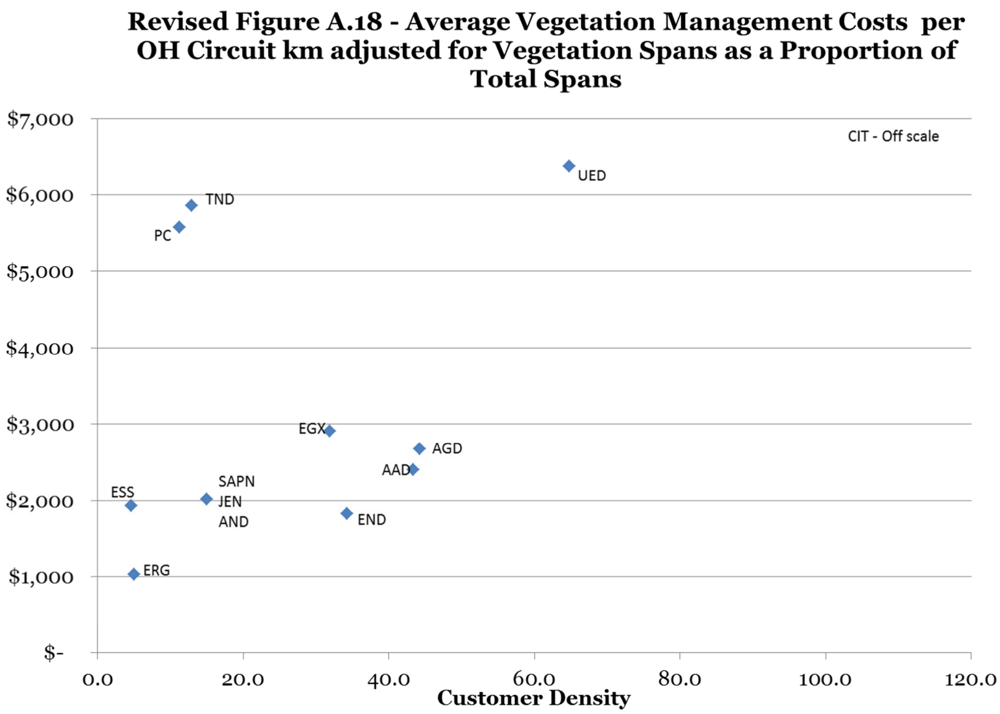

Figure 7-5 Average Vegetation Management Costs per OH Vegetation Circuit km (truncated axis)
Source: Advisian Analysis

In order to test the impact of "route km" as a base measure against "circuit km", Advisian has repeated the analysis on a route km basis. The results are shown in Figure 7-6.

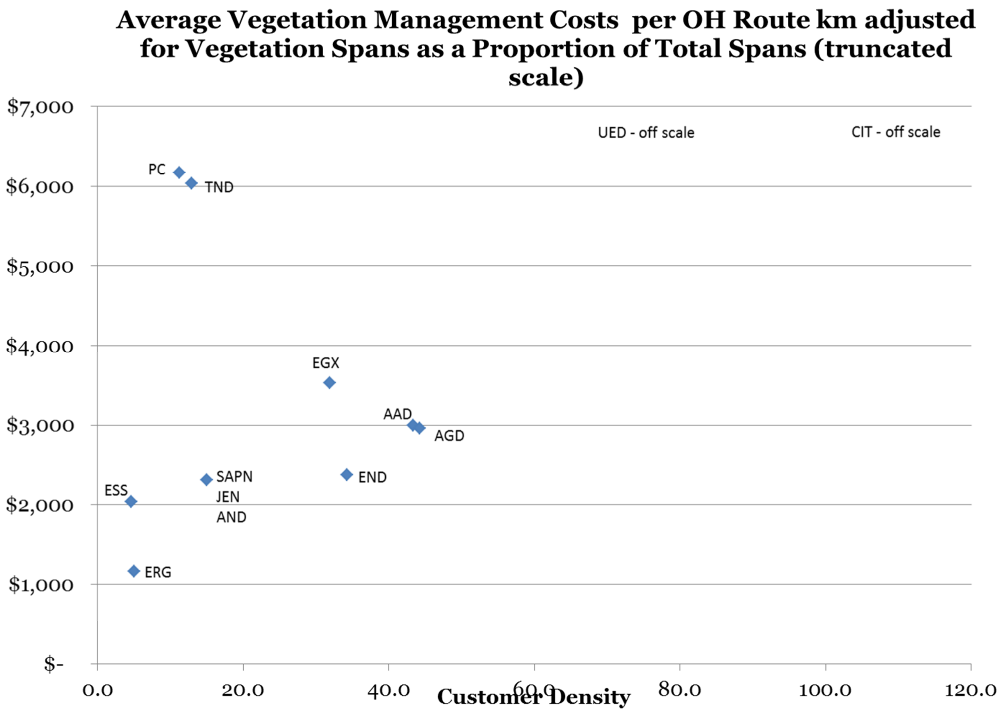

Figure 7-6 Average Vegetation Management Costs per OH Vegetation Route km (truncated axis)
Source: Advisian Analysis

Notwithstanding the reporting issues outlined above in relation to Endeavour Energy and Ausgrid (duplication of Essential Analysis), the AER in Table A-13 of the Attachment 7 to the Essential Energy Draft Decision "*Summary of category analysis metrics – NSW service providers relative costs (average over 2008-09 to 2012-13)* assigned the following Vegetation management rankings:

- Ausgrid – High
- Endeavour – High
- Essential – Very High

Whereas Figure 7-3 (Figure A-18 of the AER's report) logically leads to this conclusion for Ausgrid and Endeavour, it is far from conclusive from Figure 7-4/Figure 7-5. Given the variability in rainfall and vegetation, Advisian is of the view that there is a remarkable clustering of results. Advisian's conclusion is that the AER's generalised position that the analysis of vegetation spend supports the wider Economic Insights benchmarking model findings in relation to the efficiency of Ausgrid and Endeavour is flawed. At the very least, further checking of the reliability of data needs to be completed given that the two urban networks used in the benchmarking (Citipower and United) appear to be giving extraneous results and Powercor showing a significantly higher cost.

7.5 Basis for AER Conclusions

Notwithstanding Figure 7-3 (AER Figure A.18) that casts Essential Energy's vegetation spend over the five years favourably against all peers, the AER has assigned a "very high" ranking on vegetation management spend to Essential Energy. The primary evidence cited in support of this is AER Figure A-23 in Attachment 7.

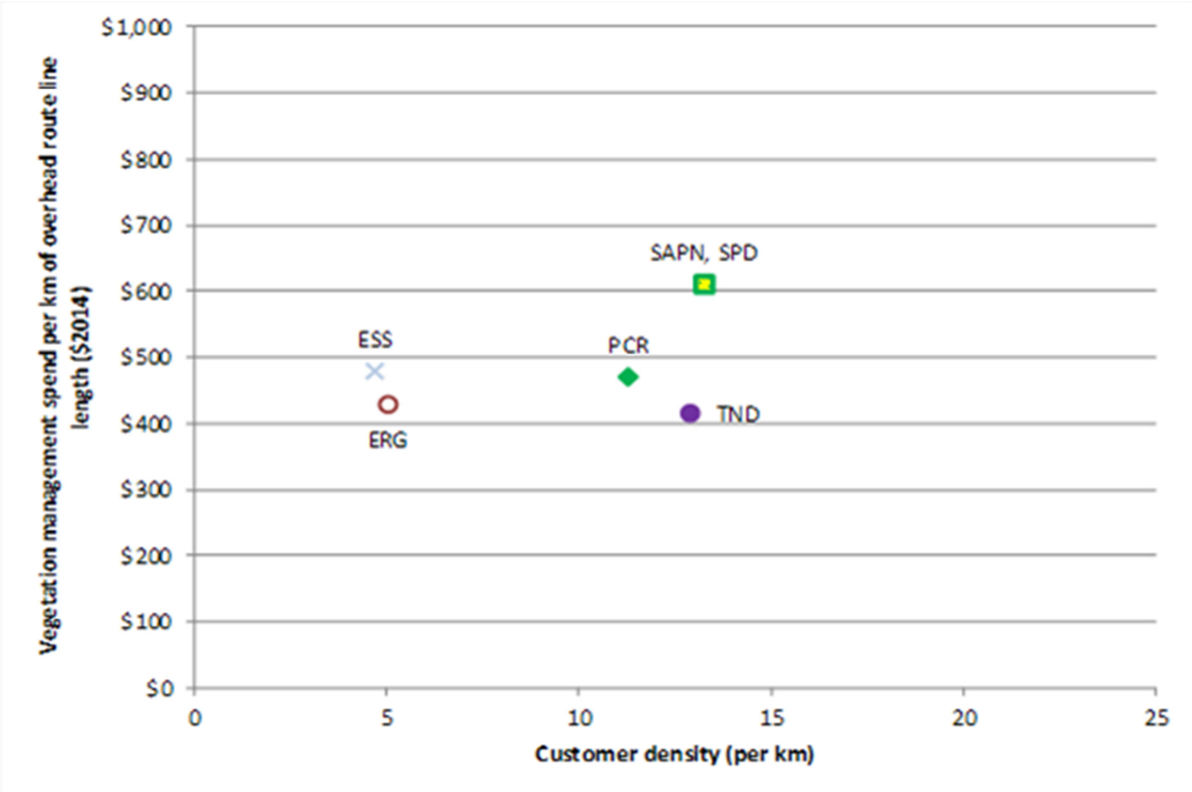

Figure 7-7 AER Assessment of Vegetation Spend per overhead route km.
Source: AER[125]

On the basis of this chart, the AER has concluded:

> *"Essential Energy appears unfavourably compared to Ergon Energy (its closest comparator) and TasNetworks, but is only marginally costlier than Powercor. Essential Energy also appears favourably compared to a combined (for confidentiality reasons) SA Power Networks, JEN and Ausnet services. However, given Essential Energy's substantially longer line length, we would expect the cost per kilometre of line length to be lower than all of these service providers."*

In this statement, the AER has moved from density based "customer / km" type benchmarking to suggesting economies of scale based on line length alone. In the context of a range of exogenous variables such as vegetation types, densities and rainfall, Advisian is not of the view that this conclusion is adequately supported by rigorous and objective analysis.

The AER has further "pursued" Essential Energy's vegetation expenditure "efficiency" by considering only the year 2012/13. This is shown in Figure 7-3, a repeat of the AER's Figure A-24 from Attachment 7.

[125] Essential Draft Decision Attachment 7 Figure A-23 Average vegetation management costs per overhead route line length for 2009-09 to 2012-13 per customer density for rural service providers ($ 2013-14)

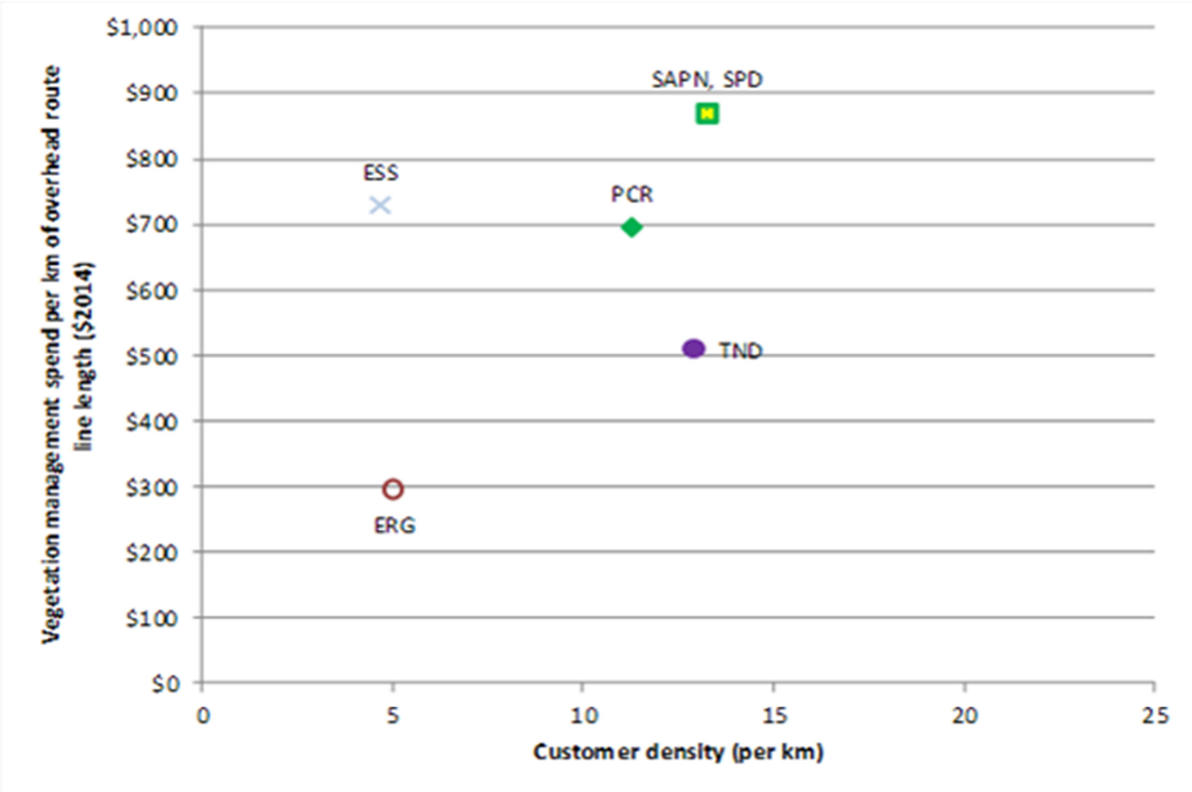

Figure 7-8 Vegetation management costs per overhead route line length for 2012–13 per customer density for rural service providers ($ 2013–14)AER assessment of vegetation spend per overhead circuit k m

Source: Essential Draft Decision Attachment 7 Figure A-24

Advisian does not believe that it is appropriate to conduct "single year" analysis in relation to vegetation management. The dangers in this are highlighted by a number of quotes from Ergon Energy's 2012-13 to 2016-17 Network Management Plan, which was written at the commencement of the 2012/13 financial year. Ergon Energy noted:

> *"Ergon Energy's vegetation management program is showing positive signs of reaching maturity, with the program becoming more stable and predictable ….*
>
> *…From September 2008 to June 2010, a revised operational strategy focused on the highest priority vegetation to mitigate safety risks that existed across the network and to maintain compliance with legislative requirements. This required change to the Vegetation Clearance Profile Standard to reduce unit costs and increase speed of treatment to ensure all parts of the network was treated as soon as possible within the constraints of budgets available at the time.*
>
> *In October 2009, it was estimated that a rural backlog over approximately 58,000 km (300,000 spans) needed to be addressed at an estimated cost of approximately $67 million*

An increased level of rainfall and favourable seasonal conditions since early 2010 has resulted in increased vegetation growth rates and vegetation density across most parts of the state." [126]

Advisian is not in a position to form an opinion on the impact that these situations may have had on Ergon Energy's spend or factors such as the reported vegetation span to total span ratio. The comments highlight the need to take a long term view of vegetation spend, and in our opinion, the AER's "single year" analysis is of little or no value in drawing generalised conclusions relating to Essential Energy. Certainly, it is an extraordinarily long bow to suggest that this analysis robustly validates Economic Insights SFA model, as implied by the AER.

7.6 Reliability Impact of Vegetation Outages

As a further step. the AER analysed the number of Vegetation related outages over the five year period. The AER notes[127]:

In addition, if we examine Essential Energy's performance data on sustained interruptions to supply due to vegetation, it shows that despite the increased expenditure, performance deteriorated markedly in 2012-13. Figure A-21 shows that the number of vegetation-related interruptions to supply more than doubled in this year from the previous four year average of approximately 820 interruptions.

Advisian concurs with the AER's conclusion on the basis that it is numerically correct. However, the industry accepted measures of reliability are SAIDI and SAIFI, not a simple count of events, and the impact of "Major Event Days" should be taken into account, consistent with the AER's approaches to schemes such as STPIS.

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[126] *Ergon Energy Network Management Plan, **Part A:** Electricity Supply for Regional Queensland 2012/13 to 2016/17 p44*

[127] *Attachment 7 p.7-92*

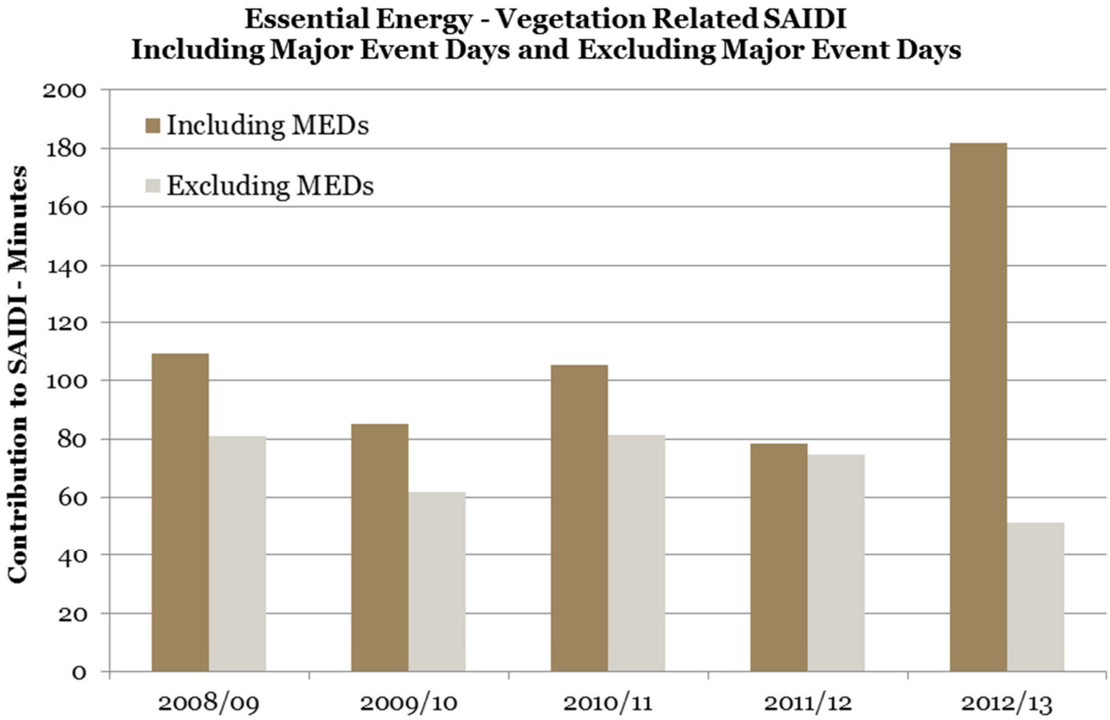

Figure 7-9 Essential Energy Vegetation Related SAIDI
Source: Advisian analysis

The SAIDI and SAIFI measures used to assess the underlying reliability of the networks generally exclude the impact of Major Event Days. Therefore it is not clear to Advisian why the AER has not used this framework, particularly since the relevant data has been collected in the Category Analysis RIN. Figure 7-9 charts Essential Energy's Vegetation Related SAIDI over the period 2008/09 to 2012/13. SAIFI over the same period is charted Figure 7-10.

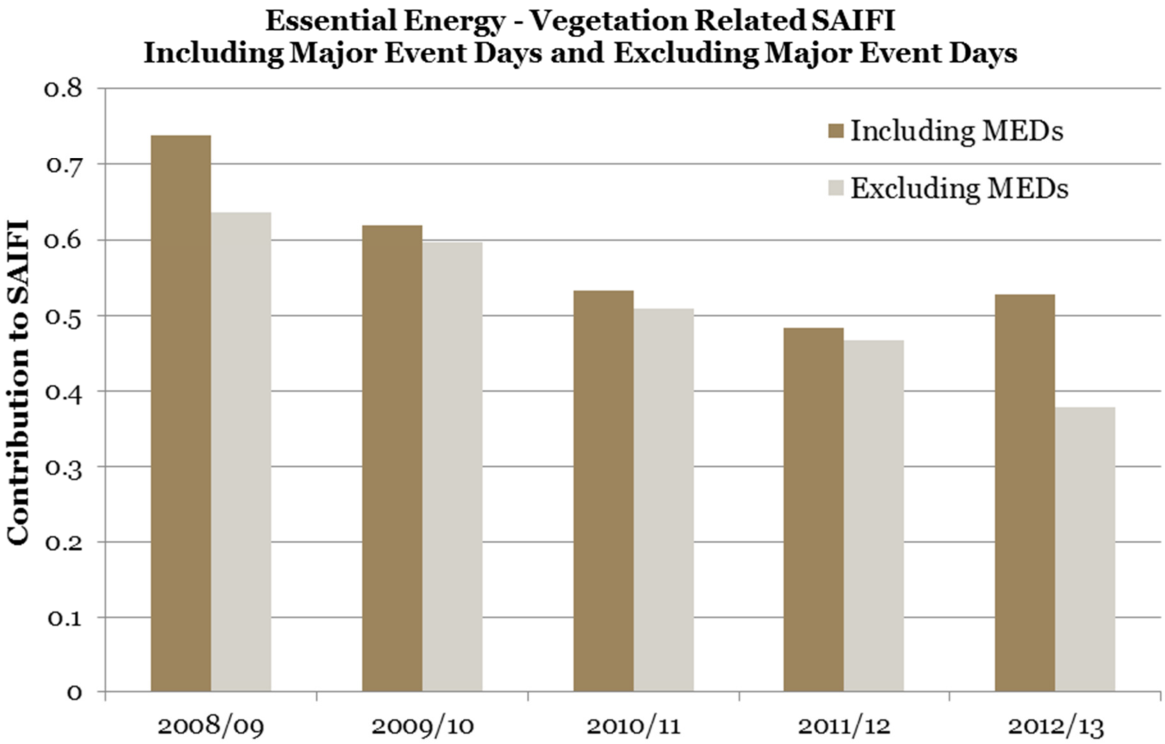

Figure 7-10 Essential Energy Vegetation Related SAIFI

Source: Advisian analysis

Both Figure 7-9 and Figure 7-10 show that in 2012/13, Major Event Days have a significant impact on both SAIDI and SAIFI. If these are excluded (and Essential Energy's reliability is measured on the basis of the parameters that are universally used in the industry) vegetation related outages are actually declining, contrary to the measure used by the AER.

Therefore Advisian is of the opinion that the AER's concluding paragraph in relation to Essential Energy's vegetation management is a questionable representation of fact:

> *"Regardless, Essential Energy's vegetation management absolute expenditure is significantly higher than all of its NEM peers, including its closest comparator. Further, its performance has deteriorated for vegetation and weather events, and overall."* [128]

In relation to "absolute expenditure" Advisian notes that Essential Energy has the longest network by some 28%, with Ergon Energy second. Therefore it is certainly not unreasonable that Essential Energy should have the highest "absolute" expenditure. Using the industry standard benchmarks for reliability SAIDI and SAIFI, Essential's performance for vegetation related events has also not deteriorated.

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[128] *Attachment 7 p7-140*

7.7 Conclusion – Vegetation Management

In Advisian's opinion, the AER's apparent pursuit of an outcome through a flawed analysis of vegetation management is highly concerning. The AER's Category Analysis exercise started out as a method of verifying the results of an international benchmarking exercise across 8 years and 3 countries. In this instance, Advisian is concerned that the analysis has been cherry picked down to comparing Essential Energy with one (otherwise 'non efficient') DNSP over one year.

This conclusion is particularly relevant given the failure of the AER to incorporate any measure of vegetation density in their modelling. To be fair to the AER, we acknowledge that our own analysis, which incorporates vegetation span analysis, shows that, while Essential Energy outperforms all others, there is a significant gap between Essential Energy and Ergon Energy. Indeed, Ergon Energy has reported a cost that is about ½ that of the closest DNSP, which happens to be Essential Energy. In the absence of detailed analysis, which is beyond the scope of this report, Advisian believes it prudent to assume that some exogenous factors or data deficiencies may be influencing this result. In our opinion Ergon Energy should, at this stage, be treated as an outlier.

On this basis, Advisian is of the view that the Vegetation Management related category analysis completed by the AER is of poor quality and the conclusions are not robust. As a result, Advisian does not agree with the AER's general conclusion that the benchmarking model's results in relation to the NSW DNSPs are validated by the vegetation management analysis, as Advisian considers this analysis to be flawed.

8 Asset Age Profiles

In considering "operating factors" that may impact DNSPs benchmarking performance, the AER has concluded:

> *We are satisfied that it is not necessary to provide an operating environment factor for differences in asset age between the NSW service providers and the comparison service providers. It raises operating environment criterion two. The age profiles of the NSW service providers and the comparison service providers are similar, and therefore should not lead to material differences in their Opex.*

The basis for this "satisfaction" is their calculation of Weighted Average Remaining Life (WARL), as shown in Figure 8-1

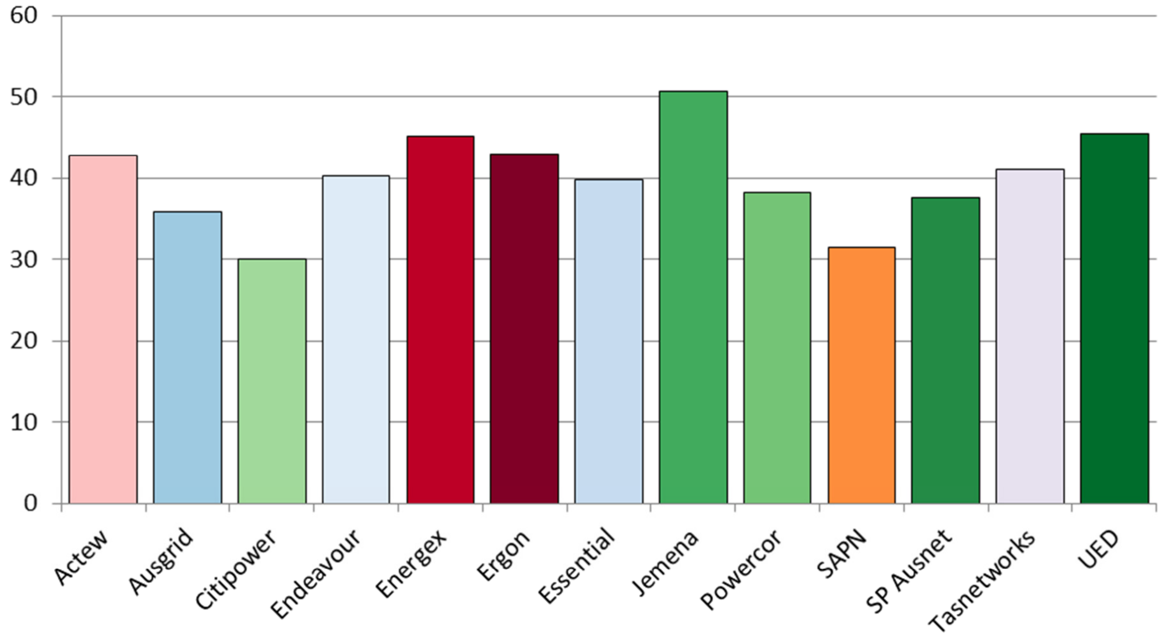

Figure 8-1 Weighted Average Remaining Life (WARL)
Source: DNSP CA RIN Information

8.1 Use of Financial Measures

In contrast to these findings, the AER makes the comment in relation to replacement Capex for each of the NSW DNSPs that:

> *"Ausgrid* [Endeavour/Essential] *has a relatively young network compared to its peers and much lower asset utilisation"*[129]

[129] AER, *Draft Decision Ausgrid* [Endeavour/Essential] *distribution determination 2015-16 to 2018-19 Overview* , p.26

This does not appear to be consistent with the AER's own calculations shown in Figure 8-1 and highlights the problem with relying on the DNSPs financial information to form a view on efficient expenditure requirements. Advisian notes that the RIN information provided by the DNSPs shows that there are a large range of 'standard lives' that are used for similar asset types. Therefore, DNSPs that report longer standard lives for depreciation purposes will typically appear to have a longer remaining life (younger network) than DNSPs that depreciate the same assets over a much shorter period. For this reason, Advisian is of the view that the AER's reliance on a WARL comparison of remaining lives for the purpose of determining replacement Capex allowances is fundamentally flawed as it is unduly influenced by accounting assumptions (depreciation lives that vary significantly between DNSPs) rather than economic factors.

Consequently the AER's assertion that the Networks NSW DNSPs assets are relatively 'young' is mainly reflective of the longer standard lives adopted for the most material asset classes in the RAB. Our analysis below is based on the reported asset age (rather than depreciation life), which shows the extent to which the AER's reliance on WARL as a measure of network age is misleading.

It is Advisian's understanding that WARL is essentially a financial calculation based on asset values in the Regulatory Asset Base. Advisian has two concerns:

- Firstly, in a time of real cost inflation such as occurred prior to the 2009 Global Financial Crisis, the RAB is biased toward younger assets;
- Secondly, it is not clear how the methodology treats assets that have ages in excess of their economic service life (presumably these simply provide 'free service' from a WARL perspective).

8.2 Alternative Approach to Network Age

In order to provide an alternative view on this issue that is immune to the above issue, Advisian has analysed the Category Analysis RIN data in two ways. Firstly, we have looked at the quantity of assets in each of the following classes that have ages in excess of their stated "mean" economic life:

- Poles
- OH Conductors
- UG Cables
- Transformers
- Switchgear
- Services.

The results are shown in Figure 8-2[130]. Figure 8-2 provides an additive total for the 6 categories, meaning that if all assets were in excess of their stated life, the "score" would be 600%

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[130] *Advisian has found it necessary to insert a small number of missing mean economic life value due to null entries. The values used have been based on similar assets within each DNSP's CA RIN.*

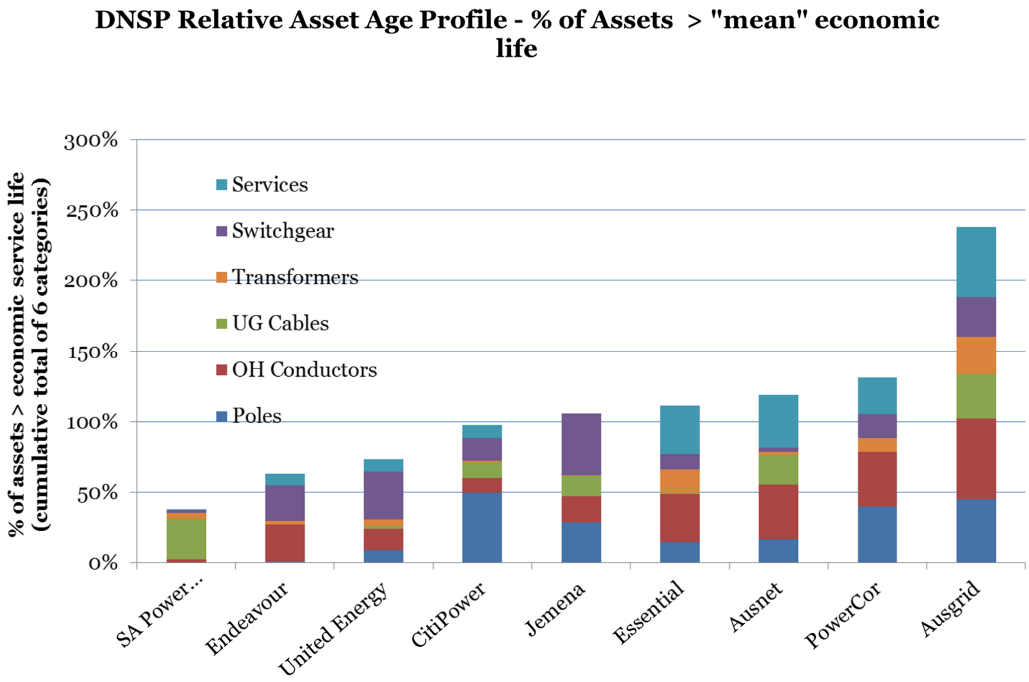

Figure 8-2 Relative Asset Ages – Proportion of Assets > Mean Economic Life[131]
Source: Advisian analysis of Category Analysis RINs Table 5.2

On this measure, even within the NSW DNSPs, Ausgrid is a "mature" network, Endeavour is a "young" network and Essential is "middle aged". Advisian would expect Opex to progressively increase as assets aged past their service life, until an Opex / Repex trade off resulted in replacement.

In making this assessment, Advisian is cognisant of the fact that DNSPs have provided significantly different "mean" economic lives for their assets. For example, SAPN provided a mean life of approximately 90 years for their "Stobie" poles. To this extent, the above graphic provides a distorted view of the age of the SAPN network.

In order to avoid issues pertaining to assumptions regarding economic life of assets, Advisian has calculated the proportion of assets that are more than 50 years old. In Advisian's opinion, significant asset holdings in this age bracket would be a leading indicator of a higher Opex requirement. This is presented in Figure 8-3

[131] *Advisian notes that the 'percentages' on the vertical axis of the graph are 'cumulative'. This means that if 70% of the poles are reported to be above their mean economic life and 50% of transformers are reported to be above their mean economic life, the 'cumulative' total will be 120%. This has been done to avoid the need to weight different asset classes to form a proportion of the total asset base (as this would require similar assumptions to be made about relative values of assets, weightings into classes and depreciation treatment that introduce bias to the AER's assessment)*

For the avoidance of any doubt, results above 100% do not indicate a figure above the total asset base.

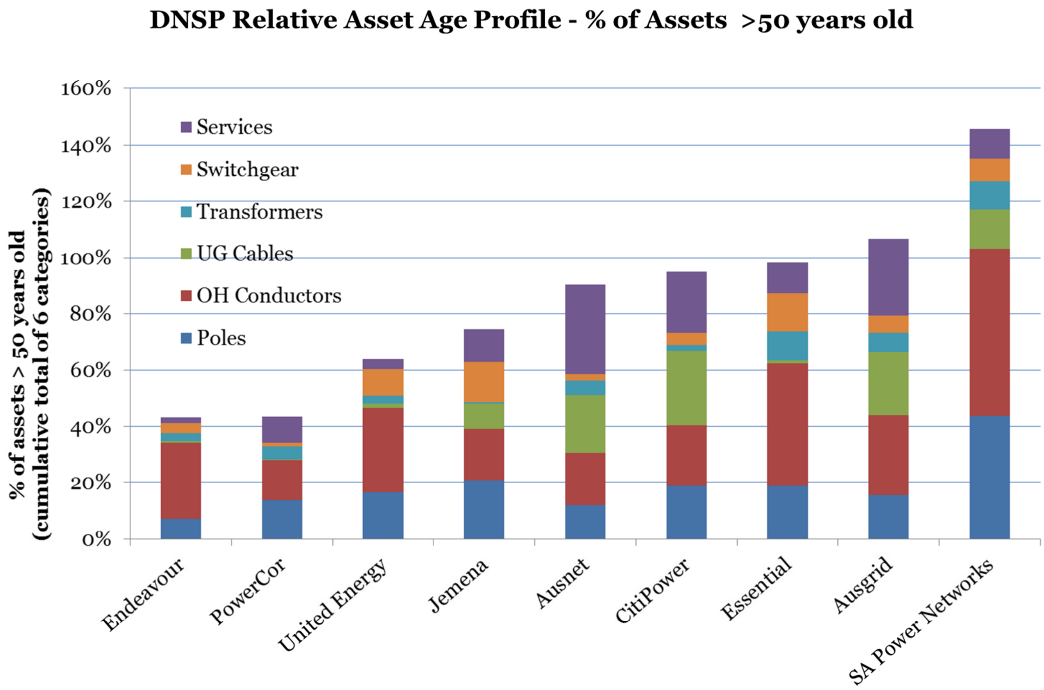

Figure 8-3 Relative Asset Ages – Proportion of Assets > 50 years old[132]
Source: Advisian analysis of Category Analysis RINs Table 5.2

In order to assess the impact that asset life assumptions are having on this analysis, Advisian has compared the ranking of each DNSP using the two methods reviewed above. The resultant rank, and the delta in the ranking between the two models is shown in Table 8-1

Table 8-1 Comparison of Asset Life Assumptions

	Ranking - > Mean Economic Life	Ranking - > 50 years	Delta Ranking
SA Power Networks	1	9	**8**
Endeavour	2	1	1
United Energy	3	4	1
Citipower	4	6	2
Jemena	5	4	1
Essential	6	7	1

[132] *Advisian notes that the 'percentages' on the vertical axis of the graph are 'cumulative'. This means that if 70% of the poles are reported to be above 50 years and 50% of transformers are reported to be above 50 years, the 'cumulative' total will be 120%. This has been done to avoid the need to weight different asset classes to form a proportion of the total asset base (as this would require similar assumptions to be made about relative values of assets, weightings into classes and depreciation treatment that introduce bias to the AER's assessment)*

For the avoidance of any doubt, results above 100% do not indicate a figure above the total asset base.

	Ranking - > Mean Economic Life	Ranking - > 50 years	Delta Ranking
Ausnet	7	5	2
Powercor	8	2	**6**
Ausgrid	9	8	1

Source: Advisian Analysis

Whereas most DNSPs have only moved one or two positions in their relative ranking, there has been a significant change with Powercor and SA Power Networks. As discussed above, the long life assigned to Stobie poles and associated lines skews the results between the two methodologies. Powercor on the other hand has a large number of poles and lines between their economic life (circa 40 years) and the 50 year threshold used in the alternative method.

8.3 Conclusion – Asset Age Profiles

Notwithstanding these anomalies identified, Advisian is of the opinion that the age profiles of the DNSPs differ, and the "ceteris paribus" assumption implicit in the benchmark modelling does not hold. On the basis of this analysis Advisian cannot concur with the AER's assertion that:

> *"The age profiles of the NSW service providers and the comparison service providers are similar, and therefore should not lead to material differences in their Opex".*

Therefore Advisian concludes that the AER's assessment of the relative 'age' of the NSW networks is fundamentally misleading when compared to reported asset age profiles contained in the RIN information provided by the businesses.

9 Conclusion

The AER's draft decision for the NSW DNSPs Opex is largely based on the analysis contained in the Economic Insights report and associated SFA CD model for Opex productivity benchmarking. Whilst benchmarking represents one of the operating expenditure factors, the overarching operating expenditure criteria and objectives must also be taken into account.

In our view, the AER's proposed adjustment to the NSW DNSPs forecast Opex does not satisfy the operating expenditure criteria insofar as it does not represent:

(c) *"the costs that a prudent operator would require to achieve the operating expenditure objectives"* [133]*;* or

(d) "*a realistic expectation of the demand forecast and cost inputs required to achieve the operating expenditure objectives*"[134]

Whilst the AER's proposed adjustment represents a lower cost, and apparently 'more efficient' forecast than the NSW DNSPs proposal, the first operating expenditure criterion is that the forecast Opex must reasonably reflect *"the efficient costs of achieving the operating expenditure objectives"*[135].

In our opinion, the AER's alternative forecast is insufficient for the NSW DNSPs to achieve the operating expenditure objectives over the 2014/15 to 2018/19 period as the underlying benchmarking approaches do not adequately take into account the fundamental differences between DNSPs and the basis for adopting the SFA CD results relies substantially on a flawed analysis of Essential Energy's vegetation management expenditure.

As the impact of these material factors are not reflected in the AER's alternative Opex forecast, the alternative forecast does not reflect the efficient costs of achieving the operating expenditure objectives for the NSW DNSPs.

Therefore Advisian concludes that the AER's benchmarking analysis, comparisons between businesses and selection of the notional efficiency 'frontier' is not a reasonable basis for an alternative Opex forecast without a fundamental engineering and commercial assessment of the components of the NSW DNSPs' forecast Opex or otherwise, the transparent normalisation for differences in reporting factors.

On this basis, Advisian recommends against the use of the AER's benchmarking analysis results as the basis for alternative Opex forecasts for the NSW DNSPs until such time as these factors can be transparently and robustly accounted for in the benchmarking methodology.

Instead, Advisian considers that any alternative forecast based on the Opex benchmarking approach should be considered informative and reconciled to the DNSP's revealed base year, either by employing the AERs historical approach or by demonstration that the specific DNSP business can be operated at the level of Opex determined by the AER. Should the Opex benchmarking approach be used to set total Opex in the AER's final decision, the inputs for other DNSPs must in any case be

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[133] *NER 6.5.6 (c) criterion 2*

[134] *NER 6.5.6 (c) criterion 3*

[135] *NER 6.5.6 (c) criterion 1*

normalised to be reported on a demonstrably consistent basis with each business' Opex, taking account of the impact of the issues identified by Advisian on both the NSW DNSPs under consideration and issues that are unique to the frontier DNSPs.

Advisian has considered the key issues that have not been taken into account in the AER's Opex benchmarking approach and concludes that:

1) the AER's benchmarking model is not suitable for determining efficient Opex as it has intentionally been specified to provide a relative measure of productivity which overlooks much of the volume of installed assets, which are a critical cost driver for DNSP Opex.

2) in relation to the Victorian and South Australian DNSPs, to whom the AER has made direct comparisons, the NSW DNSPs must each maintain substantially more assets per customer at a substantially lower unit cost per asset.

3) Correcting the model specification to account for installed transformer capacity in place of ratcheted maximum demand allows correction for a number of factors that better reflect the volume of assets that must be maintained, including material differences in the scope of network services that are provided by the frontier DNSPs. In the AER's model, this, and the impact of any other unidentified exogenous factors are misleadingly attributed to 'inefficiency'.

4) Correcting the circuit length parameter to take account of the lower Opex requirements for SWER line results in a 13% reduction in circuit length for the notional frontier business. In turn this accounts for a 1% reduction to the frontier using the AER's modelled elasticities. In the AER's model, this, and the impact of any other unidentified exogenous factors are misleadingly attributed to 'inefficiency'.

5) The assumption of constant reliability trends does not hold for Citipower or United Energy and correction should be made to account for the declining performance of these DNSPs over the analysis period.

6) There are a number of analytical inconsistencies and errors in relation to the AER's vegetation management approach that, once corrected, challenge the AER's basis for relying on the Economic Insights benchmarking results.

7) The AER's underlying assumption that the NSW DNSPs all have relatively 'young' networks is flawed as it is based on the calculation of a Weighted Average Remaining Life from the reported financial data. This is distorted by the substantially different 'standard life' assumptions used by DNSPs for similar assets. A comparison based on the Asset Age Profile information reveals that Ausgrid has the second highest proportion of 'old' assets (>50 yrs) in the NEM.

Advisian has made all the enquiries that Advisian believes are desirable and appropriate and that no matters of significance that Advisian regards as relevant have to Advisian's knowledge been withheld from the Court.

Appendix A

Terms of Reference

Advisian
WorleyParsons Group

ANNEXURE 1

SCOPE OF WORK, KEY PERSONNEL & SCHEDULE OF RATES

Client name: Ausgrid

Commencement Date: 10/12/2014

Description of Services:

Provide expert opinion on the engineering inputs and assumptions used in the AER and related consultants benchmarking report.

The Australian Energy Regulator (AER) released their Annual Benchmarking Report in November 2014, detailing the relative efficiency of the electricity distribution network service providers (DNSPs). This benchmarking report is a requirement of the National Electricity Rules, and also underpins the draft determinations for the Networks NSW businesses for the 2014-19 Regulatory Control Period.

In their report, the AER have used a number of network related inputs and assumptions in order to undertake analysis using two benchmarking techniques. The techniques used are multilateral total factor productivity (MTFP) and partial performance indicators (PPI). We contend that the factors that have been chosen as inputs to the analysis do not reflect the key cost drivers of the individual Networks NSW distribution networks. NNSW is seeking advice on the AER's use of these benchmarking techniques to examine the relative productivity of the electricity distribution networks the AER regulates.

Engineering expertise and relevant industry experience is required to review the data the AER uses in the benchmarking exercise and the reasonableness and impact of any assumptions made in the benchmarking exercise. This includes:

- Identification and quantification of the key cost drivers for each of the Ausgrid, Essential Energy and Endeavour Energy distribution networks;
- Reviewing whether these key cost drivers should be incorporated into a benchmarking exercise such as the one undertaken by the AER and, if so, how they should be incorporated;
- Where a relevant key cost driver has been incorporated into the AER's benchmarking exercise, reviewing whether it was appropriate to incorporate that particular cost driver and whether it has been appropriately incorporated;
- Where a relevant key cost driver has not been incorporated into the AER's benchmarking analysis, reviewing whether it was appropriate to exclude that particular cost driver, and quantifying the significance of any impact of the exclusion of such cost driverson the outcome of the analysis had it been included;
- Identify how these key cost drivers differ, if at all, in scope or significance for other DNSPs.

The following factors, together with any other factors you consider relevant, are to be taken into consideration:

- Regulatory & legislative requirements both legacy and current
- Legacy design issues
- Asset diversity – types and volumes
- Asset age and condition profiles
- Scale & complexity of the networks
- Network area & geography

Appendix B

Curriculum Vitae

Advisian

WorleyParsons Group

Bill Glyde

Principal

Overview

Bill has over 40 years' experience in electrical distribution, trading and generation. He has built on his early engineering experience to provide a bridge between the technical/ operational aspects and the commercial/customer service side of electrical supply. He has extensive experience in electricity pricing, forecasting, regulatory management, power purchasing, sales contracting and trading prior to joining Evans & Peck.

Bill has recently been joint lead consultant on reviews of the Northern Territory and Port Moresby Power Systems. These reviews have focused on providing a platform for significant reform of the systems going forward.

Since joining Evans & Peck, Bill acted as technical advisor to the Queensland Government's Independent Review of Electricity distribution and Service Delivery in the 21st Century. He was then retained by Government to oversee the implementation of the recommendations arising from that review, including formulation of policy and legislation relating to service standards, reliability and planning.

He has consulted extensively to the distribution and transmission sector in most Australian States, and much of this work has found its way into regulatory submissions. He has recently assisted Grid Australia in their response to the current Productivity Commission review of electricity issues.

Other consulting assignments have included the negotiation of transmission network support arrangements, including assistance with the application of the regulatory test applied under National Electricity Rules, negotiation of power purchase and connection arrangements relating to power projects, strategic advice on coal, gas and wind power station acquisition and development and ongoing reviews of reliability and planning standards.

Areas of Expertise

- Commercial Development
- Strategic Advice
- Commercial Due Diligence
- Forecasting
- Contract Negotiation
- Feasibility Analysis
- Regulatory Assistance
- Reliability Analysis
- Risk Analysis
- Project Management

Relevant Experience

Principal | Advisian | 2004 – Present

Development of Energy Sector Business

- Review of Northern Territory Power System including provision of independent forecasts
- Review of Port Moresby Power System
- Review of Western Power State of the Infrastructure report and Wood Pole performance
- Technical advisor to Independent Review of Qld's electricity distribution companies
- Strategic review – electricity network businesses
- Regulatory Assistance – Qld, SA, Tas, NSW, Vic, WA and NZ Network Revenue Reset
- Commercial due diligence – asset acquisitions.

General Manager, Manager, Business Development/Manager Trading | Enertrade | 2002 – 2004

- Structured deals including gas, network support and major electricity sale contracts
- Development of CSM/pipeline and base load power station in Townsville

Bill Glyde

Principal

- Management of Power Purchase Agreements relating to 2680 MW capacity.

Manager, Retail Markets/National Sales Manager │ NorthPower │ 1996 - 2000

- Contestable electricity Sales Strategy Development and Implementation in four states
- Franchise price formulation and implementation, including liaison with Independent Pricing and Regulatory Tribunal.

Manager, Energy Trading, Manager – Demand Management and Pricing/Engineer, Electricity Utilisation, Engineer, Pricing and Load Research │ Energy Australia │ 1983 – 1996

- Sales/demand forecasting including econometric modelling
- Pricing policy development and implementation, including rollout of TOU pricing
- Liaison with National Grid Management Council (NGMC), including membership of Market Trading Working Group (responsible for market design)
- Wholesale purchasing including initial vesting contracts, competitive contracts and power purchase agreements
- Load Research, including first end use local survey of residential energy consumption
- Demand management policy formulation and implementation
- Load research including commercial load analysis product
- Performed economic modelling and forecasting role.

Qualifications & Affiliations

- Bachelor of Engineering (Electrical) with Honours - NSW Institute of Technology
- Master of Commerce - University of NSW
- Master of Engineering Science (Partial Completion)
- Graduate - Australian Institute of Company Directors

Work History

2004 – Current	Principal, Advisian (formerly Evans & Peck), Brisbane
2002 – 2004	General Manager, Manager, Business Development/Manager Trading, Enertrade
1996 - 2000	Manager, Retail Markets/National Sales Manager, NorthPower
1983 – 1996	Manager, Energy Trading, Manager – Demand Management and Pricing/Engineer, Electricity Utilisation, Engineer, Pricing and Load Research, Energy Australia

Advisian
WorleyParsons Group

Evan Mudge

Associate

Overview

Evan has provided strategic consulting services to infrastructure clients across the Australia-Pacific region relating to major project investments, economic regulation, strategic asset management, risk management and project/capital governance frameworks.

With over 10 years of experience spanning over 25 Australian regulatory determinations, Evan has personally reviewed over $10b in capital expenditure on energy infrastructure and identified scope and cost efficiencies of over $2b. He has also assisted network businesses to prepare and optimise business cases for major ($100m+) and strategic infrastructure projects. His broad experience across project, contract and commercial management, engineering design, environmental approvals, pricing and economic regulation enables him to bring a unique combination of strategic thinking, commercial focus and pragmatism to his engagements.

Areas of Expertise

- Regulatory Advice
- Asset Strategy
- Cost Advisory
- Capital Program Review
- Risk Analysis
- Project Analysis & Evaluation
- Business Case Preparation
- Planning & Scheduling

Relevant Experience

Associate | Advisian | 2012 - Present

- Manage the preparation of TransGrid's response to the Economic Benchmarking and Revenue Reset Regulatory Information Notices that are required to support TransGrid's Revenue Proposal for the 2014/15 to 2018/19 period.
- Expert regulatory advice to regulated networks in NSW, Tasmania, Victoria, Queensland and ACT relating to cost estimation methodologies, replacement capex modelling, advanced metering infrastructure and regulatory submissions.
- Assessment of relative expenditure performance, asset intensity and the infrastructure burden placed on customers for each network serving the national electricity market.
- Explanation of the relative reliability performance trends of Australian electricity networks. Included comparison of different policy drivers and jurisdictional influences on reliability.
- Development of solar thermal commercialisation strategy and risk management plan for an Australian renewable energy technology developer.
- Development of contract management tools and performance incentive scheme for the primary coal haulage contract for a major coal-fired power station in NSW.

Consultant | Asset & Regulatory Strategy | Parsons Brinckerhoff | 2008 – 2012

- Evaluate capital investment in energy network assets including reviewing over $10b in forward expenditure portfolios for the Australian Energy Regulator, Economic Regulation Authority of WA and network businesses (including Jemena, ActewAGL, United Energy, CitiPower/Powercor and ETSA Utilities) across all states of Australia, New Zealand and the Pacific. Recommended investment program adjustments totalling over $2b.
- Expert regulatory advice to energy networks including an independent assessment of the AER's Repex model as part of the Victorian Electricity Distribution Price Review.
- Provide business case advice and analysis to support strategic initiatives such as Ausgrid's successful bid for the $100m Federal Smart Grid Smart City program funding, investigating the

optimal ownership model for electricity network communications assets in the NBN and providing an independent review of project costs for the largest transmission line project in WA ($300m).

- Due diligence evaluation of generation assets and associated contractual arrangements to support potential acquisition, including review of fuel supply arrangements for the NSW governments Gentrader divestment for a top tier energy generator-retailer.
- Advise Papua New Guinean Independent Public Business Corporation on a remedial strategy to address generation and transmission reliability issues affecting the economic development of the Lae, Madang and Highlands regions of the country.
- Energy (electricity, gas, carbon, network) procurement advice for major infrastructure operations such as Sydney Airport, Fremantle Ports, Sydney Metro Authority and major generation facilities.

Business Analyst and Commercial Manager │Gridx Power │ 2007 – 2008

- Provide technical and commercial analysis of innovative energy generation projects and communicating business/project risks and opportunities to executive management, client representatives, project finance partners and potential equity investors, including:
- Negotiate fuel pricing arrangements, power purchase agreements, capital contributions, tariffs, equipment procurement and financing arrangements for innovative cogeneration/trigeneration (heat/power/cooling) projects.
- Quantify the financial, carbon and energy efficiency benefits and development of business case to facilitate investment decision making for the business/finance partners and clients.
- Optimise plant operation and equipment sizing (electricity/thermal and export sales) for optimal commercial and risk management outcomes.
- Develop pricing and contract terms in conjunction with the client's consultants to facilitate acceptable trade-offs between technical efficiency and commercial viability.
- Monitor wholesale and retail gas and electricity markets to ensure tariffs, operating schedules and business model remained viable in increasingly volatile markets.
- Provide commercial input to regulatory matters, including changes to the National Electricity Rules.

Research Engineer │ Sustainable Energy │ Bassett Applied Research (AECOM)│ 2006 – 2007

Conducted industry leading analysis of energy and carbon efficient building design initiatives using advanced numerical modelling techniques. Also undertook complex acoustical and vibration analysis to facilitate environmental planning and assessment requirements for major infrastructure projects.

Qualifications & Affiliations

- Bachelor of Engineering (Hons), University of Technology Sydney
- Master of Applied Finance, Macquarie University

Work History

2012 - Present	Associate, Advisian (formerly Evans & Peck)
2008 - 2012	Consultant – Asset & Regulatory Strategy, Parsons Brinckerhoff
2007 - 2008	Business Analyst and Commercial Manager, Gridx Power
2006 – 2007	Research Engineer – Sustainable Energy, Bassett Applied Research (AECOM)
2004 - 2005	Mechanical Engineer, GHD Mining & Industry

Appendix C

List of Reference Documents

Below is a list of the reference documents referenced by Advisian in preparing this report. An electronic copy of these documents has been provided to Networks NSW.

1) AEMC, *Rule Determination – National Electricity Amendment (Economic Regulation of Network Service Providers) Rule 2012*, 29 November 2012

2) AER, Annual Benchmarking Report – Electricity Distribution Network Service Providers, November 2014

3) *AER, Benchmarking Fact Sheet*, November 2014

4) AER, Category Analysis Benchmarking Metrics for DNSP's, 19 August 2014

5) AER, *Draft Decision Ausgrid Distribution Determination 2014-19 – Attachment 7: Operating Expenditure*, November 2014

6) AER, *Draft Decision Ausgrid Distribution Determination 2015-16 to 2018-19 Overview*, November 2014

7) AER, *Draft Decision Ausgrid Distribution Determination - Fact Sheet,* November 2014

8) AER, *Draft Decision Endeavour Energy Distribution Determination 2014-19 - Attachment 7: Operating Expenditure*, November 2014

9) AER, *Draft Decision Endeavour Energy Distribution Determination 2015-16 to 2018-19 Overview*, November 2014

10) AER, *Draft Decision Endeavour Energy Distribution Determination - Fact Sheet*, November 2014

11) AER, *Draft Decision Essential Energy Distribution Determination 2015-16 to 2018-19 - Attachment 7: Operating Expenditure*, November 2014

12) AER, *Draft Decision Essential Energy Distribution Determination 2015-16 to 2018-19 Overview*, November 2014

13) AER, *Draft Decision Essential Energy Distribution Determination - Fact Sheet*, November 2014

14) Economic Insights, *Economic Insights AER DNSP MTFP & MPFP 10Nov2014.xls*

15) Economic Insights, *Economic Benchmarking Assessment of Operating Expenditure for NSW and ACT Electricity DNSPs*, 17 November 2014

16) *Ergon Energy Network Management Plan,* ***Part A:*** *Electricity Supply for Regional Queensland 2012/13 to 2016/17*

17) Evans & Peck, *Review of factors contributing to variations in operating and capital costs structures of Australian DNSPs*, November 2012

18) Hydro One, *Annual Report 2013*

19) Huegin Consulting, *Huegin's response to Draft Decision on behalf of NNSW and ActewAGL, Technical response to the application of benchmarking by the AER*,

20) Jemena, Citipower, Powercor, SP Ausnet, United Energy, *Transmission Connection Planning Report 2013*

21) London Economics, PowerNex Associates, *Density Study Results Stakeholder Consultation – Prepared for Hydro One Networks Inc.* October 19 2011

22) National Electricity Rules, Version 65, 1 October 2014

23) New Zealand Ministry for Primary Industries website http://www.biosecurity.govt.nz/publications/biosecurity-magazine/issue-82/aus-termites

24) Nuttall Consulting, *Report – Principle Technical Advisor Aurora Electricity Distribution Revenue Review*, November 2011

25) Ontario Distribution Sector Review Panel, *Renewing Ontario's Electricity Distribution Sector: Putting the Consumer First*, December 2012

26) Productivity Commission, *Electricity Network Regulatory Frameworks – Productivity Commission Inquiry Report No. 62 Vol 1*, April 2013

27) Qld Department of Natural Resources, Mines and Energy, Detailed Report of the Independent Panel – Electricity Distribution and Service Delivery for the 21st Century, July 2004

28) The Lines Company Website, http://www.thelinescompany.co.nz/network