Australian Energy Regulator

Independent review of Operating Environment Factors used to adjust efficient operating expenditure for economic benchmarking

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About the Authors

This report has been prepared jointly by Sapere Research Group and Merz Consulting.

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Introduction

The Australian Energy Regulator (**AER**) has retained the authors to provide independent technical advice about material differences in operating environments between Australian electricity distribution network service providers (henceforth "**DNSP**") in the National Energy Market (**NEM**).[1] This can form a technical input into the AER's annual benchmarking analysis and future regulatory determinations.

The final report is required to:

- identify the most material operating environment factors (**OEFs**) driving apparent differences in estimated productivity and operating efficiency between the distribution networks in the NEM, and
- quantify the likely effect of each factor on operating costs in the prevailing conditions.

The focus of this report is the effect on **efficient OPEX** of exogenous variables that are candidates for classification as material OEFs, not otherwise accounted for, or fully accounted for, in **econometric benchmarking**. For most jurisdictions there is a limited number of material OEFs that need to be considered in comparing benchmarking results, out of the extensive list of OEF candidates previously considered in AER determinations.

This report is intended to contribute to the AER's **economic benchmarking**. Benchmarking is a high-level, top down tool. OEFs are an adjunct, complementary component of this tool. The estimates are the best possible with the available data but are by their very nature less precise than would be the case using data rich bottom-up techniques.

This report amends and extends our December 2017 report 'Independent review of Operating Environment Factors used to adjust efficient operating expenditure for economic benchmarking.' It incorporates our responses to written feedback and a workshop held in March 2018.

Key findings

The indicative output of this project is the aggregate **OEF adjustment** columns highlighted in green in Table 1 below, representing the outcome of a project establishing a systematic approach to all OEFs simultaneously for all DNSPs in the group.

The aggregate OEF adjustment column represents the total estimated OEF adjustments to the econometric modelling outputs to account for OEFs that satisfy all the information requirements in the framework described in Section 2 such that they may be assessed against the AER's three **OEF criteria**.

1 See Appendix 1 for a glossary which provides an overview of the technical terms and definitions used throughout this report.

Table 1 Overview of aggregate OEF adjustments ($000, $June 2015)

DNSP	Optimised OPEX	Aggregate OEF adjustment	$ OEF adjustment	Efficiency Target post OEF	OEF Adjusted OPEX
Evoenergy	$42,402	0.82%	$350	57.6%	$42,752
Ausgrid	$383,230	0.70%	$2,675	59.1%	$385,905
CitiPower	$55,840	2.04%	$1,138	102.0%	$56,978
Endeavour	$208,106	3.36%	$6,986	78.7%	$215,093
Energex	$311,043	3.52%	$10,937	83.7%	$321,980
Ergon	$244,630	13.57%	$33,195	75.9%	$277,825
Essential	$289,591	6.11%	$17,706	77.9%	$307,296
Jemena	$68,661	-1.06%	-$726	93.0%	$67,936
Powercor	$190,734	0.15%	$281	100.1%	$191,015
SAPN	$248,377	0.63%	$1,556	100.6%	$249,934
AusNet	$206,141	-1.47%	-$3,035	98.5%	$203,107
TasNetworks	$62,684	1.19%	$747	98.1%	$63,430
United Energy	$117,721	-0.42%	-$493	99.6%	$117,229

1. Aggregate OEF adjustment includes taxes and levies although this quantification is indicative only

Regarding each column:

- The left hand column provides ideal optimised OPEX. This is used as the denominator to convert the dollar OEF adjustments to percentage OEF adjustments for each DNSP. This is illustrative of the outputs of econometric benchmarking.
- The two middle (green) columns provide the estimated aggregate OEF adjustments in dollar and percentage terms (i.e. change in efficient OPEX relative to ideal optimised OPEX). These are the illustrative outputs from the present project.
- As can be seen, the aggregate OEF adjustment column represents an increase in the optimised OPEX (or a reduction in OPEX optimised) in the first column.
- The two right hand (orange) columns reflect the outcomes from the application of these estimates – that is the total effect of OEF adjustments on efficiency targets and OEF optimised OPEX. This is illustrative of one process of applying the OEF adjustments to modify the outputs of econometric benchmarking.

Note that the AER's processes underpinning the base OPEX from which econometric benchmarking estimate optimised OPEX are outside the scope of this review. Proxy values have been used only for the purpose of demonstrating these OEF calculations.

Overview of OEF adjustments

These aggregate OEF adjustments combine quantification (where available) of the individual OEF adjustments for the OEF candidates determined to be comparatively material. These are largely a subset of OEF candidates previously identified as material through AER determinations for **assessed DNSPs**, now extended to all DNSPs, including all members of the **reference group**. A summary of findings for each OEF and for each DNSP and their aggregation are set out in more detail in Table 2 and Table 3 below.

Table 2 provides a summary of findings on the estimated dollar value of each material OEF adjustment for each DNSP is set out in below. For illustrative purposes in Table 3, these are expressed as percentages of ideal optimised OPEX excluding OEFs, as set out in Table 1, together with the reference point values (from which OEF estimates may be surmised, see also Section 3.10).

Method for deriving OEF adjustments

The economic benchmarking framework and particular processes are described in Section 2.2. The resulting OEF adjustments are conditional on either temporal assumptions or the preferences of the regulator regarding the selection of the comparison or reference points.

The primary results of this study are the **OEF estimates** in dollar terms for each DNSP for the **reference year**. As the econometric benchmarking is a relative metric, the relative OEF adjustments are derived from these estimates relative to a **reference point**. We follow the AER's preference employing the customer number weighted average of the reference group to derive the reference point from the OEF estimates.

The OEF estimates in percentage terms have been calculated assuming as the denominator the ideal optimised OPEX derived from the **productivity scores** and **base OPEX**, for which we have used historical OPEX for the reference year as a proxy the AER's process for deriving base OPEX. The OEF adjustments have been calculated using the reference point selected by the AER's existing practice (customer-number weighted average of the reference group).

Some clarifications and changes to the underlying OEF methodology, and for greater consistency in the application of the methodology across OEFs and DNSPs, are proposed. The proposed changes do not affect the exercise of regulatory discretion in terms of the selection of the comparison point for deriving ideal optimised OPEX, the selection of the reference point for deriving OEF adjustments, or the capping of the efficiency target for the reference group. These proposals have a significant impact on the quantification of some individual OEFs and also on the determination of the denominator used to convert OEF estimates to OEF adjustments in percentage terms. These issues are discussed at length in Section 2 below.

Table 2 Summary of OEF adjustment ($000, $June 2015)

DNSP	Sub-transmission (Licence conditions)	Vegetation Management	Taxes and levies	Termite exposure	Cyclones	Back yard Reticulation	Total (inc T&L)	Total (ex T&L)
Evoenergy	-$355	Nil	Nil	$0	NA	$705	$350	$350
Ausgrid	$6,215	Nil	-$3,335	-$205	NA	NA	$2,675	$6,010
CitiPower	$786	Nil	$393	-$41	NA	NA	$1,138	$745
Endeavour	$8,273	Nil	-$1,804	$517	NA	NA	$6,986	$8,790
Energex	$3,874	Nil	$6,049	$1,014	NA	NA	$10,937	$4,888
Ergon	$14,930	Nil	$2,753	$2,684	$12,828	NA	$33,195	$30,442
Essential	$17,535	Nil	-$2,543	$2,713	NA	NA	$17,706	$20,248
Jemena	-$878	Nil	$208	-$56	NA	NA	-$726	-$934
Powercor	-$14	Nil	-$35	$330	NA	NA	$281	$316
SAPN	$482	Nil	$1,345	-$271	NA	NA	$1,556	$212
AusNet	-$1,469	Nil	-$1,615	$49	NA	NA	-$3,035	-$1,420
TasNetworks	-$2,526	Nil	$3,341	-$68	NA	NA	$747	-$2,594
United Energy	-$209	Nil	-$224	-$60	NA	NA	-$493	-$269

Source: Sapere-Merz analysis

1. Nil indicates that data is insufficient to quantify the OEF; NA indicates the OEF is not applicable.
2. Total includes only material OEFs; the quantification of taxes and levies OEF is indicative only.

Table 3 Summary of OEF adjustment (as percentage of Optimised OPEX)

DNSP	Sub-transmission (Licence conditions)	Vegetation Management	Taxes and levies	Termite exposure	Cyclones	Back yard Reticulation	Total (inc T&L)	Total (ex T&L)
Evoenergy	-0.84%	Nil	Nil	0.00%	NA	1.66%	0.82%	0.82%
Ausgrid	1.62%	Nil	-0.87%	-0.05%	NA	NA	0.70%	1.57%
CitiPower	1.41%	Nil	0.70%	-0.07%	NA	NA	2.04%	1.33%
Endeavour	3.98%	Nil	-0.87%	0.25%	NA	NA	3.36%	4.22%
Energex	1.25%	Nil	1.94%	0.33%	NA	NA	3.52%	1.57%
Ergon	6.10%	Nil	1.13%	1.10%	5.24%	NA	13.57%	12.44%
Essential	6.06%	Nil	-0.88%	0.94%	NA	NA	6.11%	6.99%
Jemena	-1.28%	Nil	0.30%	-0.08%	NA	NA	-1.06%	-1.36%
Powercor	-0.01%	Nil	-0.02%	0.17%	NA	NA	0.15%	0.17%
SAPN	0.19%	Nil	0.54%	-0.11%	NA	NA	0.63%	0.09%
AusNet	-0.71%	Nil	-0.78%	0.02%	NA	NA	-1.47%	-0.69%
TasNetworks	-4.03%	Nil	5.33%	-0.11%	NA	NA	1.19%	-4.14%
United Energy	-0.18%	Nil	-0.19%	-0.05%	NA	NA	-0.42%	-0.23%
Reference Point	4.08%	Nil	0.88%	0.11%	0.00%	0.00%	5.07%	4.19%

Source: Sapere-Merz analysis

1. Nil indicates that data is insufficient to quantify the OEF; NA indicates the OEF is not applicable.
2. Total includes only material OEFs; the quantification of taxes and levies OEF is indicative only.
3. The reference point values reflect the AER's preference to use the customer number weighted average of OEF estimates for the reference group. See section 2.2.4for more detail

Material OEFs

Sub-transmission and licence conditions

Sub-transmission and licence conditions OEFs should be considered together. On reviewing licence conditions, these overwhelmingly relate to reinforcements to sub-transmission capacity. As a result, almost all the licence condition **candidate OEF** is not considered to meet the **non-duplication** criterion. We therefore propose to consider all of the licence conditions OEF within the sub-transmission OEF.[2]

More than 80 per cent of the sub-transmission OEF relates to variations in transformer related OPEX. In response to feedback on our December 2017 report, we have revised the methodology for quantifying the transformer component of the sub-transmission OEF. This has resulted in OEF adjustments that are, on aggregate, lower than those in the previous report.

This change reflects moving from a kVA based definition of sub-transmission asset volumes to a transformer count definition has a material impact on the outcome of the sub-transmission OEF estimates. This has also resulted in a refinement of the threshold for distinguishing between distribution and sub-transmission. Transformer count is considered a preferable basis for estimating an efficient sub-transmission substation OPEX unit rate as: it is a more accurate determinant of maintenance effort; and it is derived from a more transparent and auditable data set.

Vegetation management[3]

Variations in vegetation density and growth rates, along with variations in regulation around vegetation management, are together likely to be a material driver of variations in efficient vegetation OPEX. Analysis of vegetation, bushfire and division of responsibility for vegetation variables indicate a high level of overlap between these variables. It is probable that a vegetation management OEF candidate (or set of OEF candidates) meets the OEF criteria for a significant portion of DNSPs. As this includes the reference DNSPs, this OEF candidate (or set) is also likely to influence materially the reference point for this OEF candidate (or set).

Because of the likely materiality of a vegetation OEF reference point (or set), this may in turn result in a change (increase) in the overall reference point and hence affect the aggregate OEF adjustment outcomes for a significant sub-set of DNSPs. This effect may be greatest for those DNSPs with the highest (or lowest) vegetation OPEX as a proportion of total OPEX, depending on the extent observed vegetation OPEX is assessed to be efficient.

No quantification of a vegetation management OEF candidate (or set of OEF candidates) has been able to be estimated at this time. The summary results for this OEF candidate (or set) have therefore been reported as nil in Table 2 and Table 3.

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2 The one exception relates to Ausgrid where licence conditions relating to distribution may not be duplicative and may be material. For convenience, the Ausgrid distribution OEF has been rolled into the sub-transmission and licence conditions column in Tables 2 and 3 above.

3 The vegetation management OEF candidate is intended to subsume the relevant components of the previous OEFs for Bushfires and Division of responsibility for vegetation management

For the avoidance of doubt, this does not indicate the vegetation management OEF candidate (or set) should be zero, or that it cannot feasibly be systematically quantified in the future. Further, it does not indicate that this OEF cannot be estimated by the AER on a case by case basis until such time as a systematic quantification in implemented. As discussed further in Section 3.3, several possible approaches and methods have been explored. However, EBRIN data on vegetation density is considered less mature than other EBRIN data, upon which the EI model and some other OEF estimates have been developed or otherwise considered. Further refinement and consultation with DNSPs to ensure consistency of EBRIN data is required before it can be relied upon to the extent necessary to quantify this OEF candidate (or set) within an acceptable margin for error.

Taxes and levies

Taxes and levies are exogenous, in some cases individually material and for the most part non-duplicative. There appear to be significant differences in the treatment of taxes and levies in regulatory arrangements between jurisdictions, notably the use of a B factor adjustment in some but perhaps not all jurisdictions. In addition, there appear to be significant differences in the recording and treatment of taxes and levies between DNSPs, suggesting that some variations in taxes and levies between DNSPs may merely be apparent. On the other hand, most DNSPs made the effort of providing additional data on taxes and levies, following the workshop, and we agree that taxes and levies are therefore likely to be one of the most material OEFs. We have therefore included an indicative quantification of taxes and levies OEF in the aggregate OEF calculations in this report (with and without).

Termites

The main proposed change from the AER's approach to this OEF is to include OPEX for a more termite prevalent DNSP in the calculation of efficient unit costs, despite its relatively low productivity score. The analysis leads to drawing on a larger set of data regarding OPEX related to this OEF. The revised analysis results in upward revisions for DNSPs with higher rates of termite prevalence and larger numbers of wood poles.

Extreme weather – cyclones

The approach taken by the AER in the previous assessment for the cost impacts, of the then seven cyclones for Ergon Energy in the benchmarking period, is considered sound. Our approach extends the previous analysis to include three subsequent cyclones up to the end of financial year 2015, based on public emergency response data.[4] A fuller assessment could be made with additional cost data, as provided confidentially to the AER previously, for all cyclones in the benchmark period.

Backyard reticulation

Our analysis of backyard reticulation reflects advice from Evoenergy regarding the direct and indirect component of these incremental costs. Consistent with our general approach to indirect costs, these have been excluded. We suggest that, as the vegetation management OEF is developed and quantified, consideration be given to ensuring that any overlap between vegetation management and backyard reticulation is identified. This is to avoid any potential breaches of the non-duplication criterion for this OEF.

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4 This includes the Townsville mini tornado 2011-12 and Cyclones Larry 2005-06, Ului 2009-10, Tasha 2010-11, Anthony 2010-11, Yasi 2010-11, Oswald 2012-2013, and recently Ita 2013-14, Dylan 2013-14, Marci 2014-15.

Ongoing improvement program

The AER's previous decisions refer only to six (6) assessed DNSPs out of the total 13 DNSPs. This report has expanded the analysis of OEFs to develop a constant framework across all DNSPs in the NEM. As shown in Table 4, there are some material differences between the AER's previous decision and our findings.

A major driver of the difference is the decision not to quantify a vegetation OEF at this stage. A further factor is our finding discussed in Section 3 that some previously quantified OEF candidates do not meet the OEF criteria when considered across the full set of DNSPs. These include Licence conditions, Harmonisation of WHS regulations and the previous formulation for Severe storms.

Further work on the quantification of vegetation management and taxes and levies, including articulating subsidiary issues and any overlaps with other OEFs, should be a priority. This reflects the scale of associated OPEX and the strong likelihood of significantly material adjustments relative to the reference point for some DNSPs. On their own, OEF adjustments for these two categories, could substantially increase aggregate OEF adjustments relative to the results shown in Table 1.

In Section 4 we consider another six (6) OEF candidates prioritised through the review process, including new OEF candidates that may be significant to previously **non-assessed DNSPs**. Of these OEFs, we consider that network topology and Guaranteed Service Level payments could be material. If so, they could meet all three OEF criteria. Significant effort and resources would be required to gather information across the sector, in order to assess the candidate OEFs identified. We do not draw any conclusions on whether this investment would be worthwhile and have instead sought to develop an analytical framework in order to provide an improved setting for any such decisions.

As the Northern Territory has acceded t the NEL, Power and Water Corporation will be considered econometric and economic benchmarking by AER in future. Quantification of any OEFs relating to Power and Water is outside the scope of this report. We have provided a preliminary overview and qualitative assessment of variables suggested by Power and Water for consideration as candidate OEFs.

Comparison with previous AER decisions

For indicative purposes Table 4 below compares the OEF adjustments in this report with previous AER decisions. A key theme of this report is that the extension to all DNSPs makes explicit the quantification of the reference point in the derivation of OEF adjustments, and hence the significance of OEF estimates for DNSPs in the reference group.

Table 4 Comparison with previous AER decisions

DNSP	AER OEF adjustment	SRG/Merz OEF adjustment	SRG/Merz c.f. AER
Evoenergy	6.1%	0.8%	-5.3%
Ausgrid	6.9%	0.7%	-6.2%
CitiPower	NA	2.0%	2.0%
Endeavour	6.3%	3.4%	-2.9%
Energex	12.2%	3.5%	-8.7%
Ergon	18.6%	13.6%	-5.0%
Essential	5.4%	6.1%	0.7%
Jemena	NA	-1.1%	-1.1%
Powercor	NA	0.1%	0.1%
SAPN	NA	0.6%	0.6%
AusNet	NA	-1.5%	-1.5%
TasNetworks	NA	1.2%	1.2%
United Energy	NA	-0.4%	-0.4%
Reference point	0.0%	5.1%	5.1%

Source: Sapere-Merz analysis and AER

1. Aggregate OEF adjustment includes taxes and levies although this quantification is indicative only
2. For the purpose of this comparison the AER adjustment for Evoenergy excludes the previous OEFs for capitalisation practices (8.5%) and service classification (4%) that are now dealt with elsewhere.

Consultation process

There were four points in the process of preparing this report where consultation with stakeholders was undertaken.

- An initial information provision and request in mid-2017 to DNSPs that had not previously been assessed in terms of OEFs
- Written responses to the draft OEF report published by the AER on 11 December received in February 2019
- A stakeholder workshop held on 2 March 2018.
- Further information and data provided following the workshop, notably for taxes and levies.

The discussion at the workshop identified a number of matters where the draft report could be clarified, extended and improved. It identified a need for further data and information, due to the limitations of existing RIN data. It also identified aspects of the interaction with the econometric benchmarking that needed clarification and possible refinement.

As discussed at the workshop, following the workshop further information was sought and received from a number of DNSPs. Further information was also sought from internal stakeholders, as well as Economic Insights, on key issues deliberated with stakeholders particularly with regard to the econometric benchmarking.

The present report continues to refer to the AER's 2016 annual benchmarking report.[5] Among other things, this facilitates comparison between the draft and final Sapere-Merz OEF report.

On the basis of stakeholder feedback and additional information provided, the text of the draft report has been substantially revised in this report. These revisions are further discussed below.

Changes from preliminary report

The final report has a number of changes compared with the preliminary report (December 2017). These include:

- improvements in clearly communicating key features of the OEF conceptual framework (revisions to Section 2);
- extensive clarifications and revisions on the quantification methods and demonstrations of OEF estimates (Revisions to Section 3); and
- Revisions to the methodology for the sub-transmission OEF estimate and corresponding OEF adjustment;
- Indicative calculation of OEF adjustments for taxes and levies based on supplementary data provided by DNSPs, and additional commentary on taxes and levies
- Removal of estimates for severe storms, alongside clarification of the treatment of HILP events in the derivation of productivity scores, and further discussion of potential quantification.
- more extensive information on the assessments of OEFs that have not been quantified previously, including an indicative way forward to allow quantification of currently unquantified OEF categories (see Section 4 and Appendix 4).

5 The AER'2016 annual benchmarking reports are available at http://www.aer.gov.au/networks-pipelines/network-performance/annual-benchmarking-report-distribution-and-transmission-2016

1. Introduction

1.1 Purpose

The Australian Energy Regulator (AER) has retained the authors to provide independent technical advice about material differences in operating environments between the Australian electricity distribution network service providers (henceforth "DNSP"). This will form a technical input into the AER's annual benchmarking analysis and future regulatory determinations.

The report is required to:

- identify the most material factors driving apparent differences in estimated productivity and operating efficiency between the distribution networks in the NEM, and
- quantify the likely effect of each factor on operating costs in the prevailing conditions.

A draft of the present report was published in December 2017.[6] A workshop was held in March 2018.[7] The final report responds to feedback on the draft report and additional information provided by DNSPs.

1.2 Background

The AER uses economic benchmarking results to provide information about whether the business is operating efficiently. Benchmarking provides an indication of whether historical OPEX provides a reasonable indicator of efficient cost, and if not, what a substitute level of OPEX should be.[8]

To ensure that the AER is comparing 'like-with-like' to the greatest extent possible, the AER's benchmarking modelling takes into account the effect of differences in operating environments by:

- Directly accounting for the effects of customer density, network length, undergrounding, and network construction as output variables in the benchmarking models. These factors account for significant differences in costs between networks.
- Limiting benchmarking to network services activities, excluding costs related to metering, connections and other negotiated services which can differ across jurisdictions or are outside the scope of regulation.

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6 See *Independent review of Operating Environment Factors used to adjust efficient operating expenditure for economic benchmarking*, Sapere Merz, December 2017 available at https://www.aer.gov.au/system/files/SapereMerz%20review%20of%20operating%20environment%20factors%20-%20December%202017.pdf

7 See presentation for the workshop available at: https://www.aer.gov.au/system/files/Sapere-Merz%20-%20Operating%20environment%20factors%20review%20workshop%20-%202%20March%202018.pdf

8 AER, Draft Decision, TasNetworks Distribution Determination 2017-19, Attachment 7, September 2016, p. 14; AER, Final Decision, South Australia Power Networks Distribution Determination 2015-20, Attachment 7, October 2015, p. 11.

As a second step, the AER also adjusts the econometric modelling results for differences in other exogenous operating conditions such as geography, climate, and jurisdictional obligations. The AER refers to these as "Operating Environment Factors" (OEFs). The focus of this report is the estimation of OEF adjustments.

The AER publishes an annual benchmarking report that presents the benchmark rankings and efficiency scores of each network service provider in the National Electricity Market (NEM). The most recent report was published in December 2017.[9]

The AER's annual benchmarking reports do not reflect the additional adjustments for OEFs. Instead, the AER has only applied adjustments for OEFs for the Queensland, NSW and ACT distribution network service providers in the context of their regulatory determinations. This is because the AER used economic benchmarking to inform its five-year OPEX forecasts for these service providers.[10] The AER used its benchmarking techniques to compare the historical benchmark operating efficiency of these networks against the benchmark comparison Victorian and South Australian networks over an eight year historical period.

Table 5 sets out the material OEFs the AER identified and adjusted for each of the NSW, Queensland and ACT DNSPs, for which OEF assessments have so far been made. Overall twelve OEFs satisfied the AER's OEF criteria from over 60 OEF candidates considered in these determinations. These calculations represent the percentage increase or decrease in efficient costs relative to reference Victorian and South Australian DNSPs, as estimated from the chosen benchmarking model.[11]

While the OEFs in Table 5 apply to the Queensland, NSW and ACT DNSPs, they could equally apply to the Victorian and South Australian DNSPs, with the reverse effect. That is, they reflect cost advantages faced by the Victorian and South Australian networks when compared to the Queensland, NSW and ACT networks.

The AER has not directly identified OEFs for Victorian, South Australian and Tasmanian distribution networks. The AER has acknowledged that its information about the operating environments faced by the Victorian and South Australian networks is partial and asymmetric. The AER has noted that its current approach may favour the ACT, NSW, and Queensland DNSPs to the extent that not all of their cost advantages relative to the reference group have been revealed.[12]

The AER's analysis of OEFs relied substantially on information provided by service providers, including through regulatory submissions and consultants reports. While the

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9 See *Annual Benchmarking Report - Distribution and Transmission 2017,* AER 2017 available at https://www.aer.gov.au/networks-pipelines/network-performance/annual-benchmarking-report-distribution-and-transmission-2017

10 See Attachment 7 of the AER's final decisions for the NSW and ACT DNSPs 2014-19 regulatory period, and QLD DNSPs 2015-20 regulatory period. Available at http://www.aer.gov.au/networks-pipelines/determinations-access-arrangements

11 For explanation of the AER's methodology for calculating these adjustments, see AER, Final Decision, Ausgrid Distribution Determination , Attachment 7, April 2015, pp. 184-189

AER considered all information provided to it, it did not always have sufficient evidence to quantify the effect of individual factors. This contributed to the AER applying a conservative approach to immaterial factors, which it considered was appropriate given this was the first time benchmarking had been applied, and the level of information on OEFs available at that stage.[13] The AER noted that it may reconsider its approach to immaterial OEFs in the future as its information set improves.[14]

Table 5 Summary of OEF adjustments compared to reference networks

OEF	Ausgrid	Endeavour	Essential	Evoenergy	Energex	Ergon
Sub-transmission assets	5.2%	4.9%	3.1%		3.2%	4.6%
Licence conditions	1.2%	0.7%	1.2%			0.7%
OH&S regulations	0.5%	0.5%	0.5%	0.5%	0.5%	1.2%
Termite Exposure	0.0%	0.2%	0.6%		0.2%	0.5%
Bushfires					-0.5%	-2.6%
Extreme weather					2.7%	3.0%
Cyclones						5.4%
Vegetation management					3.4%	4.1%
Taxes and levies					2.7%	1.7%
Capitalisation Practices				8.5%		
Backyard reticulation				5.6%		
Standard control services connections				4.0%		
Total	**6.9%**	**6.3%**	**5.4%**	**18.6%**	**12.2%**	**18.6%**

Source: Australian Energy Regulator final decision for NSW and ACT DNSPs 2014-19, and QLD DNSPs 2015-20.

1. actewAGL distribution is now known as Evoenergy

The AER also received responsibility for the economic regulation of the North Territory electricity network, Power and Water Corporation, in July 2016. It will incorporate Power and Water Corporation into its 2018 annual benchmarking report. The AER has not yet considered appropriate OEFs for the Northern Territory.

13 AER, Final Decision, Ausgrid Distribution Determination , Attachment 7, April 2015, p. 180

14 AER, Final Decision, Ausgrid Distribution Determination , Attachment 7, April 2015, p. 180

The AER's use of economic benchmarking and in particular its econometric and OEF adjustments have been the subject of extensive litigation, first in the Australian Competition Tribunal and then in the High Court. In a decision handed down in May 2017,[15] the Federal Court made various findings with respect to these matters.

Consideration of OEFs by the Federal Court (and earlier by the Australian Competition Tribunal) has informed this report. This report was commissioned before the Federal Court decision was handed down and does not form an element of any response to that decision by the AER. It is nevertheless intended that the present project will contribute to the ongoing improvement of future economic regulation of DNSPs.

1.3 Conduct of the review

The first stage of this review involved a review of operating environmental factor categories previously screened by the AER, as well as familiarisation with the AER's economic benchmarking practices. This involved an extensive review of previous benchmarking reports and regulatory decisions, and their accompanying stakeholder submissions and workbook calculations, both published and internal to AER. Discussions were held with internal stakeholders familiar with these practices, as well as Economic Insights.

Key themes in the first stage included the applicability of existing benchmarking practices to the entire group of DNSPs and identifying the set of environmental factors to be considered. Based on this review and in consultation with the AER, the main focus of the review is the most material factors driving apparent differences in estimated productivity and operating efficiency between the distribution networks in the NEM, considered uniformly across all DNSPs.

We conducted an independent analysis of economic benchmarking processes as well as each environmental factor identified, including identification and assessment of relevant data sources and independent methodologies for cost estimates. An environmental factor template was populated for each factor considered. Significant work was also undertaken to consider combination of individual OEFs toward aggregate OEFs for each DNSP, taking into account the AER's wider benchmarking methodology.

The analysis focused on those OEF candidates the AER had quantified in its previous distribution network pricing determinations. The objective was to consider the effect of quantifying these OEF categories for all DNSPs, including DNSPs not previously assessed, and the resulting impact on the comparative materiality of the OEF adjustments. As none of the reference group of DNSPs had previously been assessed, OEF adjustments for this group materially change the net OEF adjustment for all other DNSPs.

Aware that both the conceptual framework for economic benchmarking in general and OEFs in particular are complicated, we sought early engagement with previously non-assessed DNSPs to raise familiarity with OEF assessment, and to commence investigating OEFs that may be particularly relevant to members of this group (see Appendix 3). The

15 Federal Court of Australia: Australian Energy Regulator v Australian Competition Tribunal (No 2) [2017] FCAF 79, 24 May 2017.

material distributed to this group included both currently deemed material OEFs and a summary of 60 OEFs previously considered in AER determinations and deemed immaterial or otherwise not satisfying OEF criteria. The responses predominately referred to potential OEF categories already identified. There was not sufficient new information provided to challenge previous AER decisions regarding OEF candidates that it considered do not meet the materiality threshold.

The draft OEF report was published by the AER on 11 December, together with the accompanying workbook demonstrating the calculation methods of OEF estimates and application in AER processes. Stakeholders were invited to make written submissions by 9 February 2018 and participate in a workshop on 2 March 2018. We received 10 written submissions.

The discussion at the workshop identified a number of matters where the draft report could be clarified, extended and improved. It identified a need for further data and information, due to the limitations of existing RIN data. It also identified aspects of the interaction with the econometric benchmarking that needed clarification and possible refinement.

As discussed at the workshop, following the workshop further information was sought and received from a number of DNSPs. Further information was also sought from internal stakeholders on key issues deliberated with stakeholders, particularly with regard to the econometric benchmarking.

On the basis of stakeholder feedback and additional information provided, the text of the draft report has been substantially revised in this report. These revisions include:

- improvements in clearly communicating key features of the OEF conceptual framework (revisions to Section 2);
- extensive clarifications and revisions on the quantification methods and demonstrations of OEF estimates (Revisions to Section 3); and
- more extensive information on OEFs that have not been quantified previously, including an indicative way forward to allow quantification of currently unquantified OEF categories (see Sections 4 and Appendix 4).

The present report continues to refer to the AER's 2016 annual benchmarking report.[16] Among other things, this facilitates comparison between the draft and final Sapere-Merz OEF report.

1.4 Structure of this report

The remainder of this report is structured as follows:

Section 2 sets out the conceptual framework and approach applied in this report. It provides a narrative for the interconnected stipulative definitions of technical terms set out in the glossary. It identifies a series of issues that cut across multiple OEF estimations and which influence OEF estimates and hence OEF adjustments.

16 The AER'2016 annual benchmarking reports are available at http://www.aer.gov.au/networks-pipelines/network-performance/annual-benchmarking-report-distribution-and-transmission-2016

Section 3 applies the analytical framework developed in Section 2 to individual candidate OEFs that are estimated to be most material driving apparent differences in estimated productivity and operating efficiency. A standard structure is applied to each OEF candidate:

- Assessment against the analytical framework including the AER's criteria for inclusion of OEF adjustments.
- Findings on OEF estimates and hence OEF adjustments across DNSPs.
- Quantification data and processes.
- Areas for further consideration.

Finally the individual material OEF estimates and adjustments are aggregated across DNSPs and OEF candidates.

Section 4 provides a discussion of candidate OEFs that have so far not been quantified with particular respect to non-assessed DNSPs.

Section 5 provides a high level initial assessment of OEF candidates for NT's Power and Water Corporation that will be included in the AER benchmarking process in the future.

A glossary of technical terms used throughout this report is set out in Appendix 1.

The terms of reference for this review are provided in Appendix 2

Appendix 3 includes some brief information on participation by stakeholders in the review process.

Appendix 4 summarises potential OEFs raised through the review process including consultation submissions and discussions, including their potential proponents and summaries of relevant AER determinations on these potential OEFs where applicable.

2. Approach

2.1 Introduction

This section sets out the conceptual framework and approach adopted for this study. Along with the definitions in the Glossary, it clarifies key terms and concepts.

The first section seeks to clarify the conceptual framework for this study. In particular, it seeks to articulate the scope of the current review relative to the broader AER economic benchmarking framework. It distinguishes between the conditions for accepting and quantifying a candidate OEF from the larger processes for applying OEFs. In other words, decisions and judgments that are the subject of the present review are identified and distinguished from decisions and judgments relating to the AER's broader benchmarking methodology.

The second section seeks to clarify particular issues in the calculation of **OEF estimates** and the conversion of these estimates to **OEF adjustments**, and the associated choices and decisions to be made. It identifies the decision points where and how the regulator may and/or has previously applied its discretion.

The third section reflects on the data sources available to make calculations of OEF estimates. A fourth section draws out the overall implications for the assessment and quantification of OEF candidates.

2.2 Conceptual framework

The consideration of OEFs is one element within the AER's broader consideration of economic benchmarking of regulated DNSPs. This section provides:

- An introduction to the broad framework of economic benchmarking, the role of OEF adjustments within that broad framework, and a clearer definition of the primary focus of the current review on dollar OEF estimates within that OEF framework.
- A high level view of the information tasks of identifying and assessing individual potential OEF adjustments for the relative cost impacts on DNSPs for a given operating environment cost driver, including the OEF criteria previously identified by the AER.
- Detailed discussion on key issues panning out to a view of the broader framework that are pertinent to results presented in the report.

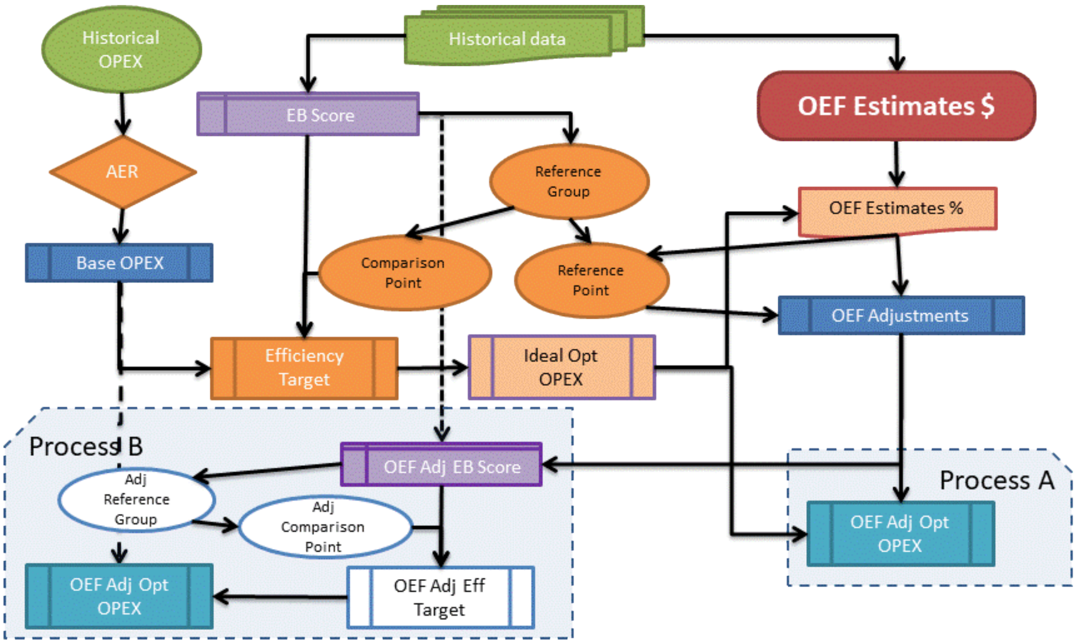
2.2.1 Broad economic benchmarking framework

OEF benchmarking is a supplement to econometric benchmarking and forms part of the larger economic benchmarking undertaken by the AER in the course of determining efficient OPEX for the purpose of regulated price setting, and in the future for periodic (annual) performance benchmarking.[17]

Generalised, the effect of such factors for an individual firm is to modify its efficient OPEX required for the same productive outputs. Hence the effect of each OEF estimate for individual firms is to improve the productivity score from econometric benchmarking, or ultimately optimised OPEX. Recognising the econometric benchmarking as a relative measure of individual firm performance among a group of firms, a relative OEF adjustment is derived from the individual OEF estimates relative to a reference value. Consequently, while an OEF estimate is inherently a positive change for the individual firm concerned, the corresponding OEF adjustment relative to the group reference may be negative. This is to recognise the impact on efficient OPEX of a variable (OEF) not otherwise taken into account in the econometric benchmarking.

The overall scheme of applying economic benchmarking to optimised OPEX is illustrated in Figure 1, showing the multiple information flows and key decision points. The primary focus of the current review is dollar OEF estimates for each and every DNSP in the NEM, highlighted in the right hand red box. However, for the purposes of demonstrating the derivation and application of percentage OEF adjustments, including comparison with the AER's previous determinations that are limited to previously assessed DNSPs, these auxiliary calculations are included in this report.

Figure 1 Information flow for processes to calculate and apply OEFs



17 The AER may use other methods for assessing efficient OPEX.

We therefore summarise these processes including the proxy values as applied in the present report.

- **Base OPEX** is the estimate of total OPEX prior to application of economic benchmarking to estimate ideal or OEF optimised OPEX. In historical decisions regarding individual firms, base OPEX is an output of an AER process based on historical OPEX.[18] For simplification, we take 2015 historical OPEX as a proxy value for base OPEX for the demonstration calculations in this report. This is unchanged from the 2017 preliminary OEF report.
- The **econometric benchmarking** (EB) **productivity scores** are produced for the AER by **Economic Insights** for the AER's annual benchmarking report.[19] The AER's determination of the reference group from these scores is the foundation for the application to both OPEX and OEFs.
  - The **reference group** includes the top five ranked DNSPs.
  - The EB score of the fifth ranked DNSP is the comparison point.[20]
  - The **comparison point** is the denominator for the calculation of efficiency targets for each DNSP from their EB score.
  - The OEF **reference point** is derived from the reference group: we have followed the AER's practice of employing a customer weighted average. The different points of reference and the significance of different origins are discussed further in Section 2.2.4 below.
  - Again, we do not reproduce these calculations, but employ the 2016 report values that have been derived from 2015 economic benchmarking data.
- The base OPEX combined with the efficiency target for each DNSP derives what we have called the "ideal optimised OPEX", which the AER has equated with efficient OPEX exclusive of OEFs, in its historical determinations.
- The efficient OPEX exclusive of OEFs is the denominator to derive a percentage OEF estimate from the dollar OEF estimate.
  - The percentage reference point may then be calculated relative to the reference group; we have followed the AER's practice of employing a customer weighted average.
  - The percentage OEF adjustment may then be calculated from the OEF estimate relative to the reference point.

This review is concerned with the generalisation of OEFs to all DNSPs, particularly for application to annual benchmarking. The use of a common denominator means that this

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18 For consistency in benchmarking all DNSPs producing period-average efficiency scores derived from econometric modelling, perhaps base OPEX should be the period-average actual OPEX for the benchmarking period. This may need to be reconciled with the regulatory decision roll-forward processes to produce base OPEX. These AER processes are outside the scope of this report.

19 Available at https://www.aer.gov.au/networks-pipelines/guidelines-schemes-models-reviews/annual-benchmarking-report-2017

20 AER, Ausgrid Final Decision, p 7-269ff

calculation is consistent combined across all DNSPs and all OEFs (discussed in Section 2.2.4).

Having obtained comparable OEF adjustments, Figure 1 demonstrates two processes applying those to the AER's various purposes.

- Process A reflects the AER's historic application of OEF adjustments directly to ideal optimised OPEX.
- Process B reflects the potential application to derive OEF adjusted EB scores. In principle these adjustments may significantly alter the ranking of DNSPs, so the process identifying the reference group and consequent processes may be repeated.

Regulatory discretion can be and is exercised at many points in the derivation and application of OEF adjustments. The application of such discretion is outside the scope of the current review. While we have employed various proxies for inputs and followed the AER's prior practice with regard to certain calculations, the choices on our part are primarily for the purposes of demonstration and do not preclude the AER's discretion when applying similar calculations in the future.

In particular, the process for determination of the OEF adjustments is independent from the alternative processes for their application. Hence, for the same OEF adjustments, there may be some variation in outcomes (further illustrated in Section 2.2.4).

Productivity scores and efficiency

The starting point for the present analysis is the Cobb Douglas Stochastic Frontier Analysis (SFA) production model. SFA is an econometric modelling technique that uses advanced statistical methods to estimate the frontier relationship between inputs and outputs. SFA models allow for economies and diseconomies of scale and estimates efficiency for each DNSP relative to estimated best performance. That is, differences in productivity scores relative to a comparator firm or set of firms are a guide to differences in efficiency between firms.

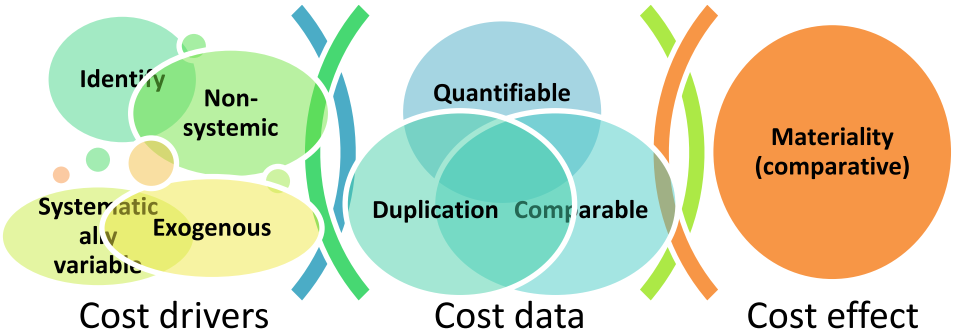
2.2.2 Identifying and assessing potential OEFs

Reference to an OEF is necessary to explain variations in efficient OPEX between equally efficient DNSPs (all other things being equal). A corollary of the equation of efficient OPEX (exclusive of OEFs), with ideal optimised OPEX, is that an OEF is not sufficiently accounted for in the econometric benchmarking to distinguish between inefficiency, on the one hand, and the impact of an OEF on efficient OPEX, on the other.

Any valid OEF candidate should reflect systematic variations in efficient OPEX across all DNSPs that may account for some portion of the differences in econometric benchmarking scores for each DNSP relative to the frontier DNSP. In other words, variations in OPEX attributable to OEFs should enable the identification of differences in productivity scores that are unrelated to differences in efficiency.

The information challenge of identifying and assessing a candidate OEF is illustrated in the scheme in Figure 2, in which a cost driver can be causally linked to an effect on OPEX using available cost data. What makes the process challenging is that a large range of conditions must be satisfied, including the AER's three specific OEF criteria, and specific conditions can only be assessed with information available at different stages in the evaluation process. This means it is possible to undertake an extensive analysis before determining that a candidate OEF is comparatively immaterial and hence should not affect the aggregate OEF adjustment.

Figure 2 Information requirements for assessing potential OEFs



In the context of a top-down benchmarking method, this suggests a conservative approach whereby any case for inclusion of a candidate OEF must be built carefully. Priority should be given to OEF candidates that, on the basis of an initial and necessarily qualitative and inaccurate assessment, are likely to result in a significant material difference between DNSPs.

First, a potential OEF cost driver must be identified with evidence of a causal link to an effect on OPEX. The initial identification may originate with either drivers or effects. Moreover there is no assumption of unitary relationships in Figure 2 – multiple drivers may influence a single effect on OPEX, vice versa or both. Consequentially, the following stages in an OEF assessment may be complicated and subject to simplifying assumptions.

The qualifying conditions for OEFs include:

- A variable affecting OPEX that is non-systemic. This means that it is not a general environment condition of operating a business in human society, or even the energy industry.[21] Systemic operating environment factors include the fact that electricity conductors are extremely hazardous and that DNSPs in all mature economies need to comply with a large suite of legislation and regulations around safety and environmental matters. Similarly, all DNSPs are required to comply with legislation and regulation applying to all Australian corporations, and across the NEM. For example Energy Safety Levies are specific to the industry and even jurisdictions, while GST and some land taxes are not.[22]

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21 We recognise the potential for confusion between the adjectives "systematic" and "systemic". We are employing these terms in their dictionary sense, and not in any technically specific way. Systematic variations are characterised by orderly or taxonomic variations. Systemic properties are general properties of an entire system.

22 In another example, the impact of extreme weather types is non-systemic not in that the climatic environment is external to human society, but rather society imposes an obligation on energy businesses exceeding businesses in general. Whereas an extreme climatic event may severely inhibit or terminate a general business, DNSPs are expected not only to remain in business but to restore services with a minimum of disruption.

- A variable affecting OPEX must systematically vary between DNSPs across the NEM. If all DNSPs experience a cost driver more or less equally, then it is systemic and does not qualify as an OEF.
- An OEF should be outside the control of service providers' management (exogenous). Where the effect of an OEF is within the control of service provider's management, providing an adjustment for the OEF may mask inefficient investment or expenditure.

Candidates for OEF adjustments[23]

In its decisions the AER has required that an OEF candidate must meet three criteria for OEF adjustments.

- **Exogeneity**: The first criterion is that an OEF should be outside the control of service providers' management. Where the effect of an OEF is within the control of service provider's management providing an adjustment for the OEF may mask inefficient investment or expenditure.
- **Materiality**: The second criterion is that an OEF should create material differences in service providers' OPEX. Where the effect of an OEF is not material, there is no motive to provide an OPEX adjustment for the factor.
- **Duplication**: The third criterion is that the OEF should not have been accounted for elsewhere. Where the effect of an OEF is accounted for elsewhere, to provide an adjustment for that factor would be to double count the effect of the OEF. This includes overlaps with econometric benchmarking.

A potential OEF driver should be causally related to one or more cost category within OPEX. This is so that, not only is the cost data quantifiable, but the cost data is comparable between *all* DNSPs so that the *comparative* cost effect is calculable. The AER's duplication criterion - the variable should not have been accounted for elsewhere in the benchmarking process – can be assessed at this point by identifying data about the costs associated with an OEF (if not earlier).

Where the effect of a candidate OEF is accounted for elsewhere, to provide an adjustment for that factor would be to double count that candidate OEF. This may include duplication of the OEF scaling relationships between DNSPs, with the inputs to the econometric benchmarking model, or via exclusion of a cost category from base OPEX. Finally, the cost data provides the basis for a calculation of the cost effect and ultimately assessment of the comparative materiality of the candidate OEF.

As noted above, calculating the dollar value of OEF estimates for each DNSP is the primary focus of this report. Additional steps required to calculate OEF adjustments depend on inputs subject to regulatory processes and discretion. These inputs include but are not limited to calculating the base OPEX for every DNSP and the selection of the reference group. While we have demonstrated these calculations using proxy values and/or following the AER's historical practice, the results in this report, including the assessment of comparative materiality, are only indicative.

[23] See for example, AER, Ausgrid Final Decision, p 7-174

2.2.3 How OEFs increase OPEX

To ensure clarity over causal connections between OEFs and OPEX, we consider three main aspects of OPEX. This is consistent with the format for RINs as well as previous advice for the AER from EMCa.[24] OPEX consists of the following.

1. Network maintenance costs: including preventative, corrective and fault maintenance activities on the electricity network. These costs can also be split into direct (field) maintenance costs and indirect maintenance costs (i.e. maintenance support);
2. Network operating costs: including costs, other than maintenance costs, that are associated with the safe and reliable operation of the electricity network; and
3. Corporate overheads: including other costs associated with the operation of the electricity network business, not specific to the operation of the electricity network. These include customer services.

In addition, the AER requires that DNSPs nominate OPEX by major activity type, namely:

> (a) routine and non-routine maintenance; (b) emergency response; (c) vegetation management; (d) network overheads; and (e) corporate overheads.

For each OEF, we have considered which type of OPEX and activity categories may be affected. Some OEFs may relate just to one type of activity or cost category, while others may relate to multiple activities or cost categories.

Systemic Factors

Systemic factors are already addressed in the economic benchmarking and therefore there is no requirement to make any further adjustment. Non-systemic environment factors may not always be candidate OEFs. This is because, to the extent non-systematic environment factors are already addressed in econometric benchmarking, they may not require OEF adjustments.

Some candidate OEFs may be accounted for entirely or partly via consideration of differences in DNSP outputs taken into account in econometric benchmarking. Other differences in operating environments addressed in econometric benchmarking outputs include:

- Customer numbers
- Circuit line length
- Maximum ratcheted demand, and
- The proportion of network underground.

These variables also allow at least a partial assessment of important candidate OEFs that can be derived from the list above, such as customer density (customer numbers divided by circuit line length). This output specification relates to the form of the econometric benchmarking model preferred by the AER – the stochastic frontier analysis model using the

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[24] See page 5, Report to AER on sparse rural network cost relationships- April 2015, EMCa.

Cobb Douglas functional form (SFACD). This output specification differs from that used in multi total factor productivity (MTFP) and multi-partial factor productivity (MPFP) benchmarks, in that it does not include energy delivered or reliability. This is relevant to the duplication criterion for OEF adjustments, where the impact on OPEX is expected to scale with an output included in the model.

In considering the OPEX impact of an OEF we focus on the efficient cost of operating or maintaining the network – the impact of the OEF on direct costs. The impact of OEFs on overheads is assessed for each of the quantified OEFs. This draws on the data on direct and overhead costs in the Category RINs completed by the DNSPs. The distinction between direct and overhead costs applied is from this data set. Direct expenditure data is extracted from tabs 2.7 Vegetation Management, 2.9 Emergency Response and 2.12 Input Tables. For each of these OEFs, any impact of the OEF on overhead costs is not considered significant relative to the scale of overhead activities within the DNSPs.

Boundary with econometric benchmarking

There are significant interactions between the analysis for OEF adjustments and econometric benchmarking. For example, in the sub-transmission OEF, part of differences in the density of sub-transmission assets is accounted for in the circuit length kilometre output. This suggests that only a residual for differences in sub-transmission asset density should be addressed in the sub-transmission OEF. (See Section 3.2 for the detailed discussion with regards to sub-transmission.) This highlights the need for careful consideration in the OEF analysis of the boundary between the econometric and OEF benchmarking.

2.2.4 Relativities between points of reference

In the present analysis, each OEF estimate is a positive value relative to a defined **zero point** for each candidate OEF.

The zero point is an arbitrary selection within the analysis. For example, all DNSPs have some sub-transmission assets. Accordingly, for this OEF, the zero point may be the DNSP with the lowest density of sub-transmission assets.

The selection of the zero point affects the OEF estimates but does not affect the OEF adjustments (following the selection and application of the of the reference point), if applied in calculations that maintain the relativity between firms. That is, the OEF adjustment outcomes are unaffected by the selection of the zero point. For simplicity, in this report, the zero point is defined as the costs in the absence of the OEF.

The zero point for making an OEF estimate should not be confused with the **reference point** for making an OEF adjustment. The OEF estimates represent the absolute variations across the sector regarding a candidate OEF. The econometric benchmarking produces relative productivity scores; that is the productivity scores represent not the absolute productivity of a firm employing its inputs to produce its outputs, but the relative productive performance between firms in the sector. Hence the OEF adjustments represent the relative differences candidate OEFs make to the productivity scores of all firms compared in the econometric benchmarking. The OEF adjustments are calculated, from the OEF estimates, relative to a representative or reference point.

The AER's OEF adjustments reflect a non-zero reference point for analysing OEFs, set as the customer-number-weighted average OEF estimates of the five DNSPs that form the **reference group** for the relevant period. Under this approach, by definition there may be negative OEF adjustments, including for around half of those in the reference group.[25] In this report we adopt the AER's practice of determining the reference point from the customer-weighted average OEF estimates of the reference group.

It is important not to confuse the reference point for making an OEF adjustment with the **comparison point** selected for the derivation of efficiency targets from productivity scores (see discussion in this section below on efficiency target employed by AER to calculated efficient OPEX exclusive of OEFs and examples in Table 8).[26] These decisions are independent, and of significant consequence in the outcomes of the two processes illustrated in Figure 1 above (schematically simplified in Figure 3 below). In particular, in the case that both the comparison point and reference point are determined by the same procedure, say using the fifth ranked firm, then Process A and Process B in that Figure result in identical outcomes (unless a capping function is applied in determining the efficiency target, which only applies to the reference group).

OPEX for estimating OEFs

OEF related OPEX is identified as incremental OPEX that an efficient firm would not otherwise have expended for the achievement of its productive outputs. An OEF causes incremental OPEX, so that the proportionate $OEF\%_A$ for firm A is defined relative to the excess OPEX over the efficient OPEX exclusive of OEFs:

$$OEF\%_A = \frac{OPEX\$^A_{exc\ OEF} + OEF\$_A}{OPEX\$^A_{exc\ OEF}} - 1 = {OEF\$_A}\Big/{OPEX\$^A_{exc\ OEF}}$$

This is consistent with the positive adjustment with respect to a firm's own productivity score or ideal efficient OPEX. Furthermore, where the OEFs are defined with reference to a common denominator, then the total OEF factor is equal to

$$Total\ OEF\%_A = \sum\nolimits_{OEFs}\left(\frac{OPEX\$^{Efficient}_{exc\ OEF} + OEF\$_A}{OPEX\$^{Efficient}_{exc\ OEF}} - 1\right)$$
$$= \frac{1}{OPEX\$^{Efficient}_{exc\ OEF}}\sum\nolimits_{OEFs} OEF\$_A$$

This is significant as not only are the measured percentage OEFs comparable for a single DNSP, but also the percentage OEF is meaningfully comparable between DNSPs. This is a pre-requisite for the following steps in the AER's process in Figure 1 in calculating the reference point and then calculating the OEF adjustment relative to the reference point. The denominator in these fractions always has the same basis, in principle.

25 The sign depends on the number in the reference group, and on the relative weighting given to members within that group.

26 AER, Ausgrid Final Decision, p 7-269ff

Further, as discussed relative to the calculation of OEFs in Section 2.3.1 below, employing as the denominator anything other than $OPEX\$^{A}_{exc\,OEF}$ introduces a significant error that is likely to exceed an error associated with an inefficient component in the costs used to identify $OEF\$_{A}$. Hence we need to identify efficient OPEX exclusive of OEFs.

Efficient OPEX exclusive of OEFs

As a top-down benchmarking method, the efficient OPEX exclusive of OEFs is not known or knowable prior to the quantification of efficient OPEX and of OEFs. This is known as a hermeneutic circle.

As a first estimate, the AER obtains the efficient OPEX exclusive of OEFs $OPEX\$^{Efficient}_{exc\,OEF}$ from the productivity metrics. The productivity score is a function of, among other things, a firm's efficiency in operational expenditure. Hence, all other things being equal, and already accounting for scale, the productivity score is a proxy for economic efficiency. An ideal efficiency target ET^{ideal}_{A} for firm A can be set by renormalizing the productivity score PS_{A} to a comparison point, that is the productivity score PS_{CP} of a comparison DNSP (or group of DNSPs) deemed to be efficient:

$$ET^{ideal}_{A} = {}^{PS_A}/_{PS_{CP}}$$

The efficient OPEX exclusive of OEFs is then equated with an ideal efficient base OPEX obtained with this efficiency target

$$OPEX\$^{Efficient}_{exc\,OEF} = {}^{PS_A}/_{PS_{CP}} \times OPEX\$_{Base} = {}^{PS_A}/_{PS_{CP}} \times \mathrm{f}(OPEX\$_{historic})$$

where the base OPEX is derived from adjustments to the firm's historical OPEX taking into account various trends and growth factors.

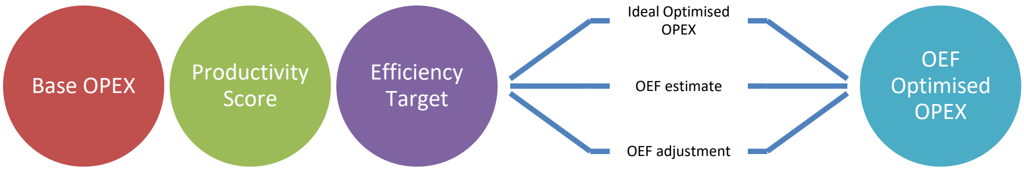
Provisionally, for the purpose of demonstrating the calculations in this report, we use an $OPEX\$^{Efficient}_{exc\,OEF}$ derived using the productivity scores from the latest 2016 productivity report and OPEX data in the accompanying benchmark RINs. The historical OPEX, efficiency target and resulting ideal optimised OPEX equated with the efficient OPEX exclusive of OEFs are provided in Table 8 below for each DNSP.

Processes for application of OEF estimate

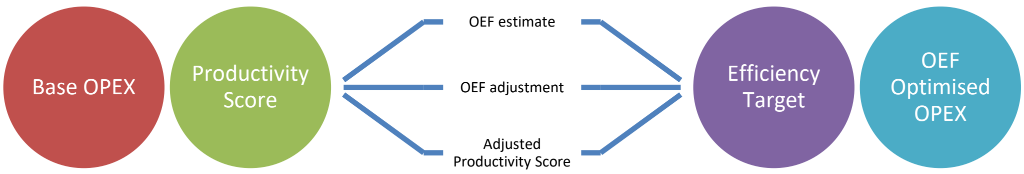
Figure 1 in Section 2.2.2 introduced the optional processes for application of the OEF estimates to modify the productivity scores and/or ideal optimised OPEX. Figure 3 provides a simplified schematic distinguishing these processes, as they depend on the AER's regulatory discretion in the selections of the comparison point and reference point, and in the process for deriving efficiency targets from productivity scores.

Figure 3 Processes for the application of OEFs

Process A



Process B



In particular, as demonstrated for the current OEF estimates in Table 6, the OEF optimised OPEX derived by these two processes is identical when the method of selecting the reference point is the same as that for selecting the comparison point, except for members of the reference group. The difference for members of the reference group occurs because of the AER's process of capping efficiency target for members of the reference group as the comparison point is selected as the lowest member of that group. [27]

Table 6 Process outcomes are dependent on the selection of comparison/reference points

DNSP	Reference Group	OEF adj Efficiency Target - Process A	OEF Optimised OPEX - Process A	OEF adj Efficiency Target - Process B	OEF Optimised OPEX - Process B
Evoenergy	No	58.0%	$43,044	58.0%	$43,044
Ausgrid	No	60.0%	$391,880	60.0%	$391,880
CitiPower	Yes	102.0%	$56,970	100.0%	$55,840
Endeavour	No	79.9%	$218,330	79.9%	$218,330
Energex	No	82.7%	$318,073	82.7%	$318,073
Ergon	No	75.6%	$276,757	75.6%	$276,757
Essential	No	79.0%	$311,834	79.0%	$311,834

[27] In mathematical terms, the function of limiting the efficiency target of those in the reference group with productivity scores greater than the comparison point to one (or 100 percent) is a non-distributive function. Unlike simple multiplication where $A*(B+C) = A*B+A*B$, where $f(x)$ describes the capping function then $f(A*B) \neq f(A)*f(B) \neq A*f(B)$.

DNSP	Reference Group	OEF adj Efficiency Target - Process A	OEF Optimised OPEX - Process A	OEF adj Efficiency Target - Process B	OEF Optimised OPEX - Process B
Jemena	No	93.3%	$68,200	93.3%	$68,200
Powercor	Yes	100.9%	$192,363	100.0%	$190,734
SAPN	Yes	100.8%	$250,300	100.0%	$248,377
AusNet	Yes	100.0%	$206,141	100.0%	$206,141
TasNetworks	No	93.6%	$60,521	93.6%	$60,521
United Energy	Yes	100.5%	$118,263	100.0%	$117,721

The ideal optimised OPEX is used as the denominator in calculating percentage OEF estimates from dollar OEF values estimates as the first, best estimate of efficient OPEX exclusive of OEFs. While useful to the derivation of OEF adjustments, this is not integral to the process of applying these OEF adjustments to the derivation of either productivity scores or OEF Optimised OPEX.

There are different outcomes for all DNSPs when the AER's previous practices for selection of the comparison point (as the lowest of the reference group) and reference point (as the customer weighted average of the reference group) are followed, as demonstrated in Table 7. In this case, the effect of the capping function is observed not only for the reference group. It also has the effect that the slightly negative OEF adjustment for the comparison firm (Powercor) translates into a slight lift for non-reference group firms when taken into account in Process B.

Table 7 Alternative process outcomes with previous practice for selection of comparison/reference points

DNSP	Reference Group	OEF adj Efficiency Target - Process A	OEF Optimised OPEX - Process A	OEF adj Efficiency Target - Process B	OEF Optimised OPEX - Process B
Evoenergy	No	57.6%	$42,752	58.0%	$43,048
Ausgrid	No	59.6%	$389,240	60.0%	$391,940
CitiPower	Yes	101.3%	$56,585	100.0%	$55,840
Endeavour	No	79.4%	$216,896	79.9%	$218,401
Energex	No	82.1%	$315,931	82.7%	$318,122
Ergon	No	75.2%	$275,072	75.7%	$276,980
Essential	No	78.5%	$309,839	79.1%	$311,988
Jemena	No	92.7%	$67,727	93.3%	$68,197
Powercor	Yes	100.2%	$191,049	100.0%	$190,734

DNSP	Reference Group	OEF adj Efficiency Target - Process A	OEF Optimised OPEX - Process A	OEF adj Efficiency Target - Process B	OEF Optimised OPEX - Process B
SAPN	Yes	100.1%	$248,589	100.0%	$248,377
AusNet	Yes	99.3%	$204,722	100.0%	$206,141
TasNetworks	No	93.0%	$60,089	93.6%	$60,506
United Energy	Yes	99.8%	$117,452	100.0%	$117,721

2.3 Calculation approach

The starting point for the present analysis is the key outputs from the econometric benchmarking, and in particular the SFACD model. Our interpretation of relevant outputs for the purpose of assessing OEFs is set out in Table 8.

The first column (base OPEX) is the estimate of total OPEX prior to application of economic benchmarking to estimate ideal or OEF optimised OPEX. The AER's process deriving base OPEX is outside the scope of this review, so for simplicity a single year of historical OPEX is used only for the purpose of demonstrating how these calculations.

The next two columns represent the results from econometric benchmarking. The second column represents the relative productivity score output from the EI model for the 2016 benchmarking report (benchmarking period 2006 to 2015), highlighting the 0.772 score for AusNet as the fifth ranked score.

The fourth column represents the efficiency target obtained by the AER from the ratio of a DNSP's productivity score with that of the DNSP selected as the comparison point; in this case this fifth ranked score in keeping with AER's past practice. As a result of selecting a firm other than the first ranked DNSP as the comparison point, all firms in the reference group with scores above/equal to the comparison point are deemed efficient, and their efficiency targets are capped at 100 per cent.

Table 8 Departure point for OEF analysis ($June 2015)

DNSP	Base OPEX	Productivity score	Rank	Efficiency Target	Optimised OPEX
Evoenergy	$74,201	0.441	13	57.1%	$42,402
Ausgrid	$652,692	0.453	12	58.7%	$383,230
CitiPower	$55,840	0.922	2	100.0%	$55,840
Endeavour	$273,242	0.588	9	76.2%	$208,106
Energex	$384,682	0.624	8	80.9%	$311,043
Ergon	$365,893	0.516	11	66.9%	$244,630
Essential	$394,604	0.566	10	73.4%	$289,591

DNSP	Base OPEX	Productivity score	Rank	Efficiency Target	Optimised OPEX
Jemena	$73,080	0.725	7	94.0%	$68,661
Powercor	$190,734	0.957	1	100.0%	$190,734
SAPN	$248,377	0.809	4	100.0%	$248,377
Ausnet	$206,141	0.772	5	100.0%	$206,141
TasNetworks	$64,629	0.749	6	97.0%	$62,684
United Energy	$117,721	0.871	3	100.0%	$117,721

Source: Sapere interpretation of AER econometric modelling outputs and RIN data

The final column provides the resulting ideal optimised OPEX for each DNSP, being the product of the historic OPEX and the efficiency target for the relevant benchmark period. Being derived from the 'raw' productivity scores, the ideal optimised OPEX is prior to any consideration of OEF adjustments.

In this section above we discussed the definition of quantified OEFs as a percentage relative to a DNSP's efficient OPEX exclusive of OEFs. As a top down method the efficient OPEX exclusive of OEFs is not known, *ex ante*. Hence we follow the AER's practice to approximate a DNSP's efficient OPEX exclusive of OEFs with the ideal optimised OPEX.

2.3.1 Overall approach to quantifying OEFs

In assessing the impact of a candidate OEF on OPEX, we have referred to evidence regarding the impact on the actual OPEX of each of the 13 DNSPs. This includes reference to evidence on the relative exposure to an OEF category, along with relevant individual OPEX line items in RIN returns, where available.

A key challenge is assessing whether all of the incremental OPEX arising from a candidate OEF is attributable to that OEF, or whether some proportion is endogenous and represents inefficiency. If the assessment relied solely on actual OPEX for the DNSP under consideration, and this included an inefficient component, then the OEF adjustment could overstate the impact of the OEF candidate on efficient OPEX for that DNSP. On the other hand, if the productivity score for any (non-frontier) DNSP were applied, this would likely understate the impact of the OEF candidate on efficient OPEX for that DNSP.

This is because, to the extent the OEF candidate meets the OEF criteria and is material, then the productivity score is not a useful guide to assessing the efficiency of the OPEX associated with the OEF in question. The productivity score does not decompose OPEX and hence represents a relationship between total OPEX (including overheads) and the outputs as defined in the SFA model. It could be expected, however, that productivity may vary between different activities within a DNSP. Consequently, overall productivity for an individual DNSP may not be a useful guide to the efficiency of any particular activity within that DNSP. These two points are independent but may interact, further reducing the usefulness of overall productivity scores for assessing the efficiency of any activities significantly affected by a candidate OEF.

The chosen approach is to seek to navigate a middle course between over or under-estimating the quantification of an OEF. As explained in detail for example in Section 2.3.1 below regarding the quantification of the sub-transmission/licence condition OEF category, the approach seeks to identify:

- a verifiable volume metric for differences in exposure to an OEF category – for example the proportion or count of assets affected; and
- an efficient unit cost metric relative to the OEF category (or cost subcomponent of that category).

While the approach to calculating a unit cost metric varies between OEF candidates relative to available data, in each case an assessment is made that the metric reflects efficient costs. This includes consideration of the reference group, but it is not assumed that the unit costs of non-reference group DNSPs are automatically inefficient (and conversely that the unit costs of a reference group firm are automatically efficient).

The unit cost metric is then applied to the volume metric to derive an initial total estimated efficient increment to OPEX. This is compared with an estimated or observed actual cost. This may be from an individual OPEX line item where available from RIN returns. Where there is a difference between the estimated efficient cost, and the estimated or observed actual cost, this implies that some portion of the observed OPEX is attributable to factors other than the OEF in question. Where there is no difference between the two, this may indicate that estimated total (or actual) OPEX in relation to that OEF is likely to be efficient.

Once an assessment of total OPEX in relation to an OEF category has been identified, consideration is given to whether the initial estimate needs to be amended to reflect efficient OPEX incremental to that already provided for an ideal optimised OPEX (through the econometric benchmarking). For example, for sub-transmission overhead lines, the initial estimate is adjusted to reflect an assessment that the SFACD model would already compensate for the efficient OPEX as if the same overhead line length were distribution instead of sub-transmission. In this case, the AER's previously stated view is that the unit OPEX of sub-transmission overhead lines is two times the distribution unit OPEX. Accordingly, in this assessment, the initial estimate of total OPEX for overhead sub-transmission is divided by half so that only the incremental component represents the OEF estimate. As discussed earlier in this section, there is a further adjustment to the OEF estimate to take into account the reference point for each OEF.

The approach adopted for quantification is, by construction, a first order, linear estimate of the efficient OEF OPEX. This reflects both that, in terms of developing an economic model that reflects the reality of the industry, OEFs represent a second order improvement of the accuracy of the SFA model, and that OEFs relate to variable costs.

While the approach adopted is considered better than relying either on estimated incremental OPEX or applying productivity scores to estimated incremental OPEX, it is recognised the resulting OEF estimates are nevertheless imperfect. This reflects, for example, differences in efficient unit rates that are attributable to the nature and impact of the OEF, to differences in scale and other non-linear effects.

One further consideration is that, in previous approaches to quantifying OEFs, in the process of converting an OEF dollar value into an OEF percentage estimate, the error arising from any inefficient component of the numerator/denominator is less significant than the use of a denominator that is inclusive of other OEFs. This underpins our consistent adoption of ideal optimised OPEX as the denominator in such calculations.

While acknowledging these limitations, it should be noted that the AER's OEF framework is an adjunct to econometric benchmarking. It is therefore fundamentally more of a 'top down' approach than a 'bottom up', engineering or activity based approach to assessing OPEX. The objective is to optimise the economic benchmarking outputs relative to varying operational environments, to the extent the econometric benchmarking does not fully take into account candidate OEFs that meet the OEF criteria. As such, the current project fits into a program of continuous development of the econometric benchmarking.

2.3.2 OPEX-CAPEX trade-offs

Differences in OPEX over time or between firms can in part be accounted for by variations in OPEX vs. CAPEX decisions over time or between firms. For example, a DNSPs utilising more expensive steel poles and termite proof cables will have an insignificant termite related OPEX compared with DNSPs with a large fleet of cheaper untreated wood poles that will have a material OPEX cost to manage the impact termites can have on these assets.

This means that, over time, OPEX-CAPEX trade-offs are within management control. Hence OEF candidates relating to these trade-offs may not meet the exogeneity criterion.

CAPEX / OPEX trade-offs for candidate OEFs in this project have been considered. If the CAPEX / OPEX trade-off is a material driver of the efficiency target, then an inverse relationship between CAPEX benchmarks and OPEX benchmarks would be evident in the econometric analysis. This is not the case.

In general, OPEX/CAPEX trade-offs do not appear to be a significant driver of variations in OPEX productivity scores between DNSPs. This reflects our understanding that the partial and total productivity scores from the econometric benchmarking are broadly in alignment.[28] This suggests that differences in apparent OPEX productivity are unlikely to be attributable to differences in asset intensity.

Looking forward, some industry dynamics need to be taken into account in considering OPEX vs. CAPEX. An example presented by multiple DNSPs is cloud based provision of information technology services, as an alternative to the capital purchase of technology assets. This suggests that OPEX vs. CAPEX may continue to require attention in the AERs OPEX benchmarking process and the evolution of the AERs benchmarking program. This can be addressed under the 'step change' assessment in the consideration of OPEX in future regulatory resets. We understand that the AER is currently reviewing differences in cost allocation and capitalisation polices between DNSPs, and their effect on benchmarking.

2.3.3 Adjustment for inflation

Quantifying OEFs inevitably involves comparing and/or combining expenditure from different reporting periods. For commensurability, all dollar values are converted into June

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28 The one exception ActewAGL and related to the capitalisation OEF, As discussed in Section 3.9, following revisions to RIN data, this OEF is no longer required.

2015 dollars in this report. Complicating this, it should be noted the data reporting periods are calendar years for Victorian DNSPs and financial years for all other DNSPs.

Similar conversions have been made by the AER for each previous decision. This means there is some variation between our estimates from the AER's previous findings on OEFs simply from updating various OEF estimates from different periods to one common period.

The AER's calculations have been consistent in that all AER methods utilise the same Australian Bureau of Statistics 6401.0 Consumer Price Index series, specifically series A2325846C (Index Numbers; All groups CPI; Australia). However, we have observed a variety of calculations for obtaining conversion factors from ABS indices.

We have obtained two conversion series of the multiplications factor to convert $1 in the calendar/financial year to $(June 2015) – the latest year for which we have benchmarking data, including operating expenditure – by the ratio of the ABS indices for June 2015 and either June (mid-calendar year) or December (mid-financial year).

2.3.4 Annualisation

As noted earlier, the efficiency target used to derive ideal optimised OPEX flows from the benchmarking period applied in the econometric benchmarking. This means that in deriving OEF estimates, duration and frequency issues need to be taken into account as the impact of the OEF over the period is summarised in an annual average value.

Benchmarking period

The 2016 economic benchmarking report provides analysis for a ten year benchmarking period. The previous results of the AER's benchmarking analysis reflect the average distance from the defined frontier for the relevant DNSPs over defined benchmarking periods. [29] The period varies depending on the DNSP, and the time of the previous AER decision. Consequently, updating information for this report may involve either extending the benchmarking period, updating the real dollar value, or both. As explained in Section 1, the calculations in this report do not take into account the 2017 economic benchmarking report.

Annualisation of effects shorter than the benchmarking period

A number of material OEFs have undergone step changes over the benchmarking period. This often reflects changes in regulation. A notable example is the introduction of new bushfire regulations in Victoria. In the AER's 2015 Queensland decisions, it noted that regulatory costs for Black Saturday regulations were in place for three of eight benchmarking years, so diluted annualised cost based on available data by three eighths.

For consistency, we have applied this approach for every OEF, where applicable. Most notably, however, the dilution factor has changed compared with prior analyses because the benchmarking period is longer – in the bushfire example the regulations have now been in effect for half of the benchmarking period.

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29 See for example AER, Annual benchmarking report - Electricity distribution network service providers, November 2016 and AER, Ausgrid final decision, Attachment 7 page 70.

Consequently, for a number of OEFs, there is an explicit annualisation step. This involves assessing the duration or probabilistic incidence of the OEF within the benchmarking period. For example, if a regulatory OEF is deemed to meet the criteria for five years out of the benchmarking period, then the initial estimate of the OEF will be divided by two in the annualisation calculation.

We are aware of the potential objection to this approach, namely that data toward the beginning of the benchmarking period may not be as useful as data toward the latter part of the benchmarking period. We consider that is principally a matter to be addressed in the economic benchmarking analysis. The annualisation step in the OEF analysis may be adjusted accordingly, following any change to the economic benchmarking analysis.

Low frequency events

A number of OEFs relate to events, typically climate related, that while randomly occurring at low frequency, are nevertheless regular and significant enough to be annual or semi-annual events with associated OPEX that may systematically differ between firms. Although the total impact of individual events will vary each year, it can reasonably be expected that Ergon will incur material incremental OPEX associated with the minimisation, preparation and response to cyclones.

It is useful to think of these low frequency events as a group and to apply a consistent approach to estimation of the effect on OPEX of these OEFs. This also highlights potential boundary issues. For example, for bushfires, a significant element of expenditure is risk avoidance and minimisation, and this may form part of ongoing OPEX, not captured in emergency response expenditure data.

In considering OPEX costs in relation to low frequency events, we consider the following four elements.

1. **Avoidance/minimisation.** This includes OPEX incurred at any time to avoid or minimise the impact of future low frequency events. This may include incremental asset inspection and maintenance cycles. These may in turn relate to vegetation management (bushfires and storms), earthworks management (floods) and ongoing asset checking and maintenance (e.g. to maintain adequate tension on feeders to reduce line sag etc.).
2. **Emergency preparation.** This includes costs incurred in preparation for an expected event, even if the event does not incur. This may include pre-positioning crews and equipment and additional avoidance/minimisation activities over and above "normal". It may also include increasing call centre resources and other additional activity.
3. **Emergency response.** This includes additional truck rolls in response to specific reports of damage etc. It may also include hiring additional resources, repositioning resources, over time, and so on.
4. **Repair and restoration.** This may include the incremental cost of short term fixes (e.g. portable generators etc.), along with any additional repair and restoration costs, depending on capitalisation policies.

Annualising these costs must give consideration not only to the total costs within the benchmarking period, but also to the relative frequency with which such costs are incurred.

High impact, low probability events

Both the frequency and severity of climatic events damaging to network services occur under probability distributions that include rare, **high impact low probability** (HILP) events. By definition, HILP events are less likely than the low frequency events discussed above. If an event has a climatic return period substantially greater than the benchmarking period, then in some way this extraordinary event is likely to distort the economic benchmarking, either in the Economic Insights' SFA model or in the OEF adjustments.

HILP impact on annualised costs

The econometric benchmarking model effectively considers annualised averages over the benchmark period, and the OEF process seeks to identify annualised averages to quantify adjustments to the SFA model. Table 9 below illustrates three examples identified where HILP events materially change the annualised cost of an OPEX item. In each case identifiable weather events (OEF cause) are associated with specific costs (OEF effect).

Table 9 Impact of HILP events on annualised OPEX

DNSP	OPEX item	Average (inc HILP)	Average (ex HILP)	HILP increase
Energex	Emergency Response	$7,407	$3,081	240%
Ausgrid	Emergency Response	$3,262	$2	181115%
SAPN	GSL	$7,963	$4,958	161%

Source: Sapere-Merz analysis of RIN data

In each case above the climatic return period has been rated between 25 and 100 years, i.e. significantly exceeding the benchmarking period. As there is evidence that climate change is reducing the return period for some types of events, including cyclones above a certain wind speed or precipitation volume, looking forward, it may be necessary to monitor changes in future climatic return periods.[30]

In calculating OPEX excluding the HILP events in Table 9, we have excluded the additional cost of the event – that is we have accounted for the event as if the associated cost were average. In each case including the full costs of the HILP event significantly increases the annualised cost of the OPEX item for the benchmark period.

Impact of Economic Insights' SFA model

Do these HILP events have an impact on the Economic Insights' SFA model? Our conclusion, following consultation with Economic Insights, is that they do not. The potential inaccuracy in the efficiency score due to the inclusion of the additional HILP OPEX needs to be considered relative to the inclusion of the error term in the model:

30 See for example *Does global warming make tropical cyclones stronger?* Stefan Rahmstorf, Kerry Emanuel, Mike Mann and Jim Kossin 30 May 2018

- The additional HILP OPEX may be significant compared to the disaggregated component of OPEX, as in the examples above, but will be much less so compared to total OPEX employed in the econometric model.
- The error terms in the econometric model encompass a wide range of effects and events, of which HILP events are only one, and unlikely to be dominant. [31]
- In practice, pass-through provisions will also reduce the OPEX impact of HILP events.

Our conclusion is that HILP events of themselves do not constitute an OPEX driver likely to require an OEF. This is consistent with the AER determination on non-recurrent costs that including an annualised average OEF adjustment for non-recurrent costs has the effect of making them recurrent. Including the total cost of a HILP event in an OEF has the effect of making these rare climatic events regular events (relative to the benchmarking period). The duplication criterion is also cited, as with the analysis above the SFA model effectively accounts for non-recurrent costs through annualisation and error terms

[31] We note AusNet Services' submission specifically questioned whether the normal distribution in stochastic variance term is an appropriate distribution for HILP events. This acknowledges that the impact of HILP events is likely to be more one-sided than symmetrical. While deferring to Economic Insights authority regarding their model, we observe the number and scale of other factors contributing to the error term reduces the significance of potential deviation from the normal distribution for this one factor.

AER on non-recurrent costs[32]

'We are not satisfied that an OEF adjustment should be made for non-recurrent costs. Providing an OEF for non-recurrent costs would treat those costs as if they were recurrent. Economic Insights' benchmarking results are used as the basis for our forecast of opex. If we adjust the benchmarking results with an OEF adjustment for non-recurrent costs, it has the effect of including those non-recurrent costs in our opex forecast.

Additionally, an OEF adjustment for a non-recurrent cost would not meet the duplication OEF criterion. Economic Insights' SFA model takes non-recurrent costs into account. The SFA efficiency scores are based on the average performance of service providers over the period. Therefore the effects of transitory increases or decreases in relative opex efficiency are reduced. Also SFA modelling accounts for transitory variations in data using a compound stochastic variance term. This statistical technique accounts for random shocks in opex.'[33]

Impact on OEFs

The results above clearly indicate HILP events can distort the annualised average cost of an OPEX category considered as part of a potential OEF. Following the foregoing argument, shocks for rare high impact events (the additional OPEX above typical OPEX for such events) should be excluded from OEF adjustments on the principle of duplication and/or the effect of making recurrent costs from extraordinary costs. Alternatively the value of OPEX associated with a HILP event may be included, reduced by a factor that accounts for the relativity between the benchmarking period and the climatic return period.

This requires care in the assessment of climatic events and the corresponding DNSP expenditures to determine whether these events and associated costs are qualify for consideration as HILP events, and their adjusted inclusion or exclusion in the OEF adjustments, as appropriate. This is likely to require reference to climatic data and metrological and actuarial expertise to correctly annualise cost.

2.4 Data sources

The project began with a desk top review of existing material held by and generated for the AER in the course of previous regulatory decisions with respect to Queensland, NSW and the ACT.

Among the challenges in extending the OEF framework to non-assessed DNSPs is the relative absence of data on OEFs for the other eight DNSPs in the NEM or in the process of joining the NEM (P+WC). Accordingly, in the course of this project additional data was sought from the non-assessed DNSPs.

32 AER, Ausgrid final decision 2015–19,Attachment 7 – Operating expenditure, p7-184

33 Aigner, D.J., C.A.K. Lovell and P. Schmidt, Formulation and estimation of stochastic frontier production function models, Journal of Econometrics 6, 21-37, 1977, p. 25.

The information sought, with assistance from the AER, was readily available qualitative information. Views of the eight non-assessed DNSPs were sought on whether any of the current material OEFs would be applicable, and whether any other OEF categories might be material.

We refer to and rely on the same data sources as the AER, except where explicitly stated otherwise. Data sources include:

- Information in the AER's Appendix 7 for each Draft and Final Regulatory Determination for the group of six.
- Data supplied by DNSPs for the purpose of both Economic Benchmarking and Categorical Analysis Regulatory Information Notices (RIN).
- Data supplied by DNSPs in or accompanying submissions from DNSPs through regulatory decision making processes
- Information in the AER's Appendix 7 for each Draft and Final Regulatory Determination for the remaining DNSPs.
- Other publicly available relevant data regarding weather and other extreme events, including from the Bureau of Meteorology (BOM) and the Australian Bureau of Statistics (ABS)
- Publicly available information regarding the economic impact of regulations. For example, regulatory impact assessments of Work Health Safety regulations for the Commonwealth, NSW and WA governments.

In assessing information for the purpose of quantifying an OEF (accepted as meeting the three OEF criteria), for an individual DNSP or set of DNSPs, we have set aside consideration of productivity scores. This reflects a view that productivity scores may not provide a useful guide as to the relative performance of the DNSP with respect to the OEF in question. As discussed below, this approach has contributed to method and data that has been applied to quantify the OEF in question. This in turn has influenced the quantification with respect to a number of OEFs.

For a number of candidate OEFs, currently available data is not sufficient to form even a preliminary view. In other cases, preliminary estimates set out in this report could be amended in light of new information and data.

2.5 Conclusion

Overall, care must be taken in describing and calculating the likely effect of each operating factor. These calculations intertwine with the processes for their application, and hence decisions subject to regulatory discretion, in addition to issues to do with the definition, sources of data and calculations for each individual OEF.

Some clarifications and changes to the underlying OEF methodology, and for greater consistency in the application of the methodology across OEFs, are proposed. The proposed changes do not affect the exercise of regulatory discretion in terms of the selection of the comparison point for deriving ideal optimised OPEX, the selection of the reference point for deriving OEF adjustments, or the capping of the efficiency target for the reference group.

Therefore, the primary results of this study are the OEF estimates in dollar terms for the reference year, where the subsequent results are conditional on either temporal assumptions or the preferences of the regulator in decisions that accommodate regulatory discretion.

- The OEF estimates in percentage terms have been calculated assuming as the denominator the ideal optimised OPEX derived from the productivity scores obtained in 2016 applied to historical OPEX.
- The OEF adjustments have been calculated using the reference point selected by the AER's existing practice (customer weighted average of the reference group in the reference year).
- The derivation of OEF Optimised OPEX from these OEF adjustments is strongly dependent on regulatory discretion in a range of decisions in their application, with two overall processes available for application to the entire group of DNSPs. The overall values calculated here have been calculated using the process more similar to previous practice as applied to DNSPs in the non-reference group.

After these conditions of the conceptual framework, there are a range of practical considerations in the calculation of OEF estimates. Some of these calculation issues lead to OEF adjustments varying from the AER's previous adjustments even when where we have used the AER's data for the OEF dollar estimate. These factors include the periods used for adjustment for inflation and annualisation.

3. Analysis of material OEFs

3.1 Introduction

Drawing on the analysis set out in Section 2, this section identifies the most material factors driving apparent differences in estimated productivity and operating efficiency between the distribution networks in the NEM, and quantifies the likely effect of each factor on operating costs in the prevailing conditions.

For convenience, the set of material OEFs identified in this report are as follows:

1. Subtransmission and licence conditions
2. Vegetation management
3. Taxes and levies
4. Termite exposure
5. Extreme weather – cyclones
6. Backyard reticulation.

In addition to the set above, this chapter also discusses other OEF candidates that are found not to meet the OEF criteria when considered across the group of DNSPs as a whole:

- Harmonisation of WHS regulations
- Severe storms.

Use of regression analysis in this report

The use of regression analysis to establish relationships between key factors must be interpreted with care. Correlation does not imply causality.

Across a sample size of 13, regression analysis can assist in identifying relationships between variables that may require further investigation. For example, if a material OEF is not accounted for in the econometric benchmarking, other things being equal, a firm with the greatest exposure to that OEF is more likely to have a lower productivity score than a firm with the lowest exposure to that OEF. Where an apparent correlation exists, it is of course possible there are explanations other than the OEF of interest.

Regression analysis has been used in the report to identify areas for further analysis. Examples of this are when seeking to test whether a candidate OEF may have already been addressed in the econometric analysis and hence affected by the duplication criterion. In general, a weak correlation between a candidate OEF factor (or a secondary determinate of a factor) and productivity scores has been interpreted as indicating that the candidate OEF is more likely to have been addressed in the econometric analysis (duplication may be present). On the other hand, a stronger correlation between a candidate OEF factor and productivity score has been interpreted as indicating the candidate OEF is less likely to have been addressed in the econometric analysis (non-duplication is more likely). In either case, further inquiries and consideration of diverse evidence are required before firm conclusions as to causality can be drawn.

3.2 Sub-transmission and licence conditions

The boundary between sub-transmission and distribution varies as a result of historical decisions made by state governments when establishing distribution and transmission electricity corporations. These decisions in turn reflected variations in the historical boundaries between vertically-integrated bulk supply organisations, owned by the State Government, on the one hand, and distribution and retail, often owned by local governments, on the other. Consequently, DNSPs are responsible for varying amounts of higher voltage assets.

Variations in sub-transmission OPEX between DNSPs reflect a number of variables, including differences in:

- total sub-transmission capacity as a proportion of maximum demand; and
- within overall sub-transmission capacity, the mix of sub-transmission transformer and lines capacity.

These variables in turn reflect differences in:

- the historical boundaries between transmission and distribution assets on the establishment of DNSPs;
- the extent to which the DNSPs supply large customers at sub-transmission voltages;
- density of sub transmission substations resulting in varying installed transformer density as a result of the efficient application of planning criteria;
- planning and reliability regulations ("licence conditions"); and
- the extent that capacity investment responded to changing forecast and actual demand patterns ('capital governance').

These differences may result in under- or over-estimation of OPEX efficiency between DNSPs. The AER has previously determined that both sub-transmission and licence conditions meet the OEF criteria and made two OEF adjustments accordingly. For reasons explained below, in this report the sub-transmission and licence conditions OEFs are considered jointly.

3.2.1 Assessment against OEF criteria

Sub-transmission

Sub-transmission related OPEX is assessed to meet all three OEF criteria. The historical boundary between transmission and distribution businesses, and the extent of demand provided at medium to high voltage (greater than 33kV), are outside the control of DNSPs. These are exogenous variables.

Variations in sub-transmission OPEX are not fully accounted for in the econometric benchmarking. The line length metric only partly accounts for sub-transmission line length. It captures the length but not the incremental cost of maintaining sub-transmission lines compared with distribution lines. Similarly, the ratcheted maximum demand metric does not take the cost of servicing sub-transmission transformer capacity into account. Sub-transmission is assessed to meet the materiality criterion.

What drives higher sub-transmission OPEX?

Sub-transmission assets require more OPEX per unit asset than distribution assets. From our analysis of RIN data, we have concluded that corrective and preventative operating and maintenance OPEX for a typical zone substation is almost four times that for a typical distribution substation on a per kVA basis. The maintenance of sub-transmission lines and cables is also more costly than for distribution per unit asset. In its previous decisions, from analysis of Ausgrid data, the AER found the unit cost of maintaining transmission assets was around double that for distribution assets, on a per-km basis.[34]

Sub-transmission assets principally consist of transformers, insulators, lines, cables and associated facilities. For lines and cables, the associated facilities include underground and overhead structures. For transformers, the associated facilities include the land and property on which the transformers are located and housed (substations).

For both types of sub-transmission assets, there is associated OPEX. For transformers this involves operating and maintaining sub-transmission substations. For open switchyards, this includes maintaining security and fencing, along with vegetation management and ground surface water control. For substations in urban areas, and especially in CBDs, this is likely to require operating, maintaining and protecting a significant enclosed space.

Sub-transmission transformers are significantly larger and more complex to maintain in comparison to distribution transformers. This is a function of the more regular on-site inspections and the need to maintain more complicated equipment such as automatic tap changes, bulk oil transformers with cooling and breathing systems, large scale breakers and switches, and secondary systems.

As a larger transformer generates more heat, there is also a higher cooling requirement. For enclosed substations, in urban and especially CBD areas, this may require air conditioning. Since the reliability impact of any sub-transmission outage is more significant than a distribution outage, there is a need for increased monitoring, maintenance and physical protection of sub-transmission transformers.

Distribution transformers, the low voltage system offer a reasonable degree of flexibility in terms of relocations, alterations, modifications and new connections. This means that any spare capacity can be more readily relocated or diverted (through network reconfiguration) to other areas, or potentially withdrawn from service, in response to changing demand.

Distinction between distribution and sub-transmission assets

The critical consideration in drawing a distinction between distribution and sub-transmission is establishing the change in the nature of the assets that will drive material cost differences in OPEX.

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34 AER, Draft decision Ausgrid distribution determination 2014-19, Attachment 7: Operating expenditure, p7-192.

We recognise the traditional technical definition of transmission and distribution as being:

> *Transmission elements support point-to-point transmission of electricity, whilst distribution elements support the movement of electricity between a single zone substitution supply point and many load points.*

These technical differences are supported by different electrical protection arrangements. We are aware that in many instances voltages at 33kV and below are used to fulfil point-to-point transmission functions.

We have chosen not to adopt this traditional technical definition of transmission and distribution elements for defining the OEF (increment in costs), driven by increased asset technical complexity of DNSPs with larger sub-transmission networks relative to others. For this economic purpose, we have selected the following definitions for each asset group.

Lines and Cables

For Lines and Cables a simple voltage delineation of 33kV and below for distribution has been adopted. The reasons for this are provided below.

1. In our experience, work practices, skills and capabilities are similar for voltages 33kV and below, and typically involve the sharing of crews. These include construction and maintenance techniques such as cable jointing, overhead line insulator and switch maintenance etc. Above 33kV there is increased prevalence of specialised equipment and capabilities required for maintenance, including: larger Elevated Work Platforms (EWP) to gain access; and the capability to work with specialised cables, insulators, lattice towers etc. that commonly require the employment of different crews with greater experience and training and more specialised equipment. By extension, travel distances and times would be greater for these specialised crews. These factors increase the (unit) maintenance costs of higher voltage (sub-transmission) assets relative to lower voltage (distribution) assets.

2. The load capacity of a circuit is directly related to voltage and current carrying capability. The impact of losing a circuit is related to the load not served in the event of a failure.[35] Therefore, prudent risk management tends to drive increased maintenance expenditure on larger voltage, higher capacity, higher impact circuits. For this reason, a simple voltage delineation is considered acceptable for present purposes.

3. There is no disaggregation of data in the RINs on circuit lengths by function (point-to-point or distributed loads) and, given the discussion in (1) and (2) above, we do not believe it to be prudent to require all of the DNSPs to provide maintenance cost breakdowns on this basis.

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[35] SAPN submitted that transmission and distribution network assets may have different planning criteria (N versus N-1) that will also impact the load lost. In our view, most interconnected distribution networks operate with a level of redundant capacity to allow loads to be supplied in the event of the failure of a network element (N-1 after an outage during which the network is reconfigured). We accept that 33kV and below assets that supply loads without redundancy (on an N basis) may be subject to increased preventative maintenance activities compared to more standard distribution networks. However, these cost drivers are a function of network topology rather than the transmission / distribution function. That is, a 132kV radial transmission line may also be subject to increased preventative maintenance compared to a typical interconnected transmission line. The topic of network topology is discussed further in section 4.2.

As an associated issue, in calculating the incremental cost of sub-transmission asset maintenance, we have relied on the AER's existing information which was derived from a single DNSP. DNSPs may in the future wish to propose a more nuanced approach distinguishing any significant differences in the cost of maintaining equipment at 11kV, 22kV, 33kV and above. We can envision, for example, a calculation based on multipliers for each voltage. At present, we have no grounds for assigning different cost values to each voltage band.

Substations

Analysis of the cost drivers for substations has identified that a strict delineation between distribution and sub-transmission on the basis of voltage is not appropriate. Ausgrid, Endeavour and Energex have large number of 33kV to 11kV substations with transformers between 15MVA and 40MVA in size. We have concluded that the maintenance costs of these transformers, the associated substations sites and secondary equipment would be more reflective of the costs of maintaining a sub-transmission or zone substation with supply voltages above 33kV than that of a smaller distribution substation. Thus, the delineation adopted in this report between sub-transmission and distribution substations has been expanded to include the size of the transformer. As a result, transformers with a primary voltage at and above 66kV and transformers with a capacity above 15MVA are designated sub-transmission assets for the purpose of the OEF calculation.

Differences in sub-transmission asset density

Figure 4 compares sub-transmission assets scaled to OPEX for each DNSP. This uses line lengths (km of sub-transmission line per $1M OPEX) and sub-transmission transformer count (sub transmission transformer count per $1M OPEX).

The data shown in Figure 4 highlights that there is significant variation in the make-up of sub-transmission assets (lines versus substations) between DNSPs. The two rural DNSPs have the lowest OPEX relative to circuit km. There is significant variation in OPEX relative to the volume of Sub-transmission transformers.

Figure 5 below provides further detail regarding variations in the composition in reported / calculated sub-transmission OPEX. This chart highlights the high proportion of sub-transmission transformer OPEX reported by CitiPower. It also reflects differences in the proportion of overhead and underground line related OPEX.

This information suggests that the OPEX for both major sets of sub-transmission asset types needs to be accounted for in a sub-transmission OEF. Accordingly, we have sought to account for transformer-related, as well as conductor-related, OPEX.

Figure 4 Sub-transmission asset density

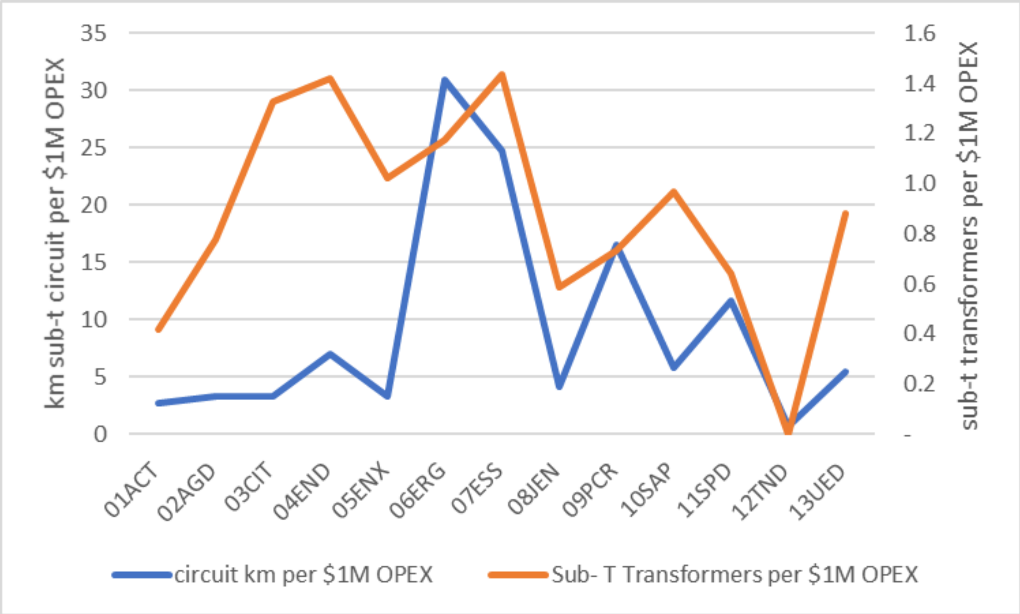
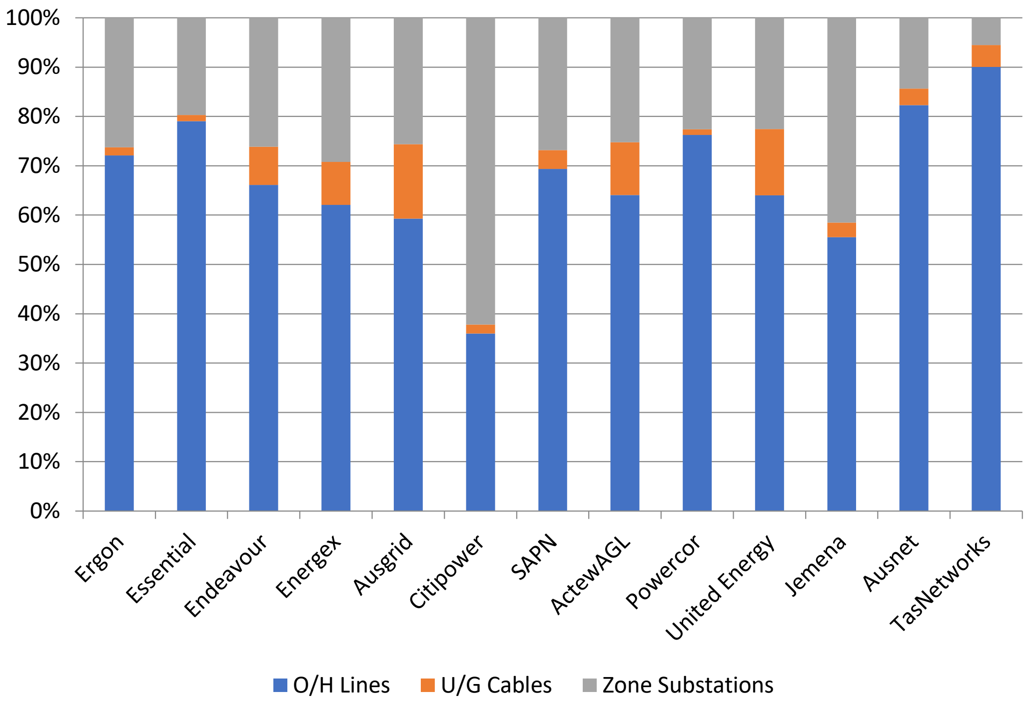


Figure 5 Variations in reported sub-transmission OPEX components



Source: Sapere / Merz analysis of CaRIN data

Reliability standards ('licence conditions')

Viewed independently from other OEFs, regulations or Codes requiring higher levels of network reliability clearly meet the OEF criteria for NSW and Queensland. These reliability requirements are imposed by State-based regulations, or a State-based Code, pursuant to State statutes. The DNSPs may seek to influence but do not control these regulations.

For the period they were in force, State-based regulations required substantial increases in sub-transmission capacity, in order to meet mandated reliability standards. The additional sub-transmission capacity gives rise to higher OPEX than otherwise and this increase is material relative to total OPEX.

Queensland

In Queensland, under an Electricity Industry Code, operating under the Electricity Amendment Bill (2004), Energex and Ergon were required to meet Minimum Service Standard (MSS) arrangements. The MSS limits are a set of network reliability standards that establish minimum levels of network performance for the duration and frequency of outages on the electricity distribution networks. The MSS were set out in Section 2.4 of the Code. The Code required that Energex and Ergon must use their best endeavours to meet these standards.[36]

The Code was implemented in 2005, in response to recommendations made by the Electricity Distribution and Service Delivery (EDSD) review panel. The Queensland Competition Authority (QCA) reviewed MSS limits and reset the initial EDSD targets in 2009. The outcome of the 2009 QCA review was a scaling down of the improvement in reliability targets envisaged by the EDSD, based on the QCA's views on the level of reliability for which customers were willing to pay.

In 2014, the Queensland Government decided to implement the recommendations of the Independent Review Panel on Network costs[37]. Accordingly, MSS were removed from the Code effective from 1 July 2014. In its place, it appears the MSS requirements were transferred to Ergon and Energex pursuant to a Ministerial direction under S115 of the Government Owned Corporations Act (Qld.). In addition, MSS were set at levels applying at 2010-11 levels, being significantly lower than would have otherwise applied from 1 July 2014.

NSW

In NSW, DNSPs operate under licence conditions under the Electricity Supply Act 1995 (NSW). A set of licence conditions for DNSPs, dated 1 December 2007, established design, reliability and performance requirements.[38] Following a review undertaken by the AEMC in 2012, these licence conditions were amended. In the current version of these licence

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36 See page 1, *Review of Minimum Service Standards and Guaranteed Service levels to apply in Queensland from 1 July 2015*, Queensland Competition Authority Draft Decision, March 2014.

37 See page 1 *Review of Minimum Service Standards and Guaranteed Service Levels to apply in Queensland from 1 July 2015,* Queensland Competition Authority, Final Decision, June 2014.

38 See *Design, reliability and performance licence conditions for Distribution Network Service Providers*, Ian Macdonald MLC, Minister for Energy, 1 December 2007.

conditions, the former schedule 1 (Design Planning Criteria) to NSW licence conditions has been removed entirely.[39]

Duplication between licence condition and sub-transmission OEFs

On reviewing licence conditions for NSW, and especially Schedule 1, it is clear these conditions overwhelmingly relate to sub-transmission, not distribution.[40] In its original form, under Schedule 1, the highest security standard (N-2) applied to sub-transmission lines and sub-transmission substations. The same standard also applied to zone substations in the CBD.

A lower standard applied to distribution substations in the CBD (N-1), and to CBD and urban distribution feeders. For urban distribution feeders, the customer interruption duration was four hours compared with nil in the CBD.

The term "CBD" is defined in the Schedule as the area within the City of Sydney that is supplied by the triplex 11kV cable system.[41] Ausgrid is therefore the only NSW DNSP that appears to be materially affected by the distribution component of the licence condition. This is not to say that the licence conditions had a zero impact outside the CBD, only that it is unlikely to be a significant component of OPEX.

Similarly, as noted in a 2015 AER draft decision, in Queensland reliability standards that applied from financial year 2005 to financial year 2012 applied to bulk supply substations and zone substations. Energex was also required to have N-1 redundancy on sub-transmission feeders.[42]

Accordingly, it appears the major impact of the licence conditions in both Queensland and NSW relates to sub-transmission. This reflects the fundamental point that improvements in sub-transmission reliability may have a significant effect on reliability and security for end users, while avoiding the very substantial cost of duplicating the entire low voltage network.

This suggests that the OPEX impact of the largest component of the licence condition OEF would be fully accounted for in the sub-transmission OEF estimate. Incorporating the OPEX impact of greater sub-transmission density in the licence conditions OEF estimate would not be consistent with the non-duplication criterion. Accordingly, any adjustment for this OEF is limited to distribution. As discussed below, in our quantification, we did not identify any material incremental distribution OPEX attributable to licence conditions.

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[39] See for example the current version of these licence conditions for Ausgrid, dated 28 November 2016 and available at: https://www.ipart.nsw.gov.au/files/sharedassets/website/shared-files/licensing-administrative-electricity-network-operations-proposed-new-licence-conditions/ausgrid-ministerial-licence-conditions-1-december-2016.pdf .

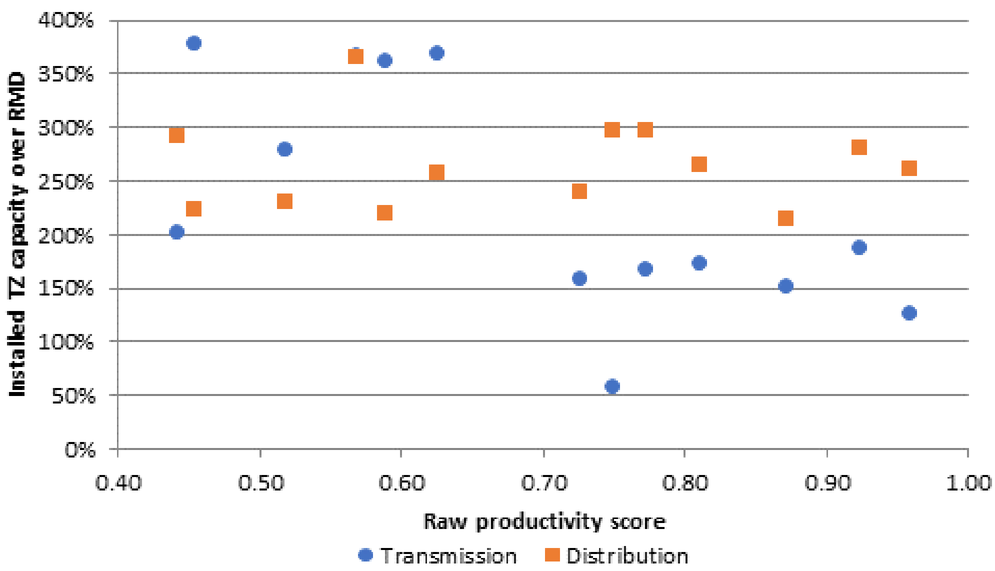
[40] See Schedule 1 (Design Planning Criteria) of the design reliability and performance – distribution network service provider's licence conditions – 1 December 2007, NSW Government.

[41] Ibid. see page 12

[42] See page 232 of Attachment 7 – Operating expenditure; Ergon Energy preliminary determination 2015-20, dated April 2015.

Figure 6 below compares distribution and sub-transmission transformer capacity relative to ratcheted maximum demand and raw productivity scores from econometric benchmarking.

Figure 6 Productivity score relative to sub-transmission capacity over ratcheted maximum demand



Source: Sapere Merz analysis of RIN data

There is a clear pattern relating higher sub-transmission capacity with the five DNSPs that operated under licence conditions. However, the distribution data indicates that, with the exception of one outlier, the DNSPs provide distribution capacity at a relatively constant multiplier of demand, independent of productivity outcomes. This lends support to the view that the distribution component of the licence condition OEF is unlikely to be material.

3.2.2 Finding

Our assessment of the OPEX impact of this OEF relative to the AER's previous assessment of sub-transmission and licence conditions OEFs is set out in Table 10 below.

The final illustrative outcomes are in most cases lower than those determined by the AER and are also lower in aggregate than those in the preliminary report. The drivers of change in the illustrative outcomes between the preliminary report and the final report are discussed below.

- The change from the kVA based definition of sub-transmission asset volumes to a transformer count definition has a material impact on the outcome of the sub-transmission OEF estimates. This difference in outcome is largely a result of the following:
  - The average transformer size varies significantly between DNSPs, resulting in materially different outcomes when using transformer count in place of total kVA. Ausgrid has a relatively high number of large transformers. This results in a significant variation due to using transformer count instead of capacity.

– The installed sub-transmission substation kVA data did not apply the division between sub-transmission and distribution adopted by this analysis. The result of the change to the threshold is that some transformers that may have been previously been included in the total zone substation kVA estimates are now excluded. Endeavour and Energex appear most significantly affected by the exclusion of 22kV and 33kV transformers smaller than 15MVA.

Table 10 Sub-transmission and Licence Conditions (%, $000, $June 2015)

DNSP	AER OEF adjustment		S-M OEF estimate		S-M OEF adjustment	
Evoenergy	0.00%	$0	3.24%	$1,376	-0.84%	-$355
Ausgrid	6.40%	$24,527	5.70%	$21,855	1.62%	$6,215
CitiPower	0.00%	$0	5.49%	$3,065	1.41%	$786
Endeavour	5.60%	$11,654	8.06%	$16,766	3.98%	$8,273
Energex	3.20%	$9,953	5.33%	$16,568	1.25%	$3,874
Ergon	5.30%	$12,965	10.18%	$24,914	6.10%	$14,930
Essential	4.30%	$12,452	10.14%	$29,353	6.06%	$17,535
Jemena	0.00%	$0	2.80%	$1,924	-1.28%	-$878
Powercor	0.00%	$0	4.07%	$7,770	-0.01%	-$14
SAPN	0.00%	$0	4.28%	$10,619	0.19%	$482
AusNet	0.00%	$0	3.37%	$6,944	-0.71%	-$1,469
TasNetworks	0.00%	$0	0.05%	$32	-4.03%	-$2,526
United Energy	0.00%	$0	3.90%	$4,595	-0.18%	-$209
Reference point	0.00%		4.08%			

As discussed in the following section our view is that transformer count is the preferred determinant of sub-transmission substation volumes as: it is a more accurate determinant of maintenance effort; and is derived from a more transparent and auditable data set.

The differences between the previous AER determination and the illustrative outcomes of this report reflect the net effect of:

- The significant OEF estimates for the reference group, such that the reference point for the calculation of the OEF adjustment is significantly higher than calculated by the AER.
- The calculation of the OEF estimates based only on the direct cost differences in sub-transmission density in contrast to averages based on each DNSPs total OPEX adopted by the AER.
- The removal of the sub-transmission component of the licence conditions OEF, which we consider does not meet the non-duplication criterion.
- The finding that the distribution component of the licence conditions OEF does not meet the materiality criterion.

- The inclusion of sub-transmission transformer counts as well as lines capacity in the sub-transmission OEF (representing 84%of the total value of this OEF).

3.2.3 Quantification

This section discusses the quantification of the sub-transmission-licence condition OEF.

Derivation of sub-transmission OEF adjustment

The sub-transmission OEF estimate is the sum of the efficient costs for each asset class (overhead and underground lines, and transformers). This is derived by multiplying, for each asset class, an efficient unit cost derived from the reference group for an asset volume.

We use specific information within the categorical RIN data on the cost and volume of the three classes of sub transmission assets. The costs included are combined direct costs (routine and corrective maintenance) of maintaining overhead and underground assets, and zone substations. Asset volumes are derived from total overhead and underground sub-transmission and distribution line lengths, zone substation installed transformer capacity, and distribution transformer installed capacity.

Selection of asset volumes

The use of line length to quantify overhead and underground line asset density has been used in previous analysis by the AER and has not been challenged by DNSPs to our knowledge. We are comfortable that line length is the dominant determinant of efficient total overhead and line maintenance costs if an appropriate efficient unit rate is applied.

In our preliminary report, we adopted installed capacity (kVA) to determine the quantum of installed sub-transmission transformer assets. Feedback from stakeholders suggested that transformer number may be a more appropriate basis. Based on this feedback, further analysis has been undertaken resulting in the conclusion that transformer number is a preferred basis for establishing the installed transformer quantum for this OEF. This conclusion reflects the following:

- Transformer number is a reasonable determinant of the scale of infrastructure that needs to be maintained and operated within a sub-transmission or zone substation. In making this assessment it is noted that the number of transformers provides guidance on the number of transformer circuits including the supporting services that need to be maintained. As an illustration, a 2-transformer substation will cost more in corrective and preventative maintenance than a single transformer substation with the same total kVA capacity. Conversely, a single transformer substation with a single 15MVA transformer will have similar corrective and preventative maintenance costs to a single 30MVA transformer substation.
- There is a robust data set of transformer count by capacity class in tab "5.2 Asset Age Profile" in the Category Analysis RINs. This data allows for an auditable like-for-like comparison across DNSPs.

Derivation of efficient unit costs

There are several issues in deriving a unit cost for each asset class from the source data. In the first step the RIN data is applied to determine a direct cost per km or direct cost per greater than 15MVA and 66kV transformer for each DNSP.

The direct overhead/underground maintenance cost data do not define the direct maintenance costs associated with the sub-transmission line lengths as they cover both distribution and sub-transmission assets. It is therefore necessary to separate sub-transmission direct maintenance costs from total direct maintenance. This requires understanding the differential cost factor between maintaining a kilometre of sub-transmission line and a kilometre of distribution line.

We have retained the AER's assumption of a factor of two between maintaining a kilometre of sub-transmission line and a kilometre of distribution line (see discussion above). That is to say, the incremental OPEX for sub-transmission feeders is assumed to be 100 per cent of the OPEX for distribution feeders. The use of this factor is not ideal and could be addressed by separating the sub-transmission and distribution direct maintenance costs within the RINs, as is the case with transformer direct maintenance costs.

Zone substation maintenance costs are identified separately within the RINs and are used directly. This means that a factor or loading relative to distribution transformers is not required.

We have adopted the direct costs of the reference firms as the basis of the efficient unit costs.

It is noted the efficient expenditure on any particular area is not necessarily the lowest expenditure amongst the DNSPs. For example, appropriate levels of maintenance and effective accounting for direct costs are considered likely hallmarks of efficient firms.

Treatment of Outliers

There is a material difference between the highest and lowest cost DNSP, for example by a factor exceeding ten for line lengths. This cost difference is beyond what the authors would expect because of situational or operating environment factors between the firms. This suggests that each firm may be using a different method to establish these costs in the Category Analysis RINs. This situation could be improved over time with increased guidance on how to calculate these costs and/or a process of audit on the calculation of these costs.

We exclude any DNSPs with costs below 30 %or above 300% of the average of the all the DNSPs as outliers[43]. The direct costs of the reference firms, excluding outliers, are used to calculate an efficient unit cost on a weighted average basis.

The treatment of outliers in the manner detailed above is based on the judgement of the authors. This position has been retained throughout the evolution of the analysis. The changes in the analysis from the preliminary report to the final report have resulted in the costs of CitiPower (as a reference firm) moving closer to the defined outlier boundaries. If, in the future, cost changes were to move a reference firm outside our defined outlier boundaries, the outcome to the efficient unit cost calculation, and in turn OEF estimate, could be material. This potential volatility is not ideal in an ongoing methodology and can be addressed by the following:

43 SAPN is excluded as an outlier from the reference group for the calculation of both overhead and underground costs per km.

- Improved consistency in RIN data reporting.
- Application of discretion by the AER in excluding outliers in the efficient cost calculation.

The issue of excluding outliers is currently most relevant to the sub-transmission OEF calculation. However, it will become more relevant to the OEF calculations for termites and vegetation as more data is made available and the methodology matures.

3.2.4 Areas for further consideration

The analysis detailed in this chapter would benefit from additional data and information on the following matters:

1. Planned and emergency maintenance costs in the Category Analysis RINs to be calculated on a common and defined basis across the DNSPs to improve confidence in the data set across all DNSPs.

2. Separation of the planned and emergence maintenance costs for sub-transmission lines and distribution lines, or by voltage, in the Category Analysis RINs.

3.3 Vegetation management

DNSPs are obliged to ensure the integrity and safety of overhead lines by maintaining adequate clearances from any vegetation that could interfere with lines or supports. This is especially important under severe or extreme weather events, including high wind, rainfall and snow or ice, and also extreme heatwaves, during which bushfire related risks are most severe.

Vegetation management OPEX represents around a fifth (20%) of total OPEX for a number of DNSPs, notably: Essential Energy, Powercor, AusNet and SAPN (see Table 11 below). On the other hand, for some DNSPs, notably CitiPower and Evoenergy, vegetation management OPEX is less than three per cent of total OPEX.

To the extent these variations in observed OPEX reflect differences in efficient OPEX, they may give rise to OPEX advantages or disadvantages not otherwise accounted for in the SFA model. Given the scale of vegetation management OPEX for some DNSPs, the OEF candidate is likely to be material for these firms.

The fundamental drivers of variations in efficient vegetation management costs are:

- the length of overhead lines requiring active vegetation management; and
- the vegetation density and rate of growth (which can vary both by location and over time at a location) in those areas requiring vegetation management.

In combination, these factors arise from the intersection between vegetation density and network assets. This intersection depends on the network footprint and configuration relative to land use, vegetation type and climate.

These fundamental drivers may in turn be modified between jurisdictions by variations in regulated responsibilities for vegetation management, including:

- variations in mandated standards (notably bushfire regulations in Victoria); and

- the allocation of responsibility for vegetation management (or its ultimate cost recovery) between DNSPs, landowners and local government.

In its previous determinations, the AER has accepted that the two regulatory related drivers of vegetation OPEX variations may meet the OEF criteria (see Table 5). Vegetation management OPEX represents the bulk of the incremental OPEX related to the Bushfire OEF category[44]. In addition to the direct cost of vegetation management, the Victorian Bushfire relations impose additional costs relating to creating and maintaining records of vegetation management activities and outcomes.

The full set of vegetation management cost drivers is largely outside the control of the network service providers. Some portion of the variation in observed vegetation OPEX may, however, arise from differences in efficiency; therefore, not all the differences in observed vegetation OPEX may be attributable to exogenous variables.

As discussed earlier (notably in relation to sub-transmission/licence conditions), our preferred overall approach to assessing OEF candidates is to seek to quantify the effects of one or more qualifying variables on efficient OPEX, rather than to seek to quantify the individual causes of higher OPEX (i.e. the individual variables set out above). Treating one or more causal variables as independent OEFs is problematic in that it can result in various combinations of double counting or omission (discussed further below with regard to related OEF candidates).

This reflects the fact that vegetation management OPEX is often multi-purpose. Ensuring adequate clearances protects lines from both bushfires and extreme storms. Attributing vegetation management activities (and related cost) to one environmental risk or another is challenging.

The remainder of this section seeks to identify the extent to which:

- exogenous factors are accounted for within the average outcome allowed for in the econometric benchmarking model; and
- residual cost differences between DNSPs may be captured through one or possibly multiple candidate OEF categories.

3.3.1 Assessment against OEF criteria

Exogeneity

To the extent that it is not economic to underground the existing overhead lines network, the consequent variations in efficient vegetation management OPEX are beyond the control of DNSPs. The AER has previously made reference to vegetation density maps such as those in Figure 7 in recognition that the vegetation management burden varies geographically. [45]

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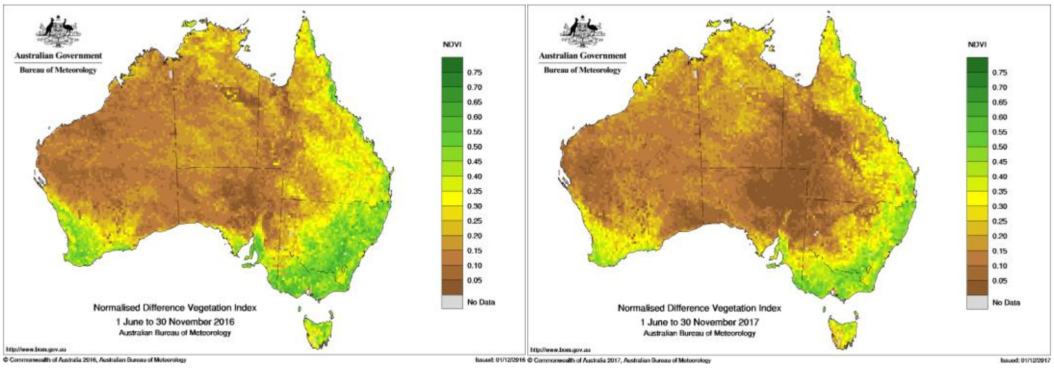
[44] The largest part of these step changes in OPEX (75-95 percent) were related directly to changes in the Victorian Electric Line Clearance obligations; p 220 of Ausgrid distribution determination 2015−16 to 2018−19, Final Decision, Attachment 7 – Operating expenditure, dated April 2015

[45] See for example page 202 of Ergon Energy preliminary determination 2015-20, dated April 2015.

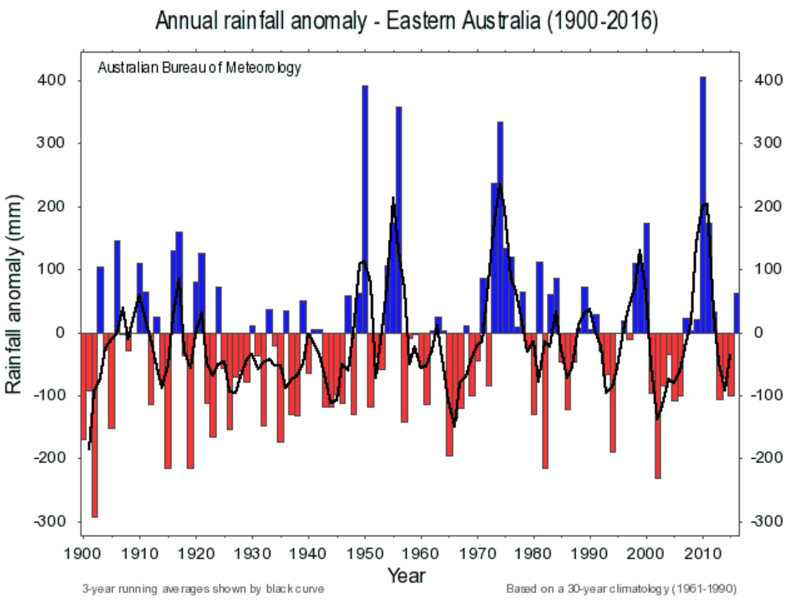
While useful, on their own, these maps do not allow conclusions to be drawn regarding differences in growth rates relative to the geographical distribution of network assets within a DNSP's total footprint. In addition, the two periods mapped in Figure 7, as well as the temporal rainfall anomaly series in Figure 8, highlight that both the seasonal and inter-annual variation of vegetative growth can be substantial. This suggests that associated vegetation management OPEX may also vary substantially over time and careful consideration is required in annualisation of observed OPEX in any one year (see Section 2.3.4).

Figure 7 Six-monthly Normalised Difference Vegetation Index Average for Australia, November 2016 and November 2017



Source: Bureau of Meteorology, http://www.bom.gov.au/jsp/awap/ndvi/index.jsp

Figure 8 Eastern Australian annual rainfall anomaly



Source: Bureau of Meteorology
http://www.bom.gov.au/climate/change/index.shtml#tabs=Tracker&tracker=timeseries

Materiality

Vegetation management OPEX is a significant cost category reported in RINs, as summarised in Table 11. For most DNSPs, a high proportion of total vegetation OPEX is represented by payments to third parties. As a result, most of the variation in OPEX is considered to reflect real differences in expenditure between firms and not differences in cost allocation policies within overall OPEX.

Table 11 Vegetation management costs ($2014/15, $'000)

DNSP	Total Vegetation Management	Proportion of Total OPEX	Contracted Vegetation Management	Proportion of Total Veg Man OPEX	Proportion of Total OPEX
Evoenergy	$2,446	3%	$886	36%	1%
Ausgrid	$39,914	6%	$36,229	91%	6%
CitiPower	$1,083	2%	$1,079	100%	2%
Endeavour	$38,551	14%	$36,277	94%	13%
Energex	$45,750	12%	$45,645	100%	12%
Ergon	$48,930	13%	$44,942	92%	12%
Essential	$91,473	23%	$80,799	88%	20%
Jemena	$3,431	5%	$3,381	99%	5%
Powercor	$36,221	19%	$34,936	96%	18%
SAPN	$45,572	18%	$43,806	96%	18%
AusNet	$37,820	18%	$32,271	85%	16%
TasNetworks	$10,753	17%	$10,435	97%	16%
United Energy	$11,381	10%	$11,381	100%	10%

Source: EBRIN/CARIN

While year-to-year costs vary, from Table 11 it may be observed that vegetation management OPEX constitutes a significant component of total OPEX for many DNSPs – for 2014/15 exceeding 10% for nine of the 13 DNSPs. As noted earlier, it is possible that some of the explanations for these cost variations arise from differences in efficiency.

Nevertheless, even if efficient vegetation OPEX is only some fraction of observed vegetation OPEX, even, say, one quarter, it could be a material OEF for a majority of DNSPs (to the extent it is non-duplicative). Moreover, since this candidate OEF category has very significant effects for four of the five reference group firms, then the effect on the reference point itself is likely to be material, which in turn affects every other DNSP.

Duplication

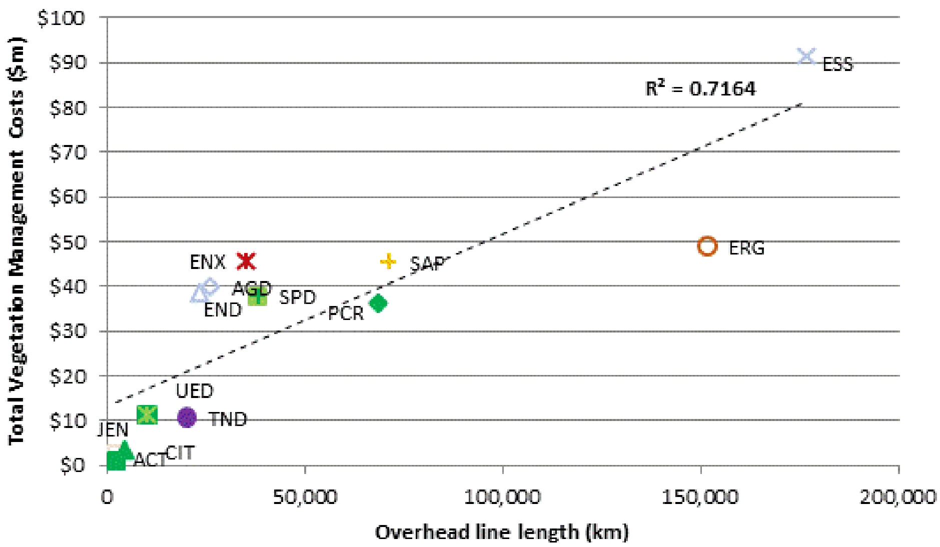
Econometric benchmarking

Further information on the SFA model was provided by Economic Insights to assist in the assessment of the duplication criterion for this candidate OEF category (or set). This included the observations that effectively the SFA model:

- Accounts for the average relationship between vegetation management OPEX and overhead line length (in terms of circuit length) across the set of DNSPs. It therefore assumes the average density and growth rate applies to all DNSPs.
- Does not allow for variations in the proportion of overhead line length requiring active vegetation management from this average across DNSPs or take into account temporal variations in vegetation density.[46]

Consideration of the relationship between circuit line lengths[47] and vegetation OPEX suggests a high proportion of the variation in vegetation OPEX may be accounted for in the econometric benchmarking. This can be seen in Figure 9 below, which compares total vegetation management costs with overhead line length, drawing on RIN data.

Figure 9 Total Vegetation Management as a function of overhead line length



Source: Sapere / Merz analysis of AER RIN and econometric benchmarking data.

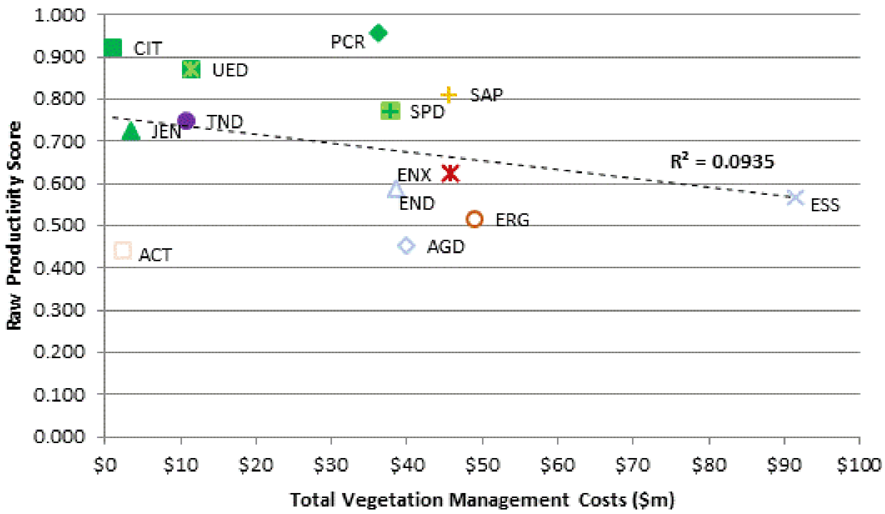
Figure 9 illustrates a moderate to weak relationship ($R^2 = 0.7$) between vegetation management OPEX and total overhead line length. That is, vegetation OPEX varies with overhead line length, but this variation does not fully explain variations in observed vegetation OPEX between DNSPs. This is consistent with the proposition that overhead line length, while being the supervening variable, is a poor proxy for the length of lines requiring active vegetation management.

46 This was reflected to some extent in the AER's 2016 benchmarking report that identified decreases in productivity results for the Victorian DNSPs were largely due to factors not accounted for by the benchmarking models, including heavy rainfall.

47 As defined by the AER's internal licence conditions OEF asset volumes spreadsheet.

Given the scale and variability of vegetation OPEX, it is possible that, if the benchmarking process did not fully account for this OPEX, there may be a relationship with raw productivity outcomes. This is explored in Figure 10 below which demonstrates there is no relationship between total vegetation management costs and raw productivity outcomes.

Figure 10 Raw productivity outcomes as a function of Total Vegetation Management Costs



Source: Sapere / Merz analysis of AER RIN and econometric benchmarking data.

Taken together, these two points suggest the SFA model addresses differences in vegetation management OPEX to a substantial degree, with the modelled variables. On the other hand, the residual difference not accounted for in the SFA model may be significant for some DNSPs and may lead to material OEF adjustments. Further, as noted above, Further, as noted above, there is evidence that variations in vegetation management over time, and perhaps also between DNSPs, may not be fully captured by the SFA model.

Economic Insights advised that it is difficult to quantify the extent that differential vegetation management OPEX is indirectly picked up by the line length variable. There is insufficient information to disentangle the various effects related to line length, and the high correlation between some output variables in the SFA model means particular coefficients may not be interpreted in isolation.

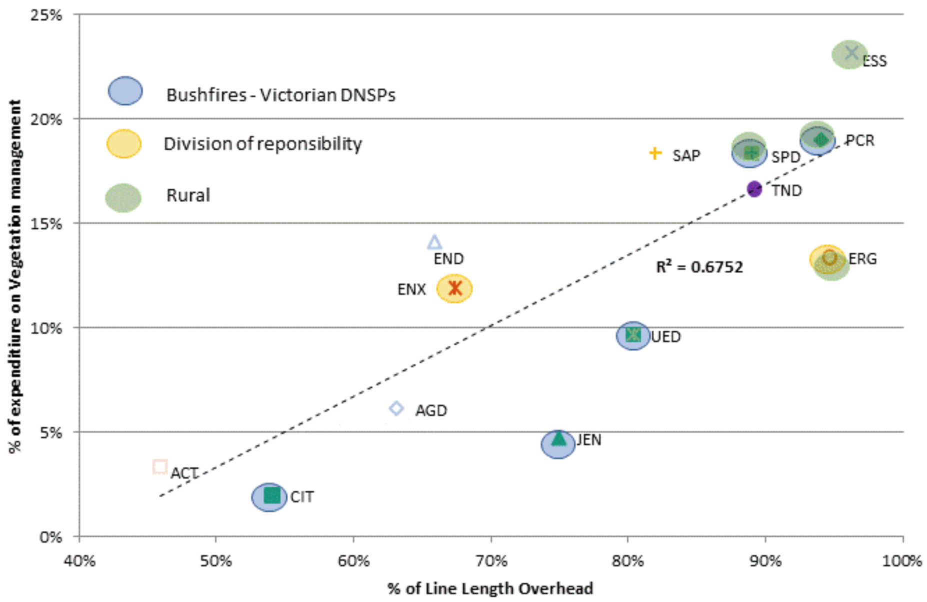
Considering the set of related OEF candidates

As noted above, the causal drivers of variations in efficient vegetation management OPEX are interrelated. For example, in the AER Queensland and NSW decisions, higher OPEX associated with higher vegetation density in some network areas of those States was offset against higher OPEX associated with bushfire regulations among the reference group firms.[48]

The interaction between vegetation density and regulation is exemplified by AusNet and Powercor, where total vegetation OPEX in response to additional bushfire regulations was broadly equivalent, despite AusNet having only half the overhead network length. This reflected the significantly higher vegetation density in the AusNet region.[49]

The complexity of interactions between causal OEF candidates is illustrated in Figure 11. The trend line represents the "average" relationship between the percentage of vegetation management OPEX as percentage of total OPEX, on the one hand, with the percentage of overhead line in the SFA model, on the other.[50]

Figure 11 Variations in observed average vegetation OPEX



Points above the diagonal line represent percentage observed vegetation management OPEX that is higher than average, and points below represent lower than average observed vegetation management OPEX. Bushfire OEFs (for Victoria) and Division of responsibility variables are denoted by blue and yellow circles (respectively) around the relevant DNSPs. The predominantly rural DNSPs are denoted with green circles.

48 See for example page 202ff of Ergon Energy preliminary determination 2015-20, dated April 2015, and p226ff of Ausgrid distribution determination 2015−16 to 2018−19, Final Decision, Attachment 7 – Operating expenditure, dated April 2015.

49 See for example p202 of Preliminary Decision, Ergon Energy determination 2015−16 to 2019−20, Attachment 7 − Operating expenditure, April 2015.

50 The trend line is not an indicator of the actual allowance for vegetation OPEX in the SFA model (and hence ideal optimised OPEX), as this information cannot be determined. As already noted above, line length parameter itself is only a partial proxy for assets requiring active vegetation management.

Figure 11 highlights several points that have been discussed already, but are worthwhile summarising together:

- To the extent the observed variations relative to the trend line are not related to inefficiency differences, they are likely to be material (positive or negative) for a majority of DNSPs.
- The Bushfire candidate OEF does not on its own seem to explain variations in efficient vegetation OPEX among the reference firms.
- The Division of Responsibility candidate OEF does not on its own seem to explain variations in efficient vegetation OPEX among the reference firms.
- Predominantly rural DNSPs are identified in Figure 11 as a proxy for firms likely to be exposed to a greater proportion of lines requiring active vegetation management and higher efficient vegetation OPEX. Even for these DNSPs, however, there is some variation that relates to other variables (possibly also including differences in vegetation OPEX efficiency).

Together, these points suggest that reference to matters other than the regulatory variables is necessary to derive a comprehensive estimate of this candidate OEF category (or set). This is so, even if the vegetation OEF category is split into multiple OEF categories.

To be clear, these variations are not readily explained by differences in total productivity (see Figure 12). There is no evidence identified so far that the principal explanation for the variations above is related to variations in efficiency.

3.3.2 Finding

The preliminary finding is that variations in vegetation density and growth rates, along with variations in regulation around vegetation management, are together likely to be a material driver of variations in efficient vegetation OPEX. Analysis of vegetation, bushfire and division of responsibility variables indicate a high level of overlap between these variables. It is probable that a vegetation management OEF candidate (or set of OEF candidates) meets the OEF criteria for a significant portion of DNSPs. As this includes the reference DNSPs, this OEF candidate (or set) is also likely materially to influence the reference point for this OEF candidate (or set).

Because of the materiality of any resulting OEF reference point, this may in turn result in a change (increase) in the overall reference point and hence affect the aggregate OEF adjustment outcomes for a significant sub-set of DNSPs. This effect may be greatest for those DNSPs with the highest (or lowest) vegetation OPEX as a proportion of total OPEX, depending on the extent observed vegetation OPEX is assessed to be efficient.

No quantification of a vegetation management OEF candidate (or set of OEF candidates) has been able to be estimated at this time. The summary results for this OEF candidate (or set) have therefore been reported as nil in Table 2 and Table 3.

For the avoidance of doubt, this does not indicate the vegetation management OEF candidate (or set) should be zero, or that it cannot feasibly be quantified on case by case basis. -Further, it does not indicate that this OEF cannot be estimated by the AER on a case by case basis until such time as a systematic quantification is implemented. Several possible approaches and methods are explored below. However, EBRIN data on vegetation density is considered less mature than other EBRIN data, upon which the EI model and some other

OEF estimates have been developed or otherwise considered. Further refinement and consultation with DNSPs to ensure consistency of EBRIN data is required before it can be relied upon to the extent necessary to quantify this OEF candidate (or set) within an acceptable margin for error.

In the absence of such data, and within the scope of the present project, we have so far been unable to identify sufficient evidence on which to distinguish between the effect of exogenous and endogenous variables on variations in observed vegetation OPEX. The methods that have been applied to quantifying unit costs and volumetric variables to support the quantification of other candidate OEFs have so far not been able to be applied to vegetation OPEX.

As a result, the error margins for any quantification of this OEF category (or set) across all DNSPs using a common methodology are considered to be significantly higher than for the quantification of other OEF categories. The likely result would be a material over estimation of the efficient OEF for some DNSPs alongside a material under-estimation for others. Because of the likely scale of the errors, and in particular the impact on the comparison point, these errors would in turn be likely to result in significant errors being introduced into the aggregate OEF adjustments and OEF adjusted efficient OPEX estimates.

3.3.3 Areas for further consideration

It does not follow from the preliminary conclusion that a vegetation candidate OEF (or set) could not be quantified in the context of a future regulatory determination by the AER, in response to proposals submitted by DNSPs on a case by case basis. With adequate supporting data and information, including improved evidence and data on exposure to the exogenous variables identified, and the efficiency of related OPEX (including any significant inter-annual factors), this OEF candidate (or set) should be capable of being quantified by individual DNSPs and the AER.

Establishing a Systematic Process for the Calculation of the OEF for all DNSPs

To progress the discussion, the remainder of this section considers options for addressing this candidate OEF (or set of OEFs) on a systematic basis across all DNSPs. Two broad approaches suggest themselves:

1. An 'additive' approach individually assessing separate causes of cost differences, taking care of issues of duplication and omission. Any residual would represent the inefficient component of total vegetation management OPEX.

2. A 'subtractive' approach, removing a (possibly deemed) inefficient component from total vegetation management OPEX. Being based on the effect revealed by actual costs, this method would be inclusive of the range of causes varying the vegetation management task, whether identified or not.

The full set of variables identified at the beginning of this section could be assessed and considered to identify volumes and efficient unit costs. The initial estimates would be modified to take into account variations in regulated responsibilities – the bushfire and division of responsibility OEF candidates previously quantified by the AER. Any remaining difference between estimated efficient OPEX and observed vegetation management OPEX would indicate inefficiency and would not form part of the OEF adjustment.

While total vegetation management OPEX is identified as a separate OPEX line item in RIN returns, the associated volume data (the count of spans affected) and the density of vegetation (trees per span) needs refinement and consultation with DNSPs to ensure consistency. If reliable and consistent volume data were available, then indicative unit rates could be estimated and assessed.

While some of this data is already collected, it is recognised that refining the development of reliable and consistent volume and other relevant data could be a significant undertaking. Given the materiality of the potential OEF adjustment for all DNSPs either directly or indirectly, this effort is likely to be worthwhile.

There are likely to be a variety of potential methods and data sources for developing volume data. This would include consideration of alternative vegetation categorisation methods and the sampling of vegetation density within each of the selected vegetation categories. This suggests there would be value in a co-ordinated and consultative approach so that resulting estimates of overall vegetation volume are comparable. In assessing the efficiency of the derived estimated actual unit rates, other relevant factors could be considered, including any differences in regulatory obligations and division of responsibility.

As a starting point for discussion, consideration could be given to data, information and evidence regarding the following points (whether in refinements to EBRIN returns, in regulatory proposals, or any collaborative process between DNSPs and perhaps the AER).

1. **Vegetation intensity (volume).** This includes:

   (a) The circuit length requiring active vegetation management (this should be comparable between networks and independent of any differences in average span length or similar). This is the vegetation-exposed network.

   (b) The overall coincidence between the network footprint and available data on vegetation density and growth rates, for example using the index of growth rates established by the Australian Government State of the Environment analysis[51] (likely simplified to a smaller set of categories – e.g. quintiles – covering multiple gradations within the selected index). This enables comparisons between networks and inter-annually for individual networks.

   (c) Information on variations in the cycle length (frequency) for scheduled activities for all of the defined growth categories. This may include reference to any legal or other restrictions increasing the frequency from what might be determined theoretically to be cost effective. Any evidence regarding the impact of inter-annual climate variations.

2. **Unit costs per unit of line length vegetation (per category).** This includes:

   (a) The extent vegetation management activities are procured from third parties, and why, and the market testing, contract design and evidence of efficient costs for each defined growth categories. This would include the impact of any accessibility or other access issues arising.

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[51] Information available at https://soe.environment.gov.au/theme/land/topic/2016/vegetation-0

(b) The cost of inspections. This would include evidence on any accessibility issues relative to the mix of inspection approaches used (e.g. road or aerial – drone or helicopter).

When establishing data on the intersection of network assets with the various defined vegetation density and growth rate zones, data could also be gathered on the intersection of the networks with other predetermined zones relating to ease of access. This information would inform further consideration of potential OEFs relating to the impact of terrain on travel costs (further discussion in section 4.2 of this report).

The core vegetation management data above could be supplemented by further data relating to regulatory matters, including the following.

3. **Bushfires:**

   (a) For DNSPs in jurisdictions not directly subject to the Victorian Bushfire regulations, an estimate of any incremental vegetation management activities (beyond vegetation trimming) for the purpose of minimising bushfire risks (such as advertising and educational campaigns). Consideration should be given to the extent to which the Victorian regulations are informing the definition of good industry practice across the jurisdictions.

   (a) For Victorian DNSPs, the proportion of the vegetation-exposed network that is affected by the Victorian Bushfire regulations, in particular the proportion defined in the regulations as high risk. This would include evidence on the additional costs (above standard vegetation trimming) of creating and maintaining auditable records on compliance with bushfire regulations.

4. **Division of responsibility:**

   (a) Reference to the *de-jure* allocation of responsibility for vegetation management under which each DNSP operates and an estimate of the proportion of the exposed network (broken down using the growth rate index categories discussed in point 3 above).

   (b) Any evidence regarding whether, and to what extent, *de facto* responsibility varies from *de-jure* responsibility for vegetation management. This would include any evidence that costs are shifted to or from DNSPs relative to local governments and property owners, and the reasonable recovery actions and other steps undertaken by the network to remedy any shortfalls.

5. Any other information or data that may be deemed to be pertinent.

6. A reconciliation between a unit-cost/activity volume build up assessment of efficient costs, drawing on a combined analysis of the evidence from the points above, on the one hand, with the total reported vegetation OPEX in any given EBRIN/CARIN return for a reporting year, on the other, and an explanation of any material differences.

If high quality information that is consistent between DNSPs can be developed, then it should be feasible to apply either additive or subtractive approaches on a systematic basis. Similarly, it should be possible to estimate this set of OEF candidates either as a single multi-factorial OEF or as sub-components (cancelling out duplication and accounting for any omissions).

3.4 Taxes and levies

A number of jurisdictions require the payment by DNSPs of State taxes and levies that are not classified as jurisdiction schemes or excluded from OPEX reported for economic benchmarking purposes. As they are State based, any such taxes or levies could vary between jurisdictions and hence DNSPs.

3.4.1 Assessment against OEF criteria

Taxes and levies are outside the control of DNSPs and hence exogenous. Cost data from RIN indicate the total cost of taxes and levies is likely to be material.

In a previous decision, the AER accepted that jurisdictional taxes and levies represent an OEF for the two Queensland DNSPs. In the case of NSW and Evoenergy, the AER found that no OEF adjustment was required because these costs are not included as line items in RIN returns and jurisdictional levies are compensated through annual price variations. This highlights that differences in whether taxes and levies are included within OPEX may result in inconsistent or inaccurate productivity scores in the econometric benchmarking.

Some taxes and levies apply to all DNSPs and therefore variations in efficient cost would not be expected – they are systemic. Other taxes and levies may vary substantially between jurisdictions, in which case variations in efficient cost would be expected. The difficulty is there is currently insufficient consistent and reliable data available from RIN returns to distinguish between systemic costs, on the one hand, and variations in jurisdictional costs, on the other.

Following the March workshop, all but three DNSPs provided additional data populating a standardised template for taxes and levy data. The objective was to generate a comprehensive data set, from which judgments could be made on variations in taxes and levies between DNSPs and jurisdictions. A summary of the various taxes and levies for which data was provided is shown in Table 12 below.

Table 12 Potential taxes and levies

Industry specific	Federal	State
• Distribution Licence Fee • Electrical Safety Levy • National Electricity Market Charge • Energy Ombudsman Levy • Climate Change Fund • PV Feed In Tariff/Solar Bonus Scheme Rebate	• Fringe benefits tax • Other Government Charges & Levies	• Land and Property tax • Distribution Lessor Corporation (DLC) Land Tax • Payroll tax • Council Rates • Water Rates • Fire Services Levy • Other Government Charges & Levies

National taxes including corporate tax and the goods and services tax were excluded from the outset. Nevertheless, significant national taxes and levies were included in DNSP data returns.

State taxes and levies are clearly relevant. The incidence and level of these taxes may vary significantly between jurisdictions and hence DNSPs.[52] For example, the Distributor Lessor Corporation land tax may be related to a specific set of ownership arrangements unique to South Australia. Land taxes may also vary substantially between jurisdictions. Council rates, water levies and the like may vary significantly within the region served by a DNSP.

There are a number of taxes and levies that relate specifically to the electricity sector and DNSPs. These include NEM participation charges and levies designed to recover the cost of sector economic and safety regulators and ombudsman offices. DNSP returns also included a material set of costs arising from jurisdictional climate related schemes including solar feed in tariffs.

It is possible that some of these costs should not form part of OPEX for economic regulation purposes. Some taxes and levy costs do not appear to be recovered from standard control OPEX. They are instead recovered from the B factor in annual pricing determinations, or through other cost recovery mechanisms other than standard control tariffs. Under these conditions, inclusion of some taxes and levies in OPEX could breach the non-duplication criterion.

With other costs, it is unclear whether differences should be considered relevant in an OEF context. For example, differences in NEM fees may relate to customer numbers, connection points or other variables that are already accounted for in the econometric benchmarking and productivity scores.

A further possible issue is that some taxes and levies may relate to DNSP operations other than standard control regulated services. Any such taxes and levies, or the portion of such taxes and levies relating to non-standard control services, should be excluded from any estimation of a taxes and levies OEF.

A Venn diagram of overlapping OEF criteria and cost recovery mechanisms, in relation to taxes and levies, is set out in Figure 12 below. This attempts to differentiate between the left hand column, in its entirety and the first and second rows. Only the third row in the right hand column would be deemed to be a qualifying tax or levy for the purpose of quantifying a taxes and levies OEF. This Venn diagram is incomplete in that it assumes all qualifying taxes and levies are attributable to standard control services.

52 See for example The Australian Industry Group, State taxes on business: how do they compare? May 2017

Figure 12 Venn diagram of overlapping OEF criteria and recovery mechanisms

A key challenge is determining the identity of taxes and levies that should be excluded or included from the consideration of variations between DNSPs on a consistent basis across all DNSPs. Despite having access to data additional to that provided in RIN returns, we have concluded there is at present insufficient information on which to allocate taxes and levies to the bottom right box or to the other five boxes. We have been unable to differentiate between differences in the data provided, on the one hand, with differences in exposure to taxes and levies that qualify for consideration as an OEF, on the other.

3.4.1 Finding

Our present view, based on analysis and consultation, is that where the relevant set of taxes and levies is clearly identified and the value attributable to standard control services can be accurately quantified, taxes and levies satisfy the AER criteria of exogeneity and non-duplication. Further, based on the currently available data, the calculation of the OEF adjustment demonstrated in Table 13 below indicates that this OEF is likely to be comparatively material.

However, there appear to be significant differences in the treatment of taxes and levies in regulatory arrangements between jurisdictions, notably the use of a B factor adjustment in some but perhaps not all jurisdictions. In addition, there appear to be significant differences in the recording and treatment of taxes and levies between DNSPs, suggesting that some variations in taxes and levies between DNSPs may merely be apparent.

We emphasise that, under these conditions, the quantification of this OEF in Table 13 is indicative and provided for the purpose of demonstrating this OEF is likely to satisfy materiality criterion.

Table 13 Indicative calculation for taxes and levies OEF (%, $000, $June 2015)

DNSP	AER OEF adjustment		S-M OEF estimate		S-M OEF adjustment	
Evoenergy	0.00%	$0	NA	NA	NA	NA
Ausgrid	0.00%	$0	0.00%	$30	-0.87%	-$3,335
Citipower	0.00%	$0	1.58%	$883	0.70%	$393
Endeavour	0.00%	$0	0.01%	$23	-0.87%	-$1,804
Energex	2.70%	$8,398	2.82%	$8,780	1.94%	$6,049
Ergon	1.70%	$4,159	2.00%	$4,901	1.13%	$2,753
Essential	0.00%	$0	0.00%	$0	-0.88%	-$2,543
Jemena	0.00%	$0	1.18%	$811	0.30%	$208
Powercor	0.00%	$0	0.86%	$1,640	-0.02%	-$35
SAPN	0.00%	$0	1.42%	$3,525	0.54%	$1,345
Ausnet	0.00%	$0	0.09%	$195	-0.78%	-$1,615
TasNetworks	0.00%	$0	6.21%	$3,891	5.33%	$3,341
United Energy	0.00%	$0	0.69%	$810	-0.19%	-$224
Reference point	0.00%		0.88%			

3.4.2 Quantification

Our approach for this candidate OEF incorporates and builds on the approach articulated in previous AER assessments, employing the qualifying taxes and levies quantified by each DNSP. The main challenge is identifying the taxes and levies qualifying for comparison in this OEF.

Our preliminary report identified some inadequacies relatives to the issues outlines above, and DNSPs were invited to provide further data providing more granular detail identifying the particular tax or levy, its value and mechanisms for recovery and reporting. Ten DNSPs supplied additional information, and this data (together with the existing data for Energex and Ergon from the AER's previous determinations) is the basis for the quantification in Table 13.

This initial quantification is heavily qualified and provided here only for the purpose of demonstrating this OEF is likely to satisfy materiality criterion and is readily capable of quantification with additional information. These qualifications include:

- No data was available for Evoenergy
- The data for Energex and Ergon from AER determinations is for a non-contiguous period.
- The purpose of data collection in the consultation was to explore and begin to articulate the criteria for qualifying taxes and levies described in Figure 12 above. Guidance for qualifying taxes and levies is yet to be developed. The practical consequences for this calculation are:
  - Not all DNSPs have quantified all categories of taxes and levies (including those that qualify), and

- The initial choice of individual taxes and levies that have been included in the calculation may err in under-estimating the impact as we have focused on industry specific (licence and safety) fees;
- It is uncertain whether taxes and levies relate to DNSPs as a whole or only to standard control services (i.e. properly forming part of OPEX as defined for purpose of this review).

3.4.3 Areas for further consideration

For benchmarking purposes, to ensure comparability of RIN data on taxes and levies, further development of guidance on RIN returns is required to differentiate between qualifying and non-qualifying tax and levy costs, building on the information provided by DNSPs. This does not preclude the AER from making regulatory determinations on a case by case basis pending the development of a consistent framework for all DNSPs.

3.5 Termite exposure

Termite prevention, monitoring, detecting and responding to termite damage, altogether increase efficient OPEX. The extent to which these cost increases are incurred is driven the number of assets that can be termite affected. There is considerable variation in this risk across the 13 DNSPs. According to the CSIRO termite hazard map, the likely cost of managing assets exposed to termites ranges from being negligible in Tasmania to being high in Australia's sub-tropical and tropical north.

3.5.1 Assessment against OEF criteria

For existing assets, the termite OEF fully meets the OEF criteria. Exposure to termite related costs is beyond the control of the DNSPs, and it is not accounted for in the econometric benchmarking. The cost is material.

The extent to which incremental termite management OPEX is incurred is driven by the number of assets that can be termite affected. Over the long run, this is within the control of DNSPs.

For example, untreated wood poles will require a termite related maintenance response whilst steel poles and termite proof cables will require little or no termite response. Based on current costs[53], the incremental cost of installing appropriately treated assets is likely to warrant the savings in ongoing maintenance response for most DNSPs. Given this, the efficient termite exposure OEF should reduce over time as assets are replaced with termite tolerant assets.

53 No assessment is made on the cost / benefit of using termite resistant technologies at the historic time of installation and therefore no judgement has been made on the appropriateness of the current population of wood poles.

3.5.2 Finding

Our preliminary assessment has resulted in a higher estimation of this OEF compared with the AER. This is set out in Table 14 below.

Table 14 Termite exposure (%, $000, $June 2015)

DNSP	AER OEF adjustment		S-M OEF estimate		S-M OEF adjustment	
Evoenergy	0.00%	$0	0.11%	$46	0.00%	$0
Ausgrid	0.00%	$0	0.06%	$213	-0.05%	-$205
CitiPower	0.00%	$0	0.04%	$20	-0.07%	-$41
Endeavour	0.20%	$416	0.36%	$744	0.25%	$517
Energex	0.20%	$622	0.43%	$1,353	0.33%	$1,014
Ergon	0.50%	$1,223	1.21%	$2,950	1.10%	$2,684
Essential	0.60%	$1,738	1.05%	$3,029	0.94%	$2,713
Jemena	0.00%	$0	0.03%	$19	-0.08%	-$56
Powercor	0.00%	$0	0.28%	$538	0.17%	$330
SAPN	0.00%	$0	0.00%	$0	-0.11%	-$271
AusNet	0.00%	$0	0.13%	$274	0.02%	$49
TasNetworks	0.00%	$0	0.00%	$0	-0.11%	-$68
United Energy	0.00%	$0	0.06%	$68	-0.05%	-$60
Reference point	0.00%		0.11%			

3.5.3 Quantification

Our approach for this candidate OEF incorporates and builds on the approach articulated in previous AER assessments. The main proposed change is to include OPEX associated with this OEF for a more termite prevalent DNSP, despite its relatively low productivity score.

We update the AER method of multiplying a unit cost by the number of wood poles for the DNSP. The unit cost is adjusted for the incidence of termites using the cost equation derived from Figure 13 below. This methodology could be significantly improved by using data on untreated wood poles as the basis of measuring exposure, but this data is not currently available.

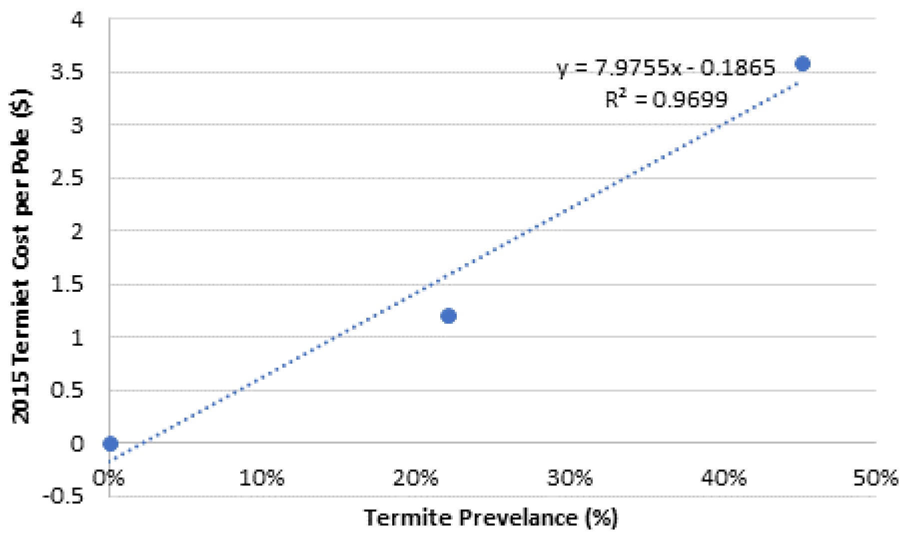
Figure 13 provides the three available references plotted against the CSIRO Termite Exposure prevalence metric.

In calculating the cost per pole, the AER used a single efficient reference (Powercor, 22 percent). Figure 13 provides both the zero cost- zero termite prevalence point and the high prevalence point (Ergon, 45 percent). The tramline added to Figure 13 provides a cost equation to derive the unit cost for each region according to termite prevalence.

The AER excluded the higher termite prevalence metric from its analysis as it was from a firm with a lower productivity score. As explained in Section 2, the efficiency of OPEX for each OEF needs to be reviewed independently of the productivity score.

Accordingly, we include all data points in developing a function between terminate maintenance cost per wood pole and termite prevalence. Consequently the cost equation derived from the tramline added to Figure 13 using all three points is steeper than the AER's, but is nonetheless still considered to reflect efficient costs.

Figure 13 Termite cost per pole



Source: Sapere analysis

Although the zero cost-zero termite prevalence is a known point it is likely there will be zero termite costs up to higher levels of prevalence. This would result in the trend line crossing the x-axis at a termite-prevalence greater than indicated in Figure 13. Hence, the efficient cost equation is likely to be steeper still.

3.5.4 Areas for further consideration

Additional data from a greater number of DNSPs on the cost of termite treatments and corrective maintenance response would significantly improve confidence in the estimated cost curve for this OEF. The analysis detailed in the chapter would benefit from additional data and information on the following matters.

1. The prevalence threshold at which termite management costs become significant.
2. Termite treatment costs from all impacted DNSPs and the extent these costs have been market tested.
3. The cost of corrective maintenance response to termite infestation including the average age of assets replaced because of termite infestation.
4. The identification of extent of un-treated wood poles to use as a base for the calculations.

By increasing compensation for termite OPEX, the proposed approach potentially mutes incentives for efficient investment in termite proof assets (e.g. concrete or steel poles). This topic should be monitored as part of the CAPEX / OPEX trade off.

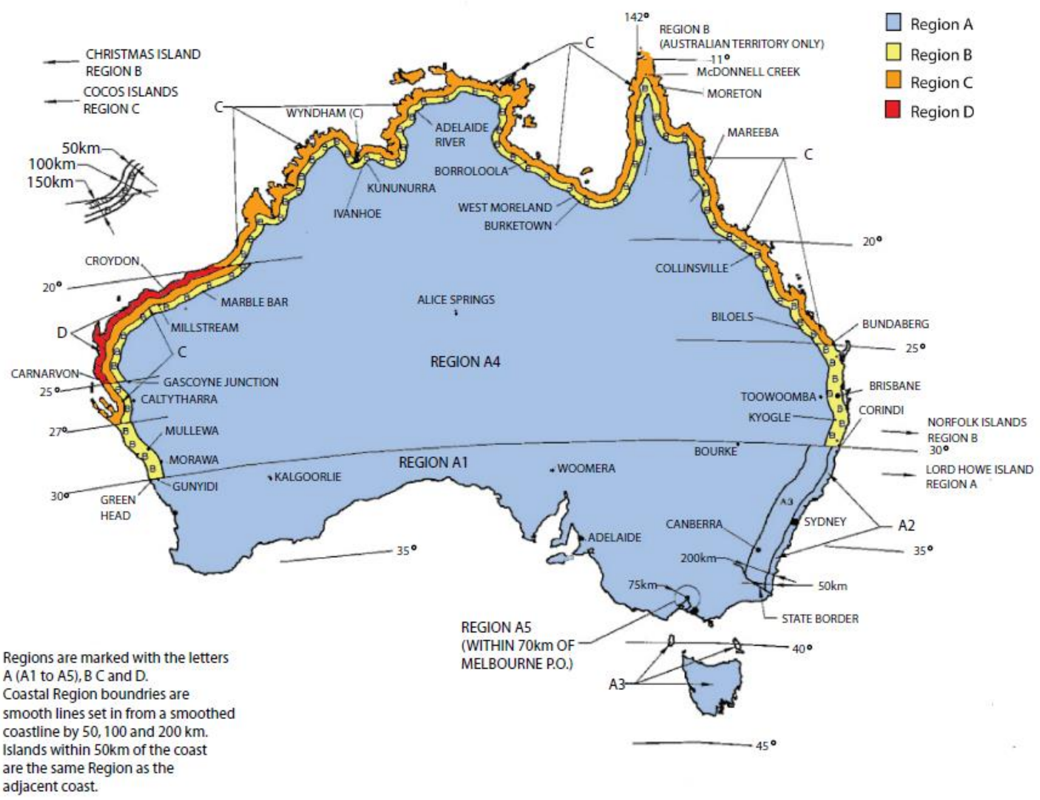
3.6 Cyclones

Cyclones result in a combination of higher insurance OPEX and higher OPEX that it is not feasible to insure. In either case, OPEX is higher than otherwise.

Our approach incorporates and builds on that articulated through the AER decisions. Extreme weather of all kinds is a likely OEF candidate as both exogenous and outside the econometric benchmarking.

Cyclones originate in the tropics in significant numbers every year, so while the systematic risk is temporally even, it is geographically unequal. In Australia DNSPs systematically at risk of cyclonic levels of wind operate in regions C and D of the wind zone categories defined in AS/NZS 1170:2:2002 as illustrated in Figure 14. To be clear, cyclone events in this region do not qualify as high impact, low probability (HILP) events – there is a significant probability of a cyclone in these regions each year, as evidenced by the seven actual cyclones in the ten year benchmarking period. For current purposes that includes only Ergon. As none of the reference group is included the reference point is zero.

Figure 14 Wind Zone Categories



Source: AS/NZS 1170:2:2002

Cyclones require a significant operational response including planning, mobilisation, fault rectification and demobilisation. These responses have direct costs and interfere with the business as usual work being delivered in an efficient manner. Service providers in cyclonic regions may also have higher insurance premiums and / or higher non-claimable limits.

As a result of the likelihood to provide documentary support for subsequent insurance claims, it is industry best practice for service providers with operations in cyclonic regions to establish specific records of the direct and incremental costs impacts of each cyclone. These records typically capture all of the direct costs of mobilising in response to a potential cyclone, addressing the faults and demobilising. These records may also include bookings from business as usual projects adversely impacted by each cyclone. As the basis for potential insurance claims, these records represent an auditable record of the direct cost impacts of each cyclonic event.

3.6.1 Finding

Our preliminary assessment has resulted in a comparable estimation of this OEF compared with the AER. This is set out in Table 15 below. As noted above, the cyclones OEF' is, presently, specific to Ergon. Not being applicable to the reference group, the OEF adjustment is equal to the estimate.

Table 15 Cyclones (%, $000, $June 2015)

DNSP	AER OEF adjustment		S-M OEF estimate		S-M OEF adjustment	
Ergon	5.40%	$13,210	5.24%	$12,828	5.24%	$12,828
Reference point	0.00%		0.00%			

3.6.2 Quantification

Our approach for this candidate OEF incorporates and builds on the approach articulated in previous AER assessments. The approach taken by the AER in the previous assessment for the cost impacts of the then seven cyclones for Ergon Energy in the benchmarking period is considered sound. This is based on the position that the AER's input data is drawn from costs captured consistent with the requirements of any potential insurance claim. Further, the costs should be net the contribution from any successful insurance claim. Finally, the costs must not include any allocation of expenditure that would otherwise be overhead expenditure

Our approach extends the previous analysis to include the three subsequent cyclones up to the end of financial year 2015.[54] These total costs are annualised by the benchmarking period.

On the one hand this incorporates more information on the costs of cyclone events derived from a large set of such events (see note below). On the other hand this data is captured over a longer period for annualisation, as well as the generalisation of our denominator. The net result is a minor change relative to the AER's previous OEF adjustment.

54 This includes the Townsville mini tornado 2011-12 and Cyclones Larry 2005-06, Ului 2009-10, Tasha 2010-11, Anthony 2010-11, Yasi 2010-11, Oswald 2012-2013, and recently Ita 2013-14, Dylan 2013-14, Marci 2014-15.

3.6.3 Areas for further consideration

Previous AER estimation of this OEF includes data on costs that were sourced, in part, from a confidential Ergon submission regarding cyclone impacts. For the last three cyclones we have not had access to similar information and have used emergency response expenditure that is only part of OPEX. The present assessment may therefore an under-estimate, and a fuller assessment could be made with equivalent cost data for all cyclones in the benchmark period. In any future enquiries on this topic, it is suggested the AER should confirm the basis for the data including:

- The deduction of any income from related insurance claims.
- The absence of any costs that are not direct or incremental to the cyclone event.

3.7 Evoenergy/Backyard reticulation

The AER has previously identified three OEFs exclusively applicable to Evoenergy that are here considered together:

- **Capitalisation practices:** Historical differences in accounting treatment of capital and operating costs between Evoenergy and other DNSPs meant that reported operating costs were not directly comparable. The AER investigated this issue as part of its earlier decisions and benchmarking, and determined that an OEF of 8.5% was applicable to correct this anomaly.
- **Backyard reticulation:** Historical planning practices in the ACT mean that in some areas overhead distribution lines are run along a corridor through backyards rather than the street frontage as is the practice for other DNSPs. In previous decisions and benchmarking reports the AER has investigated this issue and previously determined that an OEF of 5.6% is appropriate, to account for additional costs incurred by Evoenergy that are not incurred by comparable DNSPs.
- **Service classification (standard control services connections):** Evoenergy classifies some connection service costs as standard control services which are not similarly classified for other DNSPs. This results in additional reported OPEX for Evoenergy compared to other networks. Service classifications are in part determined by the AER, meaning the adjustment meets the AER's criteria for consideration as an OEF.

3.7.1 Assessment against OEF criteria

Our approach incorporates and builds on that articulated through the AER decisions.

Capitalisation practices

The accounting methodology difference giving rise to this OEF was not related to capitalisation per se, but rather the allocation of overheads. Evoenergy historically allocated overheads such as management and corporate costs to its operating costs only, whereas other DNSPs allocated these overheads across both capital and operating cost activities. Vehicle and IT lease costs were treated as operating costs whereas these were capitalised or allocated across capital and operating activities by other DNSPs This meant that Evoenergy's reported operating costs were higher (and its reported capital costs lower) than comparable DNSPs.

Evoenergy has subsequently changed its accounting policies to align with other DNSPs, and now allocates overheads across both capital and operating cost activities. While we have not reviewed the allocation methodology of Evoenergy and other DNSPs in detail (for example, the finer details of how costs are allocated according to labour-hours or as a percentage of costs across different activities, allocation to plant and equipment etc.), we do not consider any residual differences in accounting policies will give rise to material differences in reported operating costs.

Evoenergy has revised its RINs based on the new accounting policies, and the RIN data on operating costs now used by AER for benchmarking purposes is now comparable to other DNSPs so far as allocation of overheads is concerned. This OEF is now duplicative and discontinued. We understand that the AER is currently reviewing differences in cost allocation and capitalisation polices between DNSPs, and their effect on benchmarking.

Backyard reticulation

Backyard reticulation accounts for 755km or approximately 31% of Evoenergy's overhead network. Land owners are in theory responsible for tree trimming and vegetation management for the majority of this length, with Evoenergy having primary responsibility for only around 10km or 1.3% of the network. Evoenergy does, however, have responsibilities under the Utilities Act (ACT) to ensure public safety even when it does not have primary responsibility for vegetation management of backyard lines.

In practice, this requires Evoenergy to: conduct inspections of backyard lines to ensure appropriate clearances are maintained; issue notices where trimming is required; conduct follow-up inspections to ensure the necessary works have been carried out; and in some cases conduct emergency trimming itself, if the landowner has not done so after repeated notice.

Other costs associated with backyard reticulation include: additional costs associated with line and poletop maintenance; pole inspections which incur additional costs due to difficulty arranging access; and in some cases erecting scaffolding or similar to access poletops.

These costs primarily relate to:

- notification letters prior to inspections;
- cancelled inspections;
- additional time for inspections; and
- access issues.

Additional costs are incurred due to issues such: as locked gates; animals preventing access; rescheduled inspections; and additional costs associated with conducting works in backyards rather than on the street –e.g. remediating damage. Where tree trimming is conducted by landowners, they often trim the minimum amount necessary to provide required clearances, rather than an additional amount to allow for regrowth as is common practice for DNSPs conducting tree trimming. This means that the inspection and trimming cycle is often shorter than for other DNSPs and thus less efficient due to factors beyond Evoenergy's control. Even where some landowners may trim to allow for regrowth, this cannot be guaranteed and Evoenergy therefore inspects all properties more frequently.

We have no reason to disagree with the AER's previous assessment of this OEF as exogenous and non-duplicative. We suggest that, as the vegetation management OEF is developed and quantified, consideration be given to ensuring that any overlap between vegetation management and backyard reticulation is identified. This is to avoid any potential breaches of the non-duplication criterion, for this OEF.

Service classification of connections

Differences in service classifications may become an issue for economic benchmarking where there are material differences in the scope of the standard control service such as the extent connection services form part of standard control. Standard control OPEX typically excludes a significant component of connections services, as well as metering and public lighting services, among other things.

The current Evoenergy service classification OEF was originally applied by the AER in the context of setting an efficient OPEX forecast for the 2014-19 period. As noted by the AER in its draft decision (p. 165):

> *…. service classification must be considered when applying the results to produce our opex forecast. This is because if we do not provide an operating environment adjustment for service classification, service providers that provide standard control services that are not network services will be penalised. ActewAGL classifies some of the costs it incurs for connection services as standard control services.*
>
> *Our opex forecast, based on the Cobb Douglas SFA opex cost function, is for network services so it excludes connection services. Therefore, in order to make our network services forecast comparable to ActewAGL's standard control services opex forecast it is necessary to make an adjustment to account for connection services.*

Going forward, where the AER applies OEFs in the context of its annual benchmarking reports, it is possible any connection service OEF for Evoenergy may be clarified in a service classification decision.

3.7.2 Finding and quantification

Table 16 provides the quantification of the backyard reticulation OEF that is specific to Evoenergy. Not being applicable to the reference group, the OEF adjustment is equal to the estimate.

Table 16 Evoenergy (%, $000, $June 2015)

DNSP	AER OEF adjustment		S-M OEF estimate		S-M OEF adjustment	
Backyard reticulation	5.60%	$2,375	1.66%	$705	1.66%	$705
Reference point	0.00%		0.00%		0.00%	

The AER has previously investigated backyard reticulation, and accepted an estimate of additional costs provided by Evoenergy as a fixed cost. Evoenergy provided current data on their direct costs for backyard reticulation including pole inspection, vegetation management and maintenance activities. The data also indicates that a substantial proportion of the previous estimate attributed indirect costs.

For the reasons explained in Section 2.2.3, we have used the direct costs for pole inspection and maintenance activities. We have also excluded the vegetation management component for consistency of treatment with other DNSPs (for which no vegetation OEF is currently quantified). The exclusion of indirect costs is the major component of the difference compared to previous AER calculations.

3.7.3 Areas for further consideration

Regarding the remaining component of backyard reticulation, it could be useful if Evoenergy could in future provide more detail on limits around recovery of incremental access costs from landowners, recognising there are difficulties with collection and debtor management. As noted above, quantification of the proposed vegetation OEF would need to consider access difficulties, and this should include difficulties regarding gaining access from property owners during normal working hours.

3.8 Harmonisation of WHS regulations

All NEM jurisdictions other than Victoria have enacted Model WHS laws.[55] National harmonisation of WHS legislation forms part of the Council of Australian Government's National Reform Agenda (NRA), agreed through a 2008 Intergovernmental Agreement for Regulatory and Operational Reform in Occupational Safety (IGA).[56] As with other aspects of the NRA, the IGA aims to reduce regulatory burdens and create a seamless national economy.

The Victorian government decided in 2012 not to adopt the Model WHS laws. This decision accompanied publication of a report by PWC prepared for the Victorian Government.[57] This report concluded 'the costs of adoption of the Model WHS laws were significant, while it was unlikely the work safety and health benefits necessary, at least to offset these costs, would be achieved.'[58]

3.8.1 Assessment against OEF criteria

The impact of differences in Work Health Safety (WHS) laws and regulations does not meet the materiality threshold. The basis for the AER's previous quantification of this candidate OEF is a 2012 report for the Victorian government on the incremental cost impact if national WHS laws were implemented in Victoria.[59] The previous quantification substantially over-stated the potential impact on OPEX. The present finding is consistent with AER decisions not to increase OPEX following the introduction of WHS laws in jurisdictions other than Victoria.

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55 Albeit that of the nine jurisdictions that adopted the model laws, seven have made significant variations. See https://www.ohsalert.com.au/nl06_news_selected.php?selkey=51608 (Accessed August 2017)

56 See page i of Decision Regulation Impact Statement for National Harmonisation of Work Health and Safety Regulations and Codes of Practice, 7 November, 2011, Safe Work Australia.

57 See Impact of the proposed national Model Work Health and Safety Laws in Victoria, Summary Report of the Supplementary Impact Assessment, 4 April 2012, PWC.

58 See page 1, PWC, Op Cit.

59 See *Impact of the proposed national Model Work Health and Safety Laws in Victoria, Summary Report of the Supplementary Impact Assessment*, 4 April 2012, PWC

3.8.2 Finding

Our estimation of the WHS OEF compared with the AER estimation is set out in Table 17 below. The key finding is that the OEF adjustment is immaterial for all DNSPs.

Table 17 Harmonisation of WHS regulations (%, $000, $June 2015)

DNSP	AER OEF adjustment		S-M OEF estimate		S-M OEF adjustment	
Evoenergy	0.50%	$212	0.01%	$6	0.01%	$5
Ausgrid	0.50%	$1,916	0.00%	$6	0.00%	$2
CitiPower	0.00%	$0	0.00%	$0	0.00%	-$1
Endeavour	0.50%	$1,041	0.00%	$6	0.00%	$4
Energex	0.50%	$1,555	0.00%	$6	0.00%	$2
Ergon	1.20%	$2,936	0.00%	$6	0.00%	$3
Essential	0.50%	$1,448	0.00%	$6	0.00%	$3
Jemena	0.00%	$0	0.00%	$0	0.00%	-$1
Powercor	0.00%	$0	0.00%	$0	0.00%	-$2
SAPN	0.00%	$0	0.00%	$6	0.00%	$3
AusNet	0.00%	$0	0.00%	$0	0.00%	-$2
TasNetworks	0.00%	$0	0.01%	$6	0.01%	$5
United Energy	0.00%	$0	0.00%	$0	0.00%	-$1
Reference point	0.00%		0.00%			

3.8.3 Quantification – considered immaterial

The AER's previous decisions regarding WHS constituting an OEF was based on the 2012 report prepared for the Victorian government.[60] Our finding is also based principally on the 2012 PWC report.

Table 4 on page 9 of the 2012 PWC report shows that, of the total annualised ongoing cost ($586m), less than $0.05m in aggregate is attributable to power generators (used by the AER as a proxy for DNSPs). This corresponds to an average cost per business of $5,210. This annualised cost per business is not material relative to the OPEX of any of the DNSPs.

If the PWC report is taken at its face value, and the cost per DNSP is around $5,210, then the impact of WHS is clearly well below the materiality threshold. This suggests that, on the basis of the 2012 PWC report, the WHS candidate OEF does not meet the AER's materiality criterion.

In addition, it is also possible that WHS does not meet criteria relating to excluding inefficient expenditure, or duplication of factors already accounted for in other OEFs. In

60 See Impact of the proposed national Model Work Health and Safety Laws in Victoria, Summary Report of the Supplementary Impact Assessment, 4 April 2012, PWC.

this respect it is important to note that the $5,000 per generator incremental WHS cost is attributed by PWC to an increase in wages and conditions. In other words, to the extent there is an impact of WHS on labour costs, it would overlap with any observed differences in labour costs (price and volume) between networks, attributable to a range of potential market and regulatory variables. Some or all of this difference may be deemed to be inefficient rather than an exogenous environmental or regulatory factor. The wider issue of labour cost (price and volume) efficiency is addressed elsewhere in the AER's deliberations of efficient OPEX and should be accounted for there, not with respect to WHS law.[61]

3.9 Severe storms

Our preliminary report considered the material OEF for 'severe storms (extreme wet/windy weather)' in previous AER decisions.[62] This OEF is intended to account for systematic differences in the incidence, severity or extent of severe storms giving rise to incremental OPEX, predominantly through emergency response expenditures following asset failures. DNSP's incur incremental OPEX to make their networks safe in advance of storms, and to restore supply promptly in the event of storm caused outages. This may include intensive maintenance until such time that any assets, where repair is uneconomic, are replaced, in part or in full.[63][64]

In contrast to cyclones, there are no clear meteorological indicators of extent (e.g. cyclonic shape) or severity of a 'severe storm' related to that scope. Severe storm events may be extensive or localised, characterised by high wind speeds or rainfall, or both, and for brief or protracted periods of time. Unlike cyclones, severe storms may occur in all geographical regions in the NEM.

In the absence of clearly distinctive identifying features, severe storms sit on a continuum of weather events that includes high impact, low probability (HILP) events that are rare, particularly compared with the benchmarking period. A key challenge is accounting for HILP events, as discussed in Section 2.3.4. The discussion of this OEF is divided into two parts:

- The discussion in this section refers to the assessment of the previous severe storms OEFs, taking into account the treatment of HILP events.
- A preliminary assessment of a potential severe storm OEF exclusive of HILP events is discussed in Section 4.7 below.

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61 See for example Deloitte Access Economics, *NSW Distribution Network Service Providers Labour Analysis*, October 2014, pp. i-iii.

62 Sapere-Merz, Independent review of Operating Environment Factors used to adjust efficient operating expenditure for economic benchmarking, AER, December 2017 https://www.aer.gov.au/networks-pipelines/guidelines-schemes-models-reviews/review-of-operating-environment-factors-for-distribution-network-service-providers

63 Note this candidate OEF does not address OPEX intended to prevent asset failures during storms – for example vegetation management.

64 The discussion is limited to consideration of an extreme weather OEF for the purpose of economic benchmarking. It does not consider seek to quantify the cost of, or threshold for, an event to be declared a material natural disaster, in which case the pass through provisions in the National Electricity Rules may be activated.

3.9.1 Assessment against OEF criteria

Exposure to extreme storms could vary geographically and efficient costs could vary between DNSPs, depending on differences in incidence and impact.[65] Like other weather events, severe storms are exogenous. We also acknowledge that, unlike any general business, which may temporarily or permanently cease operation due to extreme weather, DNSPs operate under an obligation to maintain services even in and following extreme weather. Hence we agree that a severe storms OEF candidate could meet all OEF criteria in principle.

The severe storm OEF has in the past been quantified using cost data for a limited number of DNSPs for identified HILP events and the associated costs.

We do not agree with the previous quantification of this OEF. This is because it breaches the non-duplication criterion. The OPEX effect of HILP events are already accounted for in the econometric benchmarking as a non-recurrent cost (see Section 2.3.4). If these costs are included in efficient OPEX as an OEF, it is equivalent to converting a non-recurrent cost to a recurrent cost, compensating the DNSP as if such one in 25/50/75 year HILP events occurred every single year. The section further elaborates on this issue.

The potential for an alternatively formulated severe storm OEF candidate is discussed in Section 4.7 below

Material impact of HILP storms

In line with previous consideration by the AER, we have referred to Bureau of Meteorology maps of the prevalence of thunder and lightning averaged over a 10 year period.[66] These maps indicate that, outside cyclone regions, storm weather variations over the longer term is most extreme in the coastal regions for south-east Queensland and north-east New South Wales, with slight variations between other network areas.

However as introduced above and discussed in Section 2.3.4, HILP events must be distinguished from any systematic impact of varying environmental risk of severe storms. To begin with, cyclones are addressed as a separate OEF and these costs are excluded from consideration of Ergon's emergency response expenditure, which is dominated by cyclones. Major storm events only comprise 1.8 percent of Ergon's emergency response expenditure over a six year period, after excluding cyclones.

Figure 15 reconsiders analysis provided by the AER's Figure A.34 on the materiality of HILP events.[67] Focusing on the Queensland service providers and Ausgrid, Figure A.34 is modified in Figure 15 to show the material impact of cyclones on Ergon's and the HILP storms in Energex and Ausgrid's network areas above the typical emergency response expenditure.

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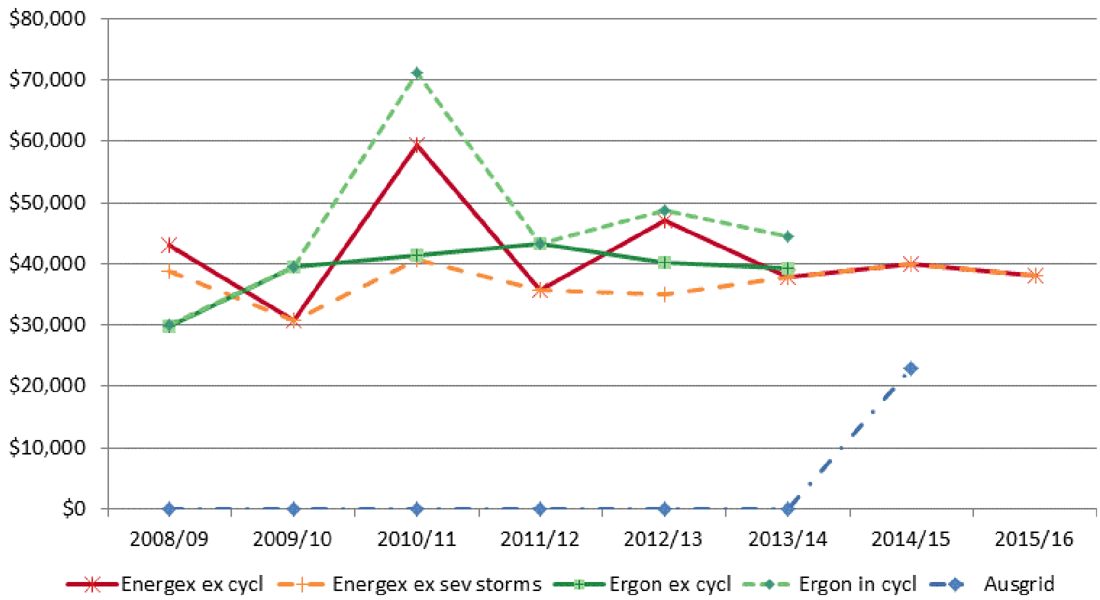
65 AER decisions have referred to Bureau of Meteorology maps of the prevalence of thunder and lightning averaged over a 10 year period. See for example in Energex, Response to AER information request AER EGX 001, 17 December 2014, p. 4

66 See BoM at http://www.bom.gov.au/jsp/ncc/climate_averages/thunder-lightning/index.jsp and http://www.bom.gov.au/jsp/ncc/climate_averages/thunder-lightning/index.jsp

67 AER, Preliminary Decision Ergon Energy determination 2015−16 to 2019−20, Attachment 7 − Operating expenditure, April 2015

Figure 15 confirms the material impact of cyclones is substantial for Ergon. The AER's previous severe storms OEF estimate was based on three significant events identified by Energex (in response to AER enquiries) that materially increased its costs during the 2008/9 to 2012/13 period.[68]. The material impact of these three events indicates significant deviations from a base level of emergency response expenditure typical of the longer period of available emergency response cost data.

Figure 15 Annual Emergency response expenditure for 2009 to 2016 ($000 2014)



Source: Sapere analysis of AER data

While the AER's analysis focused on the total cost of these events, it did not recognise their low probability of occurrence (or reoccurrence), even at the level of their frequency within the benchmarking period. By annualising over the period of available data the AER quantified the cost of these storms as if they were one-in-two year events, whereas the Queensland Flood Commission received evidence that at least one of these was a 1 in 100 year event.[69]

Likewise Figure 15 illustrates that the impact of the 27th April 2015 storm in the Hunter Valley is strongly uncharacteristic of Ausgrid's typical emergency expenditure for major storm events. This HILP event accounts for 36 percent of all emergency response costs in that year. This event had an impact across a geographical area focused in the Hunter Valley. Within this area, its probability has been assessed as one in 75 year event.[70]

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68 The Gap storm in November 2008, the Brisbane floods in 2011 and ex tropical cyclone Oswald in 2013, cited in Energex, Response to AER information request AER EGX 001, 17 December 2014, p. 4.

69 Expert witness reports on flood frequency analysis, Queensland Flood Commission, available at www.floodcommission.qld.gov.au

70 https://theconversation.com/explainer-was-the-sydney-storm-once-in-a-century-40824

3.9.2 Finding

Our present view, based on analysis and consultation, is that costs from HILP events should be excluded on the basis of the non-duplication criterion. As discussed in Section 2.3.4, through this review the AER has confirmed that HILP events are adequately accounted for in the econometric model. Including the full cost of these events as an OEF breaches the duplication criterion by treating non-recurrent costs as if they were recurrent.

3.9.3 Areas for further consideration

We acknowledge that a severe storm related OEF, exclusive of HILP events, could meet all three OEF criteria. A preliminary assessment of this potential OEF is discussed in Section 4.7 below.

3.10 Aggregate material OEFs

The following tables aggregate the findings for each of the material OEF candidates above, summarising the process from OEF estimates to reference point to OEF adjustment for the individual findings taken in aggregate. As discussed in Section 2.2, the consistent calculation of OEF adjustments across OEF candidates and DNSPs relies on the consistent employment of optimised OPEX (see Table 8) as the denominator.

Table 18 aggregates the dollar values of OEF estimates, including totals with and without the taxes and levies OEF.

Table 19 expresses Table 18 as percentage of Optimised OPEX, including the reference point values reflecting the AER's preference to use the customer number weighted average of the reference group.

Table 20 derives the OEF adjustments from the OEF estimates and reference points in Table 19.

Table 21 expresses the OEF adjustments in Table 20 as a dollar value by multiplying by the optimised OPEX for each DNSP in Table 8.

Table 18 Summary of OEF estimates ($000, $June 2015)

DNSP	Sub-transmission (Licence conditions)	Vegetation Management	Taxes and levies	Termite exposure	Cyclones	Back yard Reticulation	Total (inc T&L)	Total (ex T&L)
Evoenergy	$1,376	Nil	Nil	$46	NA	$705	$2,126	$2,126
Ausgrid	$21,855	Nil	$30	$213	NA	NA	$22,097	$22,068
CitiPower	$3,065	Nil	$883	$20	NA	NA	$3,968	$3,085
Endeavour	$16,766	Nil	$23	$744	NA	NA	$17,533	$17,510
Energex	$16,568	Nil	$8,780	$1,353	NA	NA	$26,701	$17,920
Ergon	$24,914	Nil	$4,901	$2,950	$12,828	NA	$45,593	$40,692
Essential	$29,353	Nil	$0	$3,029	NA	NA	$32,382	$32,382
Jemena	$1,924	Nil	$811	$19	NA	NA	$2,754	$1,943
Powercor	$7,770	Nil	$1,640	$538	NA	NA	$9,947	$8,307
SAPN	$10,619	Nil	$3,525	$0	NA	NA	$14,144	$10,619
AusNet	$6,944	Nil	$195	$274	NA	NA	$7,413	$7,217
TasNetworks	$32	Nil	$3,891	$0	NA	NA	$3,923	$32
United Energy	$4,595	Nil	$810	$68	NA	NA	$5,473	$4,663

Source: Sapere-Merz analysis

1. Nil indicates that data is insufficient to quantify the OEF; NA indicates the OEF is not applicable.
2. Total includes only material OEFs; the quantification of taxes and levies OEF is indicative only.

Table 19 Summary of OEF estimate (as percentage of Optimised OPEX)

DNSP	Sub-transmission (Licence conditions)	Vegetation Management	Taxes and levies	Termite exposure	Cyclones	Back yard Reticulation	Total (inc T&L)	Total (ex T&L)
Evoenergy	3.24%	Nil	Nil	0.11%	NA	1.66%	5.01%	5.01%
Ausgrid	5.70%	Nil	0.01%	0.06%	NA	NA	5.77%	5.76%
CitiPower	5.49%	Nil	1.58%	0.04%	NA	NA	7.11%	5.52%
Endeavour	8.06%	Nil	0.01%	0.36%	NA	NA	8.43%	8.41%
Energex	5.33%	Nil	2.82%	0.43%	NA	NA	8.58%	5.76%
Ergon	10.18%	Nil	2.00%	1.21%	5.24%	NA	18.64%	16.63%
Essential	10.14%	Nil	0.00%	1.05%	NA	NA	11.18%	11.18%
Jemena	2.80%	Nil	1.18%	0.03%	NA	NA	4.01%	2.83%
Powercor	4.07%	Nil	0.86%	0.28%	NA	NA	5.22%	4.36%
SAPN	4.28%	Nil	1.42%	0.00%	NA	NA	5.69%	4.28%
AusNet	3.37%	Nil	0.09%	0.13%	NA	NA	3.60%	3.50%
TasNetworks	0.05%	Nil	6.21%	0.00%	NA	NA	6.26%	0.05%
United Energy	3.90%	Nil	0.69%	0.06%	NA	NA	4.65%	3.96%
Reference Point	4.08%	Nil	0.88%	0.11%	0.00%	0.00%	5.07%	4.19%

Source: Sapere-Merz analysis

1. Nil indicates that data is insufficient to quantify the OEF; NA indicates the OEF is not applicable.
2. Total includes only material OEFs; the quantification of taxes and levies OEF is indicative only.
3. The reference point values reflect the AER's preference to use the customer number weighted average of OEF estimates for the reference group. See section 2.2.4for more detail.

Table 20 Summary of OEF adjustment (as percentage of Optimised OPEX)

DNSP	Sub-transmission (Licence conditions)	Vegetation Management	Taxes and levies	Termite exposure	Cyclones	Back yard Reticulation	Total (inc T&L)	Total (ex T&L)
Evoenergy	-0.84%	Nil	Nil	0.00%	NA	1.66%	0.82%	0.82%
Ausgrid	1.62%	Nil	-0.87%	-0.05%	NA	NA	0.70%	1.57%
CitiPower	1.41%	Nil	0.70%	-0.07%	NA	NA	2.04%	1.33%
Endeavour	3.98%	Nil	-0.87%	0.25%	NA	NA	3.36%	4.22%
Energex	1.25%	Nil	1.94%	0.33%	NA	NA	3.52%	1.57%
Ergon	6.10%	Nil	1.13%	1.10%	5.24%	NA	13.57%	12.44%
Essential	6.06%	Nil	-0.88%	0.94%	NA	NA	6.11%	6.99%
Jemena	-1.28%	Nil	0.30%	-0.08%	NA	NA	-1.06%	-1.36%
Powercor	-0.01%	Nil	-0.02%	0.17%	NA	NA	0.15%	0.17%
SAPN	0.19%	Nil	0.54%	-0.11%	NA	NA	0.63%	0.09%
AusNet	-0.71%	Nil	-0.78%	0.02%	NA	NA	-1.47%	-0.69%
TasNetworks	-4.03%	Nil	5.33%	-0.11%	NA	NA	1.19%	-4.14%
United Energy	-0.18%	Nil	-0.19%	-0.05%	NA	NA	-0.42%	-0.23%
Reference Point	4.08%	Nil	0.88%	0.11%	0.00%	0.00%	5.07%	4.19%

Source: Sapere-Merz analysis

1. Nil indicates that data is insufficient to quantify the OEF; NA indicates the OEF is not applicable.
2. Total includes only material OEFs; the quantification of taxes and levies OEF is indicative only.
3. The reference point values reflect the AER's preference to use the customer number weighted average of OEF estimates for the reference group applied to the calculated OEF estimates. See section 2.2.4for more detail.

Table 21 Summary of OEF adjustment ($000, $June 2015)

DNSP	Sub-transmission (Licence conditions)	Vegetation Management	Taxes and levies	Termite exposure	Cyclones	Back yard Reticulation	Total (inc T&L)	Total (ex T&L)
Evoenergy	-$355	Nil	Nil	$0	NA	$705	$350	$350
Ausgrid	$6,215	Nil	-$3,335	-$205	NA	NA	$2,675	$6,010
CitiPower	$786	Nil	$393	-$41	NA	NA	$1,138	$745
Endeavour	$8,273	Nil	-$1,804	$517	NA	NA	$6,986	$8,790
Energex	$3,874	Nil	$6,049	$1,014	NA	NA	$10,937	$4,888
Ergon	$14,930	Nil	$2,753	$2,684	$12,828	NA	$33,195	$30,442
Essential	$17,535	Nil	-$2,543	$2,713	NA	NA	$17,706	$20,248
Jemena	-$878	Nil	$208	-$56	NA	NA	-$726	-$934
Powercor	-$14	Nil	-$35	$330	NA	NA	$281	$316
SAPN	$482	Nil	$1,345	-$271	NA	NA	$1,556	$212
AusNet	-$1,469	Nil	-$1,615	$49	NA	NA	-$3,035	-$1,420
TasNetworks	-$2,526	Nil	$3,341	-$68	NA	NA	$747	-$2,594
United Energy	-$209	Nil	-$224	-$60	NA	NA	-$493	-$269

Source: Sapere-Merz analysis

1. Nil indicates that data is insufficient to quantify the OEF; NA indicates the OEF is not applicable.
2. Total includes only material OEFs; the quantification of taxes and levies OEF is indicative only.

4. Other candidate OEFs

As outlined in Section 1, the principal focus of the review is the most material of over 60 operating environment factors driving apparent differences in estimated productivity and operating efficiency between the distribution networks in the NEM, now considered uniformly across all DNSPs. These have been discussed in the preceding section. In line with DNSP responses to the preliminary report, and as agreed at the March workshop, the discussion on potential OEFs has been substantially expanded in this report.

Out of a large set of candidate OEFs identified by DNSPs (see Appendix 4), six potential OEF candidates are identified as having a higher chance of meeting the information challenge described in Section 2.2.2, and hence potential to completely address the AER's three OEF criteria. Based on the evidence in front of us now, we do not have a conclusive view that these 6 OEFs will meet all of the OEF criteria, including comparatively materiality. However, we consider that network topology and Guaranteed Service Level payments could be material. If so, they could meet all three OEF criteria.

Significant effort and resources would be required to gather information across the sector, in order to assess the candidate OEFs identified. We do not draw any conclusions on whether this investment would be worthwhile and have instead sought to develop an analytical framework in order to provide an improved setting for any such decisions.

4.1 Identification and initial assessment

As discussed in Section 1.3, this review was conducted following consultation with all DNSPs. A major addition was engagement with previously non-assessed DNSPs, for whom OEF candidates have not been directly identified or quantified, including all of the reference group. In the current context of extending OEFs to all DNSPs, potential OEFs for non-assessed DNSPs were a priority. As discussed in Section 2.2.4, OEFs for the reference group are significant for the potential to change the reference point and hence the OEF adjustment for all DNSPs.

The consultation identified a range of operating environment factors that each DNSP identify as significant for their particular business. Appendix 4 summarises potential OEFs identified though both rounds of submissions and discussion, including the potential proponents, the AER OEF categorisation and the AER's previous assessment, where available. Our initial view was that, while in some cases additional information was provided in relation to a single DNSP, there was insufficient new information across DNSPs from which to assess variations in efficient costs to the extent necessary to re-open the AER's previous decisions that candidate OEFs did not meet one or more of the OEF criteria.

Subsequent submissions and workshop discussion deepened our understanding of some OEF candidates. In particular, significant new information emerged about five potential OEF candidates that in our view warrant discussion and initial assessment against the OEF framework, and which may be useful for DNSPs in considering OEFs in the future.

The set of OEF candidates is as follows.

1. Network Topology. This candidate OEF would quantify differences in efficient costs between urban/meshed networks and rural/radial networks. It may also include differences in terrain and road congestion. This candidate OEF was identified by more DNSPs than any other candidate OEF. This includes a majority of the reference group. It is therefore possible that this candidate OEF could significantly influence the reference point and consequently OEF adjustments for all DNSPs.
2. Asset inspection requirements. This candidate OEF arose from discussions regarding the asset inspection component of existing OEF candidates, including vegetation management, bushfire regulations and severe storms. We are proposing a single approach across all DNSPs where previous OEFs may have partially captured these requirements as appropriate and effective for assessment.
3. Guaranteed Service Level (GSL) schemes. Identification of this candidate OEF arose from discussion about the severe storms OEF, with particular reference to SAPN. As this is a member of the reference group any differences in GSL scheme costs may be significant.
4. Labour and material costs. This candidate OEF arises in particular with respect to Tasmania and Northern Territory, where cost variations may be more pronounced than in the mainland states that have been the focus of previous reviews of OEFs.
5. Demand Management/Advanced Metering Infrastructure. Discussions highlighted broader costs and cost savings than previously considered, and AMI is nearly ubiquitous for four of the five members of the reference group.

In addition, while in Section 3.9 the severe storms OEF based on HILP events were considered not to meet the OEF duplication criteria, we consider further evidence relating to an alternative (non-HILP) approach to quantifying a severe storms OEF candidate.

In identifying this set of candidate OEFs, consideration was also given to the information assessment requirements (see Section 2.2.2) relative to the OEF criteria. Further information is required for each candidate OEF currently considered, either to make a preliminary assessment of whether comparably material OEFs are probable, or to fully quantify the OEF and make a final assessment of materiality.

4.2 Network topology/topography

4.2.1 Submissions from DNSPs

Multiple DNSPs (see Table 26 below) have raised the question of whether differences in network topology and topography are a material driver of variations in OPEX, including associated issues of urban/rural networks, customer density and terrain. Comments included:

> *SA Power Networks operates network assets specified in a lease from the SA Government. Therefore, the design of our network has been inherited, including long lines to sparsely populated rural areas. While the AER's benchmarking approach has some account for customer density by way of customer numbers and line length, the AER's approach does not adequately account for the fact that costs to serve customers in rural / regional areas are greater than those in denser metropolitan areas. That is, it is not only the length of line that matters, but the length of line that traverses through rural / regional areas. For example: there are greater costs due to increased travel time to reach sites, and increased difficulties in bundling larger volumes of work to create efficiencies. SA Power Networks' cost to serve is weighted more to line length than customer numbers with approximately 70 per cent of our assets serving 30 per cent of our customers.*
>
> *Based on its estimation using the CD SFA model, AusNet Services found unexplained efficiency differences between AusNet Services' urban and rural distribution networks. Therefore, AusNet Services claims that the OEF framework is failing to account for material OEFs that affect its business, including those that stem from the rural nature of much of its network business and the Victorian regulatory obligations relating to bushfire mitigation. AusNet Services also consider that there are material cost differences due to terrain differences among the network businesses.*
>
> *TasNetworks concurs with SA Power Network that while the AER's benchmarking approach makes some allowance for customer density by way of customer numbers and line length, it does not adequately account for the fact that costs to serve customers in rural / regional areas are greater than those in denser metropolitan areas.*

4.2.2 Description

The proposition is that the line length output in the econometric model may not fully account for variations in network topology and topography. This section explores whether significant differences in topology and topography between DNSPs may result in variations in efficient OPEX that are not addressed in the econometric analysis and hence may meet the duplication test.

Network topology/topography

The fundamental issue in this potential OEF is the implication for efficient OPEX of the extent any individual DNSP tends more or less toward the two types of network topology described in Figure 17 below. Network topology is closely associated with urbanisation and terrain - topography.

For clarity, consider the dictionary definitions:

- topology - (mathematics) the study of geometrical properties and spatial relations unaffected by the continuous change of shape or size of figures.
- topography - the arrangement of the natural and artificial physical features of an area.

In considering the topology of electrical networks in natural or urban landscapes, the two concepts are intertwined as the features of a natural or built landscape influence the engineering design of the network. Hence rural or mountainous topography is more likely to be radial network topography and urban topography is more likely to be meshed network design.

The key drivers of any OPEX variations associated with this candidate OEF appear to arise from:

- Total travel distance
- Total travel times
- The relative extent of radial lines that may require higher levels of preventative maintenance to meet reliability standards.

Each of these is explored further below.

4.2.3 Previous AER consideration

The AER has considered the issue of network topology/topography in previous determinations. It refers to advice from Economic Insights that:

> *Economic Insights considers that the long circuit length of Essential Energy and Ergon Energy does not underestimate their efficiency. …if Essential Energy and Ergon Energy were genuine outliers, it would expect the flexible translog function to have given them much higher efficiency scores than the less flexible Cobb Douglas function. The results, however, are very similar.*[1] *Economic Insights acknowledges that it would be desirable to have more 'large' rural providers in the sample, but considers these two service providers are unusual with no service providers in comparable countries with accessible data having the same extent of lines.*[2] *Economic Insights did not consider there was justification to adjust Essential Energy's and Ergon Energy's efficiency scores on the basis of their very low customer density.*

In addition, the AER engaged EMCa to consider whether

> *…from an engineering perspective—the relationship between OPEX and customer density changes at the very low densities of Essential Energy and Ergon Energy. EMCa found it is feasible to compare*

[1] Economic Insights, 2015, p. 30.

[2] Economic Insights (2015), p. 30 (section 3.3)

sparse rural distributors (like Essential Energy and Ergon) with other rural distributors included in the benchmarking data set.[3] As such, the findings for our benchmarking model are applicable to the sparse rural service providers.

The AER Ausgrid Final Decision (p7-187) includes a discussion on spatial density and customer density. It concluded that it is not satisfied that linear density is insufficient to capture the effects of customer density. This is because OPEX will be driven by the length of line that just be maintained rather than the area that the service provider nominally covers. It pointed to the fact that Power and Water Corporation's actual service area is only a fraction of the total area of the Northern Territory. It concluded that:

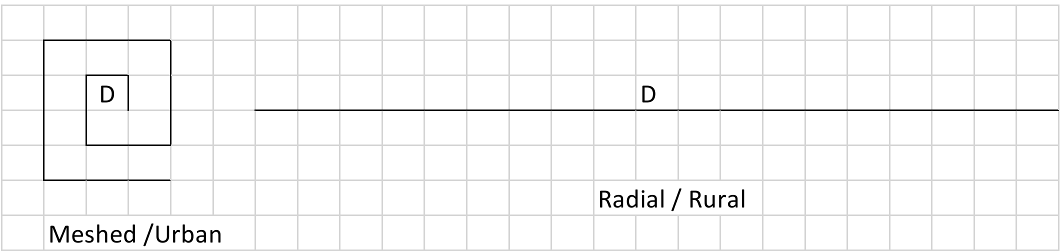
Therefore, measuring customer density using Power and Water Corporations nominal service area would provide a misleading picture of the customer density of Power and Water Corporation's network.

4.2.4 High level assessment against OEF criteria

Efficient travel times and the optimal number of depots may be higher for networks with more linear topologies. Linear topologies may result in greater distances to travel for preventative and corrective maintenance and can result in a requirement for an increased number of depots or service centres for an equivalent length of line and customers served.

A more linear topology may not necessarily service a more extensive area. The area serviced by a network is described by a corridor either side of the built network. For meshed networks, areas serviced are typically back to back following the topography of the city / urban subdivisions they service. The travel and depot cost differences may be illustrated by the highly simplified and stylised representation of two broad types of network topologies depicted below.

Figure 16 Radial versus Meshed network topology



In Figure 16 the lines in the meshed and the radial network are both exactly 19 units long. It is assumed that both network types service an area that is half a unit either side of the two lines.[71] Both network types are capable of servicing the same number of customers. The maximum distance travelled from the Depot (D) in the meshed topology is three (3) units. The maximum distance travelled under the radial topology is nine (9) units. It is assumed that, if acceptable service levels could not be maintained with a travel distance of nine units, another depot would be required in the radial configuration. In the radial network, the probability of service interruptions may be higher than in the meshed network. This may

[3] EMCA, 2015, p. 1.

71 The meshed network has some overlap at the corners.

give rise to a more demanding asset management regime being applied in the radial network, in order to maintain equivalent levels of reliability.

With the possible exceptions of CitiPower and Evoenergy, most DNSPs have a combination of the two stylised network topologies illustrated. The point is there may be structural variations in the balance between the two types of network topologies. For example, it seems likely that Ergon and Essential would have a higher than average exposure to the rural/radial topology.

Exogeneity

Differences in network topology relate to sources of demand and evolve with changes in the topology of sources of demand over time. Outside urban areas, sources of demand, such as businesses and residences, may tend to develop along features such as roads, rivers, or a coastline. The topography (terrain) in which DNSPs operate is also a function of the location of sources of demand.

Differences in topology and topography are outside the control of DNSPs. Any variations in efficient OPEX attributable to differences in network topology and terrain are exogenous.

Duplication

There may be no contradiction between the proposition that differences in topology/topography could drive differences in efficient OPEX, on the one hand, and evidence presented in previous AER consideration of this matter, on the other. This is because, even if linear customer density (customer count per unit of line length) were identical between the two illustrative types of network topology in Figure 16, the radial type topology may require higher OPEX, other things being equal.

The econometric model does not incorporate variables explicitly relating to topology or topography, and inherently models average OPEX and average linear customer density for DNSPs within which topology varies. It is possible that the lack of variations in outcomes from the different forms of econometric modelling do not explain variations in OPEX that are attributable to differences in topology or topography instead of to differences in efficiency.

Similarly, the point illustrated by Figure 16 is unrelated to any differences in the extent of the areas within which the two networks exist. In both cases, it is assumed that the physical extent of the area within which sources of demand is supplied is more or less identical (limited by a fixed distance from the main line). We agree with the AER's previously expressed view that differences in the extent of the area within which networks operate is not a sensible framing of a topology/topography OEF.

We also agree with the AER's previously expressed view that it is reasonable to compare radial/rural network topologies across most DNSPs, since all but possibly two DNSPs appear to have significant radial/rural components. The difficulty is that the balance between the two types of network topology illustrated in Figure 16 is likely to vary significantly between DNSPs, taken as a set.

Nevertheless, it is possible that variations in OPEX associated with topology and topography are not fully accounted for in the econometric benchmarking, and in particular the combination of the line length and customer number outputs (i.e. customer density). If this were so, then productivity scores for some networks may be lower than otherwise. On the other hand, it may be the case that congestion related costs may be significant for highly urbanised networks and this may not be fully accounted for in the productivity scores. In either case, it is possible that this candidate OEF could meet the duplication criterion.

The issue of duplication is explored further below based on the data currently available in the RINs.

Materiality

Vehicle expenditure (not including labour) varies between 0.7 and 5.9 per cent of DNSPs total expenditure. Travel distances per customer appear to vary from 11 km to 290 km across DNSPs. Labour OPEX associated with differences in average travel time could be material. Building related OPEX varies between 1.6 per cent and 12.3 per cent of total expenditure. This variation in expenditure is also material and may be in part or all related to exogenous rather than endogenous factors (i.e. decisions on whether to own or lease buildings).

Other things being equal, reliability outcomes may be lower for radial network topologies compared with meshed topologies. This would reduce productivity scores, other things being equal.

It is also possible preventative maintenance activities may need to be higher for radial feeders with no backup supply options, depending on the value of customer reliability (VCR) . Any decision to undertake increased maintenance activities could depend on the nature of the assets and their operating environment. Any decisions should be detailed in the Asset Management Plans and Strategies for each DNSP including a justification (based on VCR) of the increased activities.

A large portion of OPEX variation arising from differences in topology should be addressed by the circuit length and customer number outputs in the econometric model. The relative weighting of these outputs relative to the full set of outputs could influence whether any residual effect of differences in network topology, not already addressed by the econometric modelling, is material.

So far, DNSPs have not provided any data from which to determine whether any variations in travel costs, building costs or changes in preventative maintenance strategies for radial feeders, not explained by circuit length or customer numbers, would be material. Accordingly, at this point, no conclusions can be drawn as to whether the materiality criterion would be met.

4.2.5 Analysis of Available Data

Cost Data

The impacts of variations in travel time, number of depots, and maintenance activity are not clearly identified in any of the data available for this review. It seems likely that any such impacts would be dispersed over number of OPEX line items including: direct (preventative and corrective) maintenance expenditure (travel, depots and preventative maintenance intensity); overhead costs (depots).[72]

Within the Category Analysis RIN there is data on the cost drivers themselves, specifically:

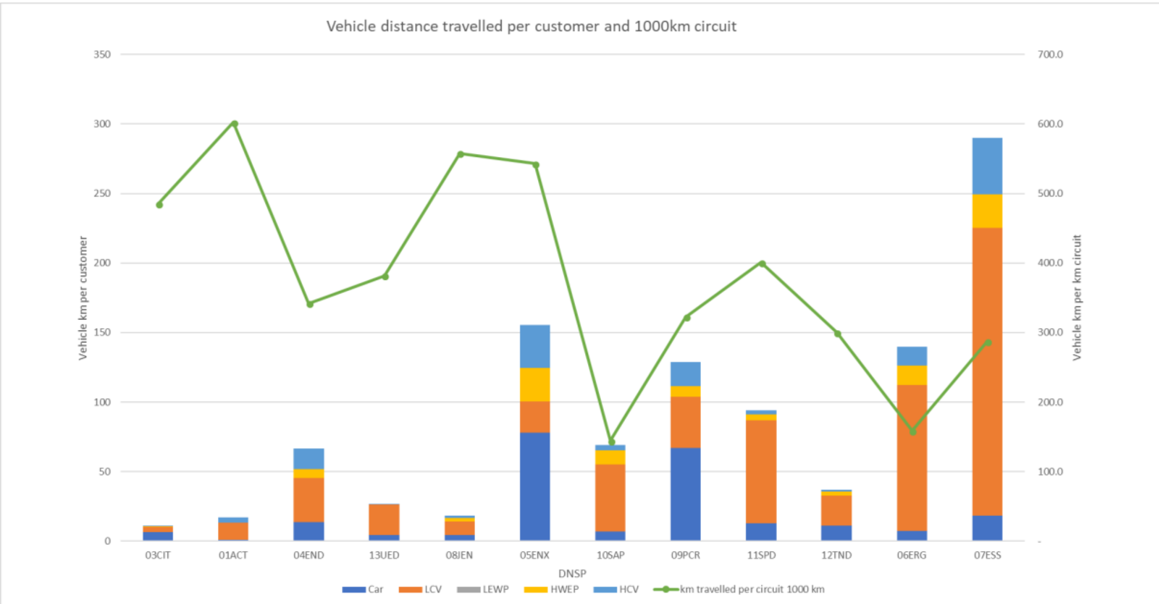
- Vehicle distance travelled by type.
- Costs of building maintenance.

The limitation of considering cost driver data is that there will be other variables reflected in this data, including any inefficiency. Similarly, DNSPs have so far not provided data to support the proposition there is a material difference in preventative maintenance OPEX for radial feeders, in order to meet reliability obligations / value of customer reliability drivers.

Vehicle distance travelled

Figure 17 uses information in Category Analysis RINs to compare vehicle distance travelled per customer and the per km circuit length by DNSP. The DNSPs are sorted from entirely urban, through largely urban, mixed, to fully rural.

Figure 17 Vehicle distance travelled per customer and customer density



Source: Sapere Merz analysis of Category Analysis RIN data.

Figure 17 indicates there is clearly a significant difference between DNSPs in terms of the distance travelled per customer and km circuit length (distance travelled normalised on Benchmarking outputs). The differences suggest a moderate relationship between travel distances and network topology.

Efficiency of operations

[72] For DNSPs that do not have advanced metering infrastructure.

The difference in distance travelled between DNSPs is not correlated with productivity scores from the econometric benchmarking. It cannot be concluded from this that variations in distance travelled do not affect productivity.

Addressed in Benchmarking Modelling

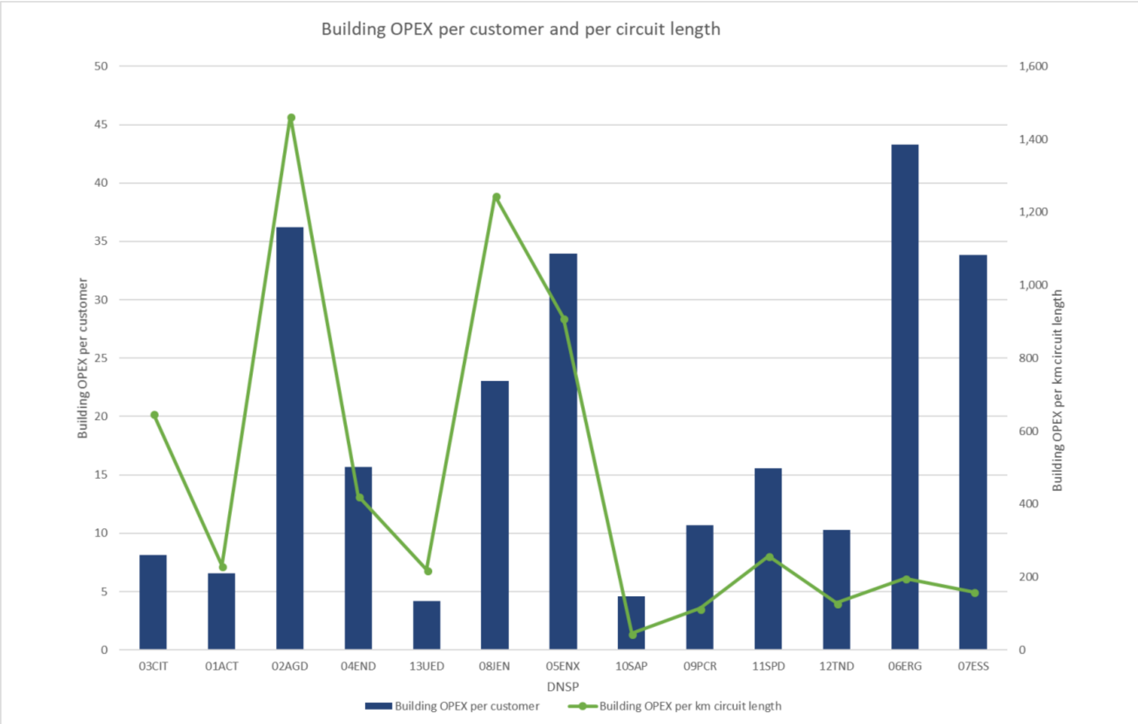
The AER has confirmed that for major OPEX items econometric modelling reflects an average cost per unit of output over the full set of DNSPs. Outputs from this modelling include both circuit length and customer numbers. Reviewing Figure 17, we see that the vehicle distance travelled per customer generally increases to the extent that DNSPs are more rural. Thus, the application of an average allowance for distance travelled per customer could overstate the efficiency of urban relative to urban DNSPs. Conversely, the application of an average allowance for distance travelled per circuit length could overstate the efficiency of more rural DNSPs.

The relative impact on OPEX of the two variables considered in Figure 17 is difficult to determine. This is because econometric outputs such as ratchetted maximum demand and total energy are more closely related to customer numbers than they are to circuit length. Further work would be required to establish the extent to which differences in efficient OPEX relating to topology are already addressed in the derivation of productivity scores.

Building expenditure

There is no data in the Category Analysis RINs on the number or scale of depots / service centres for each DNSP. There is information on building-related OPEX. This data is limited as it does not consider the lease / buy trade-offs between DNSPs and does not detail differences in the number of depots /service centres. Noting these limitations, Figure 18 demonstrates the building OPEX per customer and customer density for each DNSP.

Figure 18 Building expenditure per customer and km circuit length



Source: Sapere Merz analysis of Category Analysis RIN data.

There is little or no correlation between building OPEX and circuit length and customer number (customer density). The two most rural DNSPs (Ergon and Essential) have consistently higher building OPEX per customer than other DNSPs, if Energex and Ausgrid are excluded as outliers.

4.2.6 Possible approach to quantification

If network topology is considered a material explanatory variable for variations in efficient OPEX, then consideration could be given to adding a further variable to the econometric model on a trial basis (i.e. in addition to the current percentage underground OEF variable). The objective would be to test whether inclusion of an additional variable had merit. Alternatively, an OEF could be established through considering the impacts on travel costs, depot costs and preventive maintenance.

A topology modelling output could draw on the feeder definitions detailed in the RINs tab"6.3 Sustained Interruptions" being CBD, Urban, Short Rural and Long Rural. If a list of feeders for each DNSP were provided with length and topology classification, an integrated output factor could be established for each DNSP such as "percentage rural". This output could be included in the econometric model.

If the inclusion of a topology related output has limited or no impact on productivity scores, it would suggest the matter is already adequately addressed by the current set of benchmarking outputs. Conversely, it network topology has a material impact, then it suggests the current set of benchmarking outputs need to be amended.

Unit Rates (Including discussion on Topography)

If DNSP topology OEF were quantified, an efficient unit rate per distance travelled needs to be established. This unit rate would include:

- Vehicle costs per km.
- Labour costs per km.

Vehicle costs are typically accrued on a time (hourly) basis (cost of capital) and a per km basis (fuel and servicing). Labour costs are accrued on a time (hourly) basis and require consideration of an efficient average crew size. Thus, to establish an efficient unit cost per km travelled, an assumption must be made on the average distance travelled per hour (average speed) and the efficient average crew size.

Differences in the average speed of travel will depend on the extent of **congestion / terrain**. The average speed between assets when undertaking a line inspection on a residential urban street will be very different from that when moving between assets on an off-road track. The impact of geographic terrain on operational costs has been raised by AusNet. Jemena raised the issue of traffic congestion and management costs.

It should be possible to establish estimates for benchmark efficient average travel cost for a range of terrains. For example, classifications could include: CBD; congested; standard; and difficult access. If information were available from DNSPs on the percentage of line exposed to each of classification, the different unit rates could be applied accordingly. This approach could address both the network topology and the terrain / congestion factor of travel costs. The result would be variations in estimated overall average travel related OPEX between DNSPs. This would enable comparisons to be drawn between DNSPs.

A network topology OEF could consider three components: travel, depot, and radial feeders. Possible steps in the quantification of each component are set out below.

Travel costs

1. Adjust distances travelled by each DNSP for average efficient rates per circuit kilometre and customer number.
2. Establish an efficient unit cost for travel for a defined set of topographies.
3. Establish the efficient average unit cost for travel captured in econometric model.
4. Determine differences in exposure of each DNSP to the defined terrains.
5. Apply the difference between the weighted travel unit cost for each DNSP to the efficient average unit costs contained in the econometric model to the non-adjusted distance travelled.
6. Apply the weighted travel unit cost for each DNSP to the adjusted distance travelled (not captured in the benchmarking analysis) to establish the component of the OEF estimate related to travel costs.

Depot Costs

1. Seek from each DNSP the number and scale, purpose and ownership of depots (e.g. whether it is operated directly by the DNSP or by a sub-contractor and only partly funded by the DNSP).

2. Use the data in 1) to estimate an efficient number of depots per circuit length for urban, largely urban, mixed and rural topologies. Use this estimate to establish an efficient number of depots for each DNSP.

3. Establish efficient unit costs for depots, perhaps segmented in size if there are significant differences in scale of depots / service centres.

4. Apply the adjusted depot numbers to the efficient unit costs to establish the component of the OEF estimate related to depot costs.

Preventative maintenance on radial feeders

1. Seek any evidence from Asset Management plans that a more rigorous and costly planned maintenance regime is adopted for radial feeders.

2. Seek data on the number and length of radial feeders (feeders without any potential backup).

3. If broad supporting evidence is provided for item 2) above, establish a unit cost per radial feeder (likely expressed as a function of feeder length) and apply that to the data provided in 1) above.

4.3 Asset inspection regimes

An asset inspection regime candidate OEF arose from consultation discussion, particularly regarding the revised approach to vegetation management OEF. We are not aware that an asset inspection regime candidate OEF has previously been proposed.

4.3.1 Identification of the potential OEF cost driver

The bushfire OEF for Queensland and NSW DNSPs was influenced by regulatory obligations imposed in Victoria following the Black Saturday bushfires. The bushfire OEF was associated with vegetation management – differential vegetation density (also exogenous) was considered a mitigation factor opposing differential line clearance regulations in the NSW decisions.[73] This is one of the objectives in the consolidated formulation of vegetation management OEF discussed in Section 3.4.1. To the extent differential line clearance obligations are included in the vegetation management OEF, maintaining a separate bushfire OEF does not meet the duplication criterion.

For the Victorian DNSPs, the proposed vegetation OEF gave rise to the question of how to account for the component of the (former) bushfire OEF that related to regulatory obligations to inspect electrical assets in high bushfire risk zones. Some of these requirements include audit programs for specific assets, increased asset inspection frequencies and audits of asset inspectors.

When discussing the issue of asset inspection regimes in isolation, other DNSPs identified intensification of their own asset inspection regimes in response to variables other than

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73 AER, Ausgrid 7-216ff

bushfire risk. These drivers are typically geographically dominant forms of extreme weather, demonstrating seasonality. For the Queensland DNSPs, asset inspection activities were connected with preparation for the storm season. For Tasmania and South Australia, as with Victorian DNSPs, inspection arrangements were in preparation for the bushfire season.

4.3.2 High level assessment against OEF criteria

In terms of the tests for accepting and quantifying a candidate OEF, substantial further work is required to evaluate whether variations in asset inspection regimes are a material driver of differences in efficient OPEX. There are claims of multiple cost drivers leading to similar cost effects, and at this time no attempt to identify relevant OPEX data in RIN returns.[74]

Indicatively, the drivers of any variations in efficient OPEX relating to asset inspection are similar. This is preparation for extreme exogenous weather conditions. However, to the extent all DNSPs undertake similar asset inspection arrangements, there may be no material variation in efficient OPEX.

4.3.3 Possible approach to quantification (materiality)

The first step in developing an assessment of this potential OEF would be to review whether there are fundamental differences in asset inspection plans between DNSPs, and if so, whether this could be attributed to exogenous variables not otherwise accounted for in productivity scores or other OEF adjustments. This would allow an assessment as to whether there are systematic variations in efficient asset inspection OPEX between DNSPs.

4.4 Guaranteed Service Level payments

Identification of the potential OEF cost driver

Guaranteed Service Level (GSL) payments were identified by SAPN in the context of the discussion about severe storms (see Section 3.9). There is some overlap with the severe storms OEF, but for current purposes this extension is regarded as a potential OEF on its own, particularly given the query over the status of the severe storms OEF.

The severe storm OEF was concerned with a single cost driver, severe storms, linked to a single cost effect, emergency response OPEX. In consultation, SAPN highlighted that in its case service interruptions due to severe storms also lead to GSL payments, funded from standard control OPEX. Moreover SAPN pointed to the specific regulatory requirements of the South Australian GSL scheme that mean that its GSL payments can be up to 10 per cent of OPEX compared to DNSPs in other jurisdictions where compensation payments to customers for reliability is immaterial (see box below).

74 We note that the original bushfire OEF was based on a cost pass through decision at a single point in time.

SA Power Networks' distribution licence and the National Energy Customer Framework require that SAPN complies with a GSL scheme that it considers is significantly more onerous and costly than those applying in other jurisdictions. In contrast to other jurisdictional schemes, our GSL scheme:

- is uncapped, both in terms of total payments across all customers, and payments to individual customers;
- requires payments on Major Event Days (MEDs) (i.e. major storm type events); and
- has multiple thresholds with increasing payments for longer duration outages.

SA Power Networks' individual payments can be up to $605 per customer, whilst it can be as low as $80 in other jurisdictions. Additionally, it is required to provide payments to all impacted customers.

The variation in GSL costs between jurisdictions does not represent differing levels of reliability, rather the exogenous application of the state-based service standard framework.

High level assessment of criteria

As a potential OEF identified by a cost effect, GSL payments can be associated with multiple cost drivers of which severe storms are one. Specifically in the case of SAPN, where the scheme trigger is MEDs, then it is notable that weather events are the reported "Reason for interruption" in about one third of cases (see Table 23). That is there are multiple cost drivers that are grouped by the reliability definition leading to the cost effect.

Our initial assessment against the information requirements identified in Section 2.2.2 includes:

- GSL schemes are non-systemic cost drivers as the regulatory requirement on energy service providers to provide services that are guaranteed to a specified level goes beyond Australian consumer law for the supply of services that are 'reasonably fit for purpose'.
- While the initial premise is that the primary cause of outages of sufficient duration to trigger GSL payments are severe weather events, and primarily storms, recognised as exogenous, the RIN data indicates multiple primary cause categories that are not exclusively exogenous.
- The variability of regulatory schemes for GSL payments between jurisdictions that are determined by their respective governments is exogenous. The regulatory GSL scheme in SA differs from other States, most particularly that payments are automatic and not initiated by customer claims. It is a reasonable hypothesis that these differences may lead to material differences in efficient OPEX between DNSPs.
- Cost data for GSL payments are specifically identified in RIN templates (under 2.5 Connections and 2.10 Overheads as well as 4.1 Public Lighting), therefore the associated costs should be quantifiable and comparable.[75]

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[75] Note that public lighting and connections are not standard control services and hence any GSL payments may not be recoverable from standard control OPEX.

- SAPN highlighted that in 2016/17 SAPN incurred almost $30 million of GSL payments due to severe weather events. As for the severe storms candidate OEF, this highlights the need to clearly assess severe weather causes and corrections for HILP (this extreme weather event in particular is one of the examples discussed in Section 2.3.4.
- GSL payments do not appear to be accounted for in any other mechanism for assessing relative productivity.
- OPEX costs for GSL payments may be of a similar magnitude to emergency response costs for some DNSPs. Together with variable regulatory schemes as a cost driver, there is some likelihood there is a comparative material difference that may require correction via an OEF.

Way forward

Building on the initial assessment, the next steps in considering a potential OEF for regulatory variation of GSL schemes include:

1. A review of the jurisdictional variation of GSL schemes to confirm these schemes do represent an exogenous driver for variation in efficient OPEX between DNSPs.
2. A deeper examination of the categories of primary causes that may lead to GSL payments under these schemes, and a determination of whether or not a correction may be required in any calculation for endogenous primary causes (i.e. differences in efficiency). This should also consider the delineation between GSL payments for standard and alternate control services (public lighting and connections).
3. An analysis of existing RIN data to confirm the clarity of relevant definitions and the consistency of completion of particular data identified to underpin OEF calculations. This will need to assess whether existing data is sufficient to identify HILP events and to isolate associated costs, or whether additional RIN data would be required.

4.5 Labour and material costs

Identification of the potential OEF cost driver

The AER's analysis of OPEX escalation is undertaken on a state by state basis recognising labour and material costs vary from state to state.[76] The drivers of these costs factors are influenced by State based industrial relations policies and geographic impacts on supply chains. These drivers may be exogenous.

Labour and material cost variations are most pronounced for areas outside Queensland, New South Wales and Victoria. Previous determinations by the AER have considered these states in the greatest detail. Perhaps for this reason, any variations in labour and material costs across states have not been considered to meet the OEF criteria. With the extension to Power and Water Corporation, it is possible that variations in labour and materials costs

[76] Refer: https://www.aer.gov.au/system/files/Deloitte%20Access%20Economics%20-%20Labour%20Price%20Forecasts%20-%206%20February%202017_3.PDF

between DNSPs could form part of the explanation for differences in efficient OPEX between DNSPs.

High level assessment against OEF criteria

Labour and material costs represent the bulk of OPEX for all DNSPs. There is a wealth of independent data on labour and material costs differences within jurisdictions over time.

The Australian Energy Regulator (AER) commissioned Deloitte Access Economics to provide forecasts for Wages Index growth for the electricity, gas, water and waste services (utilities) (EGWWS)) industries in each state. That report does not include a relative index between the states for the reference industry. It is possible this gap could be overcome by consideration of relevant Australian Census data.

Labour costs

Labour costs represent 62 per cent of allowed OPEX[77]. This percentage could be adopted and applied to the state based relative utility industry index to establish an OEF estimate for variations in labour costs across states.

Materials costs

Of the allowed OPEX, 38 per cent relates to materials, based on forecast to changes in the Consumer Price Index (CPI).[78] This percentage could be adopted and applied to the state based relative materials index to establish an OEF estimate for variations in material costs across states.

Way forward

The currently available data is not sufficient to conclude that variations in labour and materials costs meet the OEF criteria for any DNSP considered so far. It also suggests that differences in Wage Index and CPI between Queensland, Victoria and NSW may not be material. It is, however, possible that the inclusion of Northern Territory and Tasmania in the econometric modelling may mean that consideration should be given to whether variations in labour and materials costs could result in variations in efficient OPEX. It is suggested that the AER consider the merits of expanding the existing regular reviews of labour and material price indices by state (Deloitte Access Economics Report) for the purpose of OPEX forecasting to establish the following:

1. A comparable Wage Price Index for the electricity, gas, water and waste services (utilities) industry in each state that can apply to the 62% of expenditure allocated to labour in the OPEX forecasting process to establish an OEF estimate for the impact of state based variations in labour cost.

2. An appropriate comparable materials price index that can apply to the remaining 38% of expenditure to establish an OEF for the impact in the differences in across states of materials procurement.

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77 As explained in the memo from Economic Insights to the AER: *Opex input price index weights*, dated February 2016.

78 Ibid.

4.6 Advanced metering infrastructure/demand management

4.6.1 Description

A number of submissions identified Advanced metering infrastructure (AMI) and demand management technologies (DM) as potential OEF candidates. This topic was also discussed at the March 2018 workshop.

We have combined consideration of AMI and DM in these section because of the interrelated and similar manner in which these technologies can potentially vary network OPEX. In particular, both technologies have the potential to provide increased accuracy in the remote monitoring of the network and more granular remote switching. These outcomes (whether delivered by AMI or DM) may have an impact on efficient network OPEX.

DNSPs noted that there are substantial differences in the penetration of AMI between DNSPs. All but one of the reference group is notable for near ubiquitous AMI penetration.

Differences in the penetration of AMI/DM technologies between DNSPs could result in variations in efficient OPEX that are not otherwise accounted for in the derivation of productivity scores. For example, if AMI/DM technologies increase reliability while at the same time reducing OPEX, then DNSPs with high AMI/DM could expect to achieve higher productivity scores, other things being equal. This would over-state the efficiency of DNSPs with AMI/DM while under-stating the efficiency of DNSPs without AMI/DM.

4.6.2 Previous consideration by the AER

In its previous consideration of whether there is a systematic impact on benchmarking outcomes from AMI, the AER limited its consideration to whether there were any avoided OPEX benefits for Victorian DNSPs arising from sharing metering and network overheads. See for example page 249 of attachment 7 to the AER's Ausgrid Final decision. We agree with the AER's view that:

> *Pursuing the ability to share overheads between network services and other services is a business decision on service diversification. The ability to share overheads between network services and metering services are not likely to lead to material differences in network services OPEX.*

OPEX benefits unrelated to the allocation of overheads are discussed in an August 2011 report for the Victorian government by Deloitte.[79] The Deloitte report substantially reduced the estimated size of these benefits relative to earlier reports undertaken by Oakley Greenwood, NERA and Futura. Nevertheless, it acknowledged this set of benefits was material. It summarised the benefit categories as follows:

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[79] Refer: http://www.smartmeters.vic.gov.au/__data/assets/pdf_file/0003/1175574/Deloitte-Final-CBA-2-August.pdf

This category comprises of the following benefits: Reduction in unserved energy due to faster detection of outages and restoration times. Avoided cost of special meter reads, manual disconnections and reconnections (and avoided revenue loss). Avoided additional cost of energy from time switch clock errors. Savings from reduction in non-technical losses (theft). Avoided cost of proportion of transformer failures on overload and avoided unserved energy. Ability to set emergency demand limits to share limited supply at times of network stress or supply shortage.

Only the benefits that relate to standard control services are relevant in the present context. Hence benefits relating to: the avoided cost of special meter reads, additional energy due to time switch clock errors, non-technical losses and revenue loss from delayed connections are not relevant.[80] Nevertheless, the Deloitte report suggests AMI could result in increased outputs and reduced inputs, and hence increased efficiency and higher productivity scores.

4.6.3 High level assessment against OEF criteria

Exogeneity

The penetration of AMI is largely outside the control of DNSPs. In the case of the Victorian DNSPs, the adoption of AMI was the result of a jurisdiction specific regulation that mandated the installation of AMI by licenced DNSPs. In the remainder of DNSPs, AMI penetration is at negligible levels for mass market customers. Limited penetration largely relates to pilots and trials such as the Smart Grid, Smart City trial.

Interval meters are widespread, especially where mandated for solar PV installations. Interval meters do not have AMI capabilities. Under rule changes that began to take effect in 2017, decisions on the installation of AMI are a matter for retailers, not DNSPs. It therefore appears that AMI meets the exogeneity criterion.

DM (in the absence of AMI) could be implemented through the Demand Management Incentive Scheme (DMIS) and forms a key CAPEX / OPEX trade- off . Although not exogenous, the OPEX costs / savings resulting from DM would be independently determined as efficient (considering both CAPEX and OPEX) through the DMIS application process and, if material, may need to be considered as an OEF.

Duplication

We agree with the AER's previous view that the sharing of network and metering function overheads relating to AMI/DM would not meet the non-duplication criterion. As noted, we do not consider sharing of overhead costs is relevant to this OEF candidate.

To the extent AMI/DM improves efficiency, it appears to meet the duplication criterion. While AMI/DM could affect both the inputs and the outputs used to derive productivity scores, the derivation of productivity scores does not take into account differences in the penetration of AMI/DM between DNSPs.

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80 Although it should be noted that, in the absence of the three avoided energy consumption benefits (for DNSPs without AM/DM), the energy output as measured in the econometric model would be higher than otherwise.

Potential efficiency benefits (the sharing of overhead costs) from the fact that DNSPs provide standard control services, as well as alternate control and negotiated services, is not unique to AMI/DM and applies to a number of OEF candidates. This issue does not seem to be relevant to whether differences in AMI/DM penetration between DNSPs could distort productivity scores.

Materiality

The first issue arising with regard to materiality is whether a high penetration of AMI/DM increases or decreases OPEX, relative to no AMI/DM, other things being equal. Our initial assessment is that AMI/DM may both reduce and increase OPEX. Hence the net outcome for OPEX is far from clear.

AM/DM can reduce DNSP OPEX through the following mechanisms:

- Removing the need to perform manual field-based load or voltage readings of distribution transformers or connection points for planning or incident assessments.
- Where distribution transformer load readings are not otherwise completed, avoiding distribution transformer overloads and associated OPEX and CAPEX.
- Reduced fault response times and truck rolls through improved information on the location and extent of a fault, and potentially the nature or source (e.g. whether a transformer or a section of a feeder). This will reduce both OPEX and outage duration (SAIDI).

AM/DM can increase DNSP OPEX through the following mechanisms.

- Neutral faults can be identified and acted on immediately. This is a potentially life-saving benefit but requires crews to be dispatched as soon as possible where traditionally they would only have been dispatched when a customer recorded flickering lights or a shock.
- AM/DM can detect out of voltage parameter events that would not otherwise have been detected. Once this information is available, quality of supply codes often require the DNSPs to act where they would not have otherwise had an obligation (or the information triggering an obligation) to do so.

In summary, DNSPs with AMI and DM technologies can potentially respond more effectively to network issues but are likely to have more issues to which they must respond.

The Demand Management Incentive Scheme (DMIS) managed by the AER allows for OPEX allowances under Part A (DMIA) and Part B.[81] We understand the Part A related OPEX would not affect productivity scores.

We understand Part B related OPEX could affect productivity scores. This is because it could give rise to additional OPEX for the procurement or operation of network capacity substitutes or; reduced OPEX due to increased remote monitoring and switching capabilities. In addition, it could also reduce maximum demand (although perhaps not

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[81] Refer https://www.aer.gov.au/system/files/AER%20DMIS%20Assessment%20report%20for%202010-11%20and%202011%20-%20Non-Vic%20and%20Victorian%20DNSPs.pdf

ratcheted maximum demand) and energy volumes. Both these topics are related to the broader issue of OPEX/CAPEX trade-offs discussed elsewhere in this report.

From our direct involvement in the assessment of AM/DM, alongside our review of previous analysis, it is difficult to assess whether the net impact of differences in AM/DM would result in material variations in OPEX, other things being equal.

Way forward

As with all candidate OEFs, further consideration is unable to proceed without the provision of relevant data in a consistent format by all DNSPs. This data would need to include both relevant outputs and the impact on OPEX. If such data were available, an assessment could be made as to whether differences in AM/DM have a material effect on productivity scores.

4.7 Severe storms

Section 3.9 discussed the finding that the previous OEF for 'severe storms (extreme wet/windy weather)' has been identified as failing the non-duplication criterion as the high impact, low probability events on which it was quantified are adequately accounted for in the econometric model. Nevertheless, we acknowledge that a severe storm related OEF, exclusive of HILP events, could meet all three OEF criteria. Hence a question remains whether a potential OEF to account for systematic differences in the regular occurrence of severe storms might be coherently constructed.

Identification of the potential OEF cost driver

The basis for a potential (non-HILP) severe storms OEF is already established by the previous OEF identified in AER decisions and discussed in Section 3.9. This OEF is intended to account for systematic differences in the incidence, severity or extent of severe storms giving rise to incremental OPEX.

High level assessment of criteria

Table 22 contrasts the assessment of both the previous and potential severe storms OEFs against the information requirements illustrated in Figure 2, including the AER's three OEF criteria.

As discussed in Section 3.9, in contrast to cyclones, there are no clear meteorological indicators to identify a 'severe storm', and such storms sit on a continuum of weather events that includes high impact, low probability (HILP) events. Nevertheless there is some evidence that exposure to extreme storms could vary geographically and efficient costs could vary between DNSPs.[82][83] Unlike cyclones, severe storms may occur in all geographical regions in the NEM, and are likely to impact all DNSPs.

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82 AER decisions have referred to Bureau of Meteorology maps of the prevalence of thunder and lightning averaged over a 10 year period. See for example in Energex, Response to AER information request AER EGX 001, 17 December 2014, p. 4

83 See BoM at http://www.bom.gov.au/jsp/ncc/climate_averages/thunder-lightning/index.jsp and http://www.bom.gov.au/jsp/ncc/climate_averages/thunder-lightning/index.jsp

Like weather events generally, stormy weather is exogenous, but moreover unlike businesses generally, DNSPs operate under an obligation to maintain services even in and following extreme weather.

Due to the absence of a clear identification of the boundaries of this candidate OEF, there are identifiable inconsistencies in the existing RIN data. These compromise comparison between DNSPs on an equivalent basis. This prevents a conclusive assessment of the comparative materiality of a non-HILP severe storm OEF.

Cost data issues for a potential severe storms OEF

The analysis to date has focused on Emergency Response (ER) costs following the AER's approach in its regulatory determinations. Some submissions to the preliminary OEF report raised questions about preparation costs. We discuss these costs in the context of a potential asset inspection regime OEF in section 4.3 above.

As indicated in Table 22, data limitations arise from the absence of a clear definition of the 'severe storms' events in guidance for the preparation of RIN data. This means there is a corresponding ambiguity in the associated definition of 'major events' in the RIN data. As a result, it does not appear that RIN returns have been completed consistently and therefore that ER data is comparable between DNSPs for benchmarking purposes.

Table 22 Information assessment of severe storms OEFs

Requirement	Previous OEF	Potential non HILP OEF
Cost drivers		
Identify	Specific storms	Unclear definition of events
Non-systemic	Obligation to maintain services in any environment	
Systematically variable	Moderate climatic evidence of geographical variation	
Exogenous	Climatic events are exogenous Obligation to maintain services in extreme weather	
Cost data		
Quantifiable	Emergency Response OPEX associated with specific HILP events	Emergency Response data available but unclear data segment associated with undefined events.
Comparable	Not previously assessed	Currently identifiable errors in comparability
Duplication	Excluded as identified HILP events	In principle non -duplicative
Cost effect		

Requirement	Previous OEF	Potential non HILP OEF
Comparative materiality	Not applicable	Not assessable

There are three emergency response cost categories identified in the RINs:

- Total Emergency Response (ER). The definition of this cost category includes the cost of responding to equipment failures unrelated to severe storms. The consistency of total ER unit rates indicatively suggests there is no systematic variation in actual ER costs between DNSPs (see discussion below).
- Major Event Days (MED) are clearly defined by STPIS by the 2.5 beta method. While still liable to include non-weather events (see Table 23 below), the coincidence of events points to external drivers, whether weather or electrical systems. The 2.5 beta statistical method means that the event capture is statistically similar for all DNSPs (theoretically on average, 2.3 major event days per year). As a result, the OEF variation between DNSPs is minor and only meets the materiality threshold for Energex and Essential. This initial estimate may need to be discounted to exclude non-weather events, resulting in a further decrease in materiality relative to the threshold. At the same time, it is possible that the present definition of major event days may understate severe storm related ER costs for multi-day events or for events that give rise to costs over a period of days.
- The 'major event' category in the RINs seeks data about identified individual storm events, so clearly attempts to link to severe weather drivers and exclude other events such as equipment failures. Indicatively, some DNSPs identify higher major event costs than MED costs, consistent with the view that the MED definition may be too strict. Conversely, other DNSPs have lower than MED costs, and other DNSPs have not populated this category at all. The resulting cost data is not comparable; hence variations between DNSPs may not be reliably quantified.

Table 23 provides an indication of the variation in the reasons for sustained interruptions on Major Event Days, based on two networks in one year. This highlights variation in the extent weather is attributed as a reason for an interruption. It may also indicate variation in the preparation of RIN data.

Table 23 Reported "Reason for interruption"

Reason	Essential	SAPN
Weather	58%	34%
Planned	20%	6%
Vegetation	7%	2%
Animal	3%	1%
Other	2%	0%
Third party	1%	0%

Reason	Essential	SAPN
Overloads, Network business, Asset failure	8%	13%
Unknown	0%	42%
Total sustained interruptions	1686	395
Number of MEDs	5	3

Source: Sapere analysis of 2014/15 CARIN data, 6.3 Sustained interruptions

One possible way forward suggested by Table 23 above would be to isolate MED costs by those with an identified weather reason for interruption, or apply the proportion to MED costs (perhaps weighted by an reliability metric CAIDI/SAIDI). While it remains to be investigated, further reducing MED ER costs is likely to reduce differences between DNSPs. This may lead to an outcome where any OEF may be immaterial for many or even all DNSPs.

The potential comparative materiality of a severe storms OEF

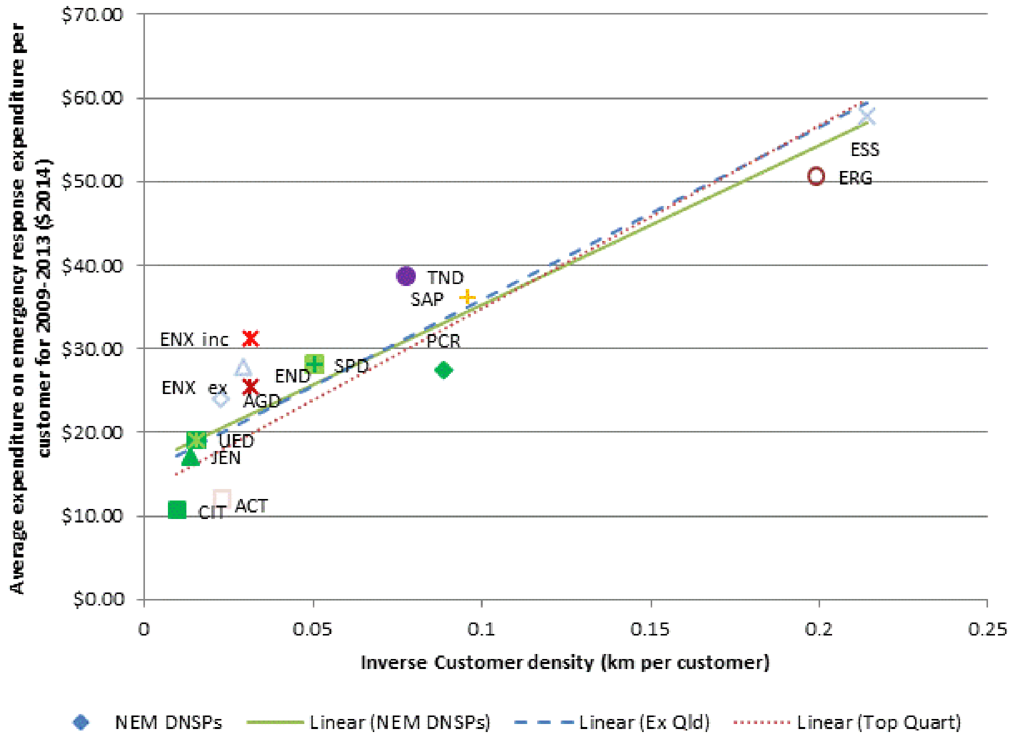
In the absence of quantifiable, comparable cost data for all DNSPs with which to make a full assessment, the AER must rely on proxy indicators to reach a preliminary judgement of the of the comparative materiality of a potential OEF that justifies further action. In Figure A.35 of its Preliminary Decision, the AER examined the trend in category analysis over the 2009 to 2014, comparing the average cost of emergency response per customer across service providers in the NEM.[84]

Presented as a reciprocal relationship in the AER Preliminary Decision, no relationship is clearly discernible. Figure 19 inverts the data of the horizontal axis of Figure A.35 so that the expected linear relationship is revealed. This includes three trend lines: one inclusive of all services providers (solid line); one exclusive of Energex and Ergon (dashed line), and one for the reference group (dotted).[85]

84 See Figure A.35, AER Preliminary Decision Ergon Energy determination 2015–16 to 2019–20, Attachment 7 – Operating expenditure, April 2015

85 Powercor, CitiPower, United, SAPN, AusNet

Figure 19 Average emergency response per customer for 2008/09 to 2013/14 against inverse customer density ($000 2014)



Source: Sapere analysis of AER data

The figure effectively shows the average OPEX per kilometre line length increases for remote and rural areas, inclusive of the two regional outliers Essential Energy and Ergon Energy (exclusive of cyclones), and is a minimum for the wholly urban CitiPower. This relationship is unsurprising and reflects the fact differences in the time required to restore services will be related to the distances emergency crews have to drive to failed assets. This linear trend occurs within a natural spread of cost per customer such that the trend line does not substantially deviate with the exclusion of the Queensland DNSPs or when constrained to the reference group.

Figure 19 includes the AER's two data points for Energex including and excluding the three identified HILP events. Exclusive of these additional HILP costs, the Energex estimate is more closely aligned with a group of service providers. Inclusive of these additional HILP costs Energex is not outside the range of variation from the group of trend lines by DNSPs in general.

Way forward

Table 22 indicates the primary challenge with a potential (non-HILP) severe storms OEF stems from the difficulty in providing a clear demarcation of OPEX relating to severe storm events. Two paths forward involve:

1. Using existing data on MED causes to develop loadings to apply to MED ER OPEX for each DNSPs; or

2. Developing more specific guidance on the definition of extreme storm events in RIN returns and collecting consistent data against these definitions.

Overall Figure 19 suggests that differences in efficient emergency response costs are unlikely to be comparatively material. Proponents of a severe storm OEF (excluding HILP events) need to provide positive evidence for the likelihood of a comparatively material outcome to justify further effort on severe storms.

5. Power and Water Corporation

The Northern Territory has acceded to parts of the National Electricity Law, including Chapter 6 of the National Electricity Rules, regarding regulation of electricity network prices. It is intended that the Power and Water Corporation in the Northern Territory (Power and Water) will be included in the AER benchmarking process in the future. This section is intended to identify the OEFs that may be material to Power and Water and how these OEFs may be addressed.

In response to a request from the AER, Power and Water provided a preliminary list of OEFs it believes will be relevant to any benchmarking process. The authors of this report have also been provided a report by Meyrick and Associates, which include quantification of material OEFs.[86] This Meyrick and Associates report includes a quantification of material OEFs.

No new information specifically regarding OEFs and Power and Water Corporation has emerged or been provided following the December 2017 preliminary OEF report. Accordingly, the discussion below is largely unchanged from the preliminary OEF report.

5.1.1 Initial assessment

There is at present no recent econometric benchmarking of Power and Water's core distribution service. Power and Water only submitted RIN data to the AER in March 2018. As a result it is not possible, within the scope and timing of this final report, to quantify any OEFs that may be required to address systemic environmental operating variables affecting Power and Water.

Power and Water is unique amongst the DNSPs within the benchmarking process as it remains a vertically integrated power utility and a water utility. This highlights the importance of careful classification of services deemed to be standard control. This is to ensure they are clearly separated from the generation, transmission and water functions, in the AER's framework and process determination. This will include cost allocation of shared or common costs.

There will an interrelationship between the cost allocation process and the OEF quantification process that should be considered for each OEF. It may be appropriate for the AER to include an additional test for a valid OEF for Power and Water that considers if the costs associated with the OEF have not been addressed in the cost allocation process.

Based on this information, a summary of the potential OEFs / differential costs identified in each document is provided below. The summary provides an opinion on whether the identified costs are likely to be material and how these costs may best be addressed in the benchmarking process.

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86 See *Benchmarking Power and Water Corporation's Power Networks O&M Costs*, dated 7 January 2003.

Table 24 Power and Water Corporation - qualitative assessment

Description of Cost	Discussion
Expenditure capitalisation – Allocation of corporate IT costs as OPEX to the DNSP function	The treatment of business process support costs that have typically been capitalised is a growing issue with the advent of external cloud based solutions. These costs are within management control. Incurring these costs as OPEX may be the most economically prudent course of action for management.
Population – NT has the lowest average population growth of any state or territory in Australia	It is noted that customer numbers is addressed within the benchmarking model. Differences in population growth have generally not been viewed in the rest of this report as a significant driver of variations in efficient OPEX. The sensitivity of aggregate demand to population change has weakened over the last decade. High population growth may require higher rates of network augmentation and place additional demand for planning and decision-making activities that can result in marginal increases in OPEX. Accordingly, it is possible this variable advantages rather than disadvantages Power and Water.
Base / unavoidable costs – fixed corporate allocation costs.	Power and Water suggests that corporate overhead costs may be higher than for other DNSPs, due to scale effects. Power and Water is substantially smaller than the other NEM DNSPs in terms of customers served. In terms of total OPEX, as a vertically integrated utility, Power and Water is broadly comparable with other DNSPs in the benchmarking program (especially, Actew AGL, CitiPower, and TasNetworks).
Proportion 11kV and 22kV lines driven by historical network designs	Power and Water identified that an historical decision to operate at 11kV results in greater feeder length and a larger number of lower capacity zone substations. Distribution line length is an output of the benchmarking process and the AER has stated that its accounts for customer density when combined with the customer number output, but not on its own. Zone substation density is not necessarily driven be the selection of feeder voltage. Similar zone substation capacities can be used for 22 or 11kV. It is assumed that Power and Water is referring to the distance that 22kV and 11kV can reticulate power over before voltage control becomes problematic. If this is the case, for a given customer density, 11kV will result in less total distribution line length (as the feeder lengths are lower as they originate from more localised zone substations), and more substations. Adopting an N-1 planning criterion, a greater number of substations will result in more installed zone substation transformers (this position

Description of Cost	Discussion
	may be partially impacted by the use of distribution transfer capacity). This suggests the modes of cost increase resulting from increased 11kV network are either addressed within the benchmarking process (distribution line length) or within the proposed sub-transmission OEF (including zone substation transformer count). Note also the AER's previous determinations (see Ausgrid 7-261) did not identify differences in OPEX due to varying mixes of 11/22kV high-voltage distributions systems, including between four of the five reference group.
Four Separate Networks – PWC must provide services in 4 highly remote locations with little population between.	Power and Water suggested three modes of OPEX increase associated with the four isolated separate networks. 1. The loss of economies of scale that come from requiring localised specialist resources to respond to fault / outage conditions in order to maintain supply reliability within acceptable limits. Given the scale of the local asset base, these specialist resources may not be economically utilised on an ongoing basis. We acknowledge there may be some specialised technical resources that may be required to be located at remote networks to maintain supply reliability to an acceptable level. The requirement to locate resources in areas where these resources may be under-utilised is driven by the need to respond to fault conditions in acceptable time. The acceptable time is often detailed in local customer quality of supply regulation. 2. The development and implementation of specific technical standards for each system. Technical standards in electricity networks do not require significant ongoing development once established. Implementing technical standards is largely through the development of new assets. It would therefor likely have a more significant impact on CAPEX but less effect on variations in OPEX. 3. Higher procurement costs due to scale effects. This mode of cost increase is discussed further below. The loss of economies of scale within the network could meet the OEF criteria and may represent a new OEF category. *Development and implementation of specific technical standards:* It is not considered likely that the development and implementation of specific technical standards would meet

Description of Cost	Discussion
	the OEF criteria.
Higher cost of labour inputs	Based on Australian Bureau of Statistics Wage Price Index[87] Northern Territory public service labour cost have grown over time by 20% more than East Coast states. This suggests that higher labour unit rates are a factor that needs to be considered in the overall economic benchmarking. This matter has not been addressed elsewhere in this report and may meet the OEF criteria. This potential OEF is discussed further in Section 4.5.
Higher costs of materials and inputs	Based on the Rawlinson's construction cost data referenced, it seems likely that Power and Water will experience higher procurement costs, some of which will affect OPEX levels, other things being equal. This matter has not been addressed elsewhere in this report and may meet the OEF criteria. This potential OEF is discussed further in Section 4.5.
Lack of competition	This factor may already be reflected in variables related to labour rates and construction cost data, already discussed above. However, to the extent it is not, then any differences in the competitiveness of OPEX procurement needs to be accounted for in economic benchmarking, possibly via an OEF.
Building regulations	Further data on the content of differences in building regulations and any OPEX effects is required in order to consider this matter. An initial view is this matter may not meet the OEF criteria.
Environmental regulations	Further data on the content of differences in environmental regulations and any OPEX effects is required in order to consider this matter. An initial view is this matter may not meet the OEF criteria.
Disposal of asbestos	Disposal of asbestos is likely to be a systemic issue facing numerous DNSPs. Further data on any higher rates of asbestos affected assets is required to assess whether there are any OPEX effects in relation to this matter.
Vegetation management	As discussed in Section 3.4.1, variations in vegetation management OPEX do not appear to be fully accounted for in econometric benchmarking. Proposals for reviewing the

[87] http://www.abs.gov.au/ausstats/abs@.nsf/mf/6345.0

Description of Cost	Discussion
	treatment of variations in vegetation management costs discussed earlier should also be considered for Power and Water.
Compliance monitoring and reporting	Further data on the content of differences in compliance monitoring and reporting regulations, and any OPEX effects, is required in order to consider this matter. An initial view is this matter may not meet the OEF criteria.
OH&S Regulations – compliance safety.	Power and Water Corporation suggest two modes of cost increase in this area. On satisfying different legislative and regulatory obligations; in the discussion on the Work Health Safety law in Section 3.1, it is considered unlikely differences between Victorian WHS laws and national WHS laws have significant impacts for OPEX. On extreme heat resulting in different work practices and lower productivity; further data on the content of differences in environmental regulations and any OPEX effects is required in order to consider this matter.
Increased input costs due to NT Government policies	Increased material costs due to locational factors are addressed elsewhere. In this discussion, it is assumed that the purchasing policy of the NT Government is a policy and not implemented through regulatory or legislative requirements. It is arguable whether a policy of the owner of a DNSP would be considered outside management control and therefore an OEF. For example, if the owner of a privately owned DNSP was to establish a policy that resulted in cost increases it would be unlikely that the impact of this policy would considered an OEF. The determination of this mode of cost increase as an OEF is matter of clarification of AER policy and beyond the scope of this report.
Cultural heritage	It is noted that cultural heritage obligations more directly impact new construction and augmentation. In planning for and constructing any asset right of access should be resolved. The costs of achieving this should be captured in the capital costs of establishing the asset. An initial view is that this matter may not meet the OEF criteria. This OEF category has so far not been found comparatively material for any of the DNSPs that have been assessed so far.
Uptake of embedded generation creating localised cost increases	The cost increases described by Power and Water can be managed through effective technical requirements for the connection of new embedded generation. An initial view is that this matter may not meet the OEF criteria.

Description of Cost	Discussion
Diversity of skill requirements	More information on this item would be required to consider whether it represents an issue for benchmarking.
Extreme weather – cyclones, lightning, extreme precipitation and constant high temperatures	A proposed methodology for addressing the extreme weather OEFs, as set out in sections 3.6 and 3.9, and consistent with previous AER decisions, appears to provide a sound basis for considering variations in OPEX attributable to this candidate OEF. This matter may meet the OEF criteria and can be addressed within an existing OEF category and methodology.
Reduced network accessibility	Network accessibility is a systemic issue for all DNSPs. Further data would be required to consider whether this issue would represent a candidate OEF.
Termites	The approach set out for consideration of termite-related costs as an OEF, set out in Section 3.5 should be applicable to Power and Water. This matter may meet the OEF criteria.
Grounding conditions	Further data would be required to consider whether this matter would meet the OEF criteria. This OEF category has so far not been found material for any of the DNSPs that have been assessed so far.

Appendix 1 Glossary

To ensure analytical clarity and for ease of communication, we have developed a set of inter-related stipulative definitions of key technical terms used throughout this report. Accordingly, the technical definitions below go beyond a typical glossary. Technical terms in bold signify cross references.

AER	Australian Energy Regulator.
Annualisation	A process to standardise the value of intermittent or limited duration OEFs over the **benchmark period.** Multi-year OEFs are converted to annual values.
Assessed DNSPs (OEFs)	DNSPs for whom **OEF adjustments** in addition to **econometric benchmarking** have been assessed, as part of a regulatory decision making process. To date this includes NSW, ACT and Queensland DNSPs.
Base OPEX	The **base OPEX** is the estimate of total OPEX prior to application of economic benchmarking to estimate ideal or OEF optimised OPEX. For simplification, we take 2015 historical OPEX as a proxy value for base OPEX for the demonstration calculations in this report. In historical decisions regarding individual firms, base OPEX is an output of an AER process based on historical OPEX. For consistency in benchmarking all DNSPs producing period-average efficiency scores derived from econometric modelling, perhaps base OPEX should be the period-average actual OPEX for the benchmarking period. This may need to be reconciled with the regulatory decision roll-forward processes to produce base OPEX. These AER processes are outside the scope of this report.
Benchmark period	The period over which the **econometric analysis** is applied to derive **productivity scores**. In the AER's 2016 annual benchmarking report, this period was 2006 to 2015. In the AER's 2015 Queensland determinations, this period was 2006 to 2013. A complication is that Victorian DNSPs report data on a calendar year and all other DNSPs on a financial year.
CAPEX	Capital expenditure. Expenditure that is capitalised and not **OPEX**. Differences in capitalisation boundaries may require OEF adjustments due to the OPEX implications of operating and maintaining additional CAPEX.
Capital governance	The framework and processes by which **DNSPs** internally regulate **CAPEX**. Differences in capital governance effectiveness may influence differences in **productivity scores** by increasing the asset base to be operated and maintained for a given productivity output.

Comparison point (benchmark comparison point)	The **productivity score** of the DNSP (or average of a group of DNSPs) selected by the AER to be the comparison point for the purpose of setting an **efficiency target**. Not to be confused with **reference point** for calculating **OEF adjustments**. [88]
Distribution assets	DNSP assets operating at a threshold of 33kV and below. This threshold is applied to measure differences between DNSPs in the density of **sub-transmission** assets above this threshold.
DNSP	Distribution network service provider. The entity to which **economic benchmarking** is applied to standard control services.
Duplicative	A **OEF candidate** that duplicates an operating environment variable fully or partially accounted for by the **productivity score**, or via another mechanism such as annual pricing variation decisions, where an **OEF adjustment** would duplicate the existing expenditure allowance**.** One of three **OEF criteria** for an **OEF adjustment**.
Economic benchmarking (AER)	OEF adjustments form part of **economic benchmarking** and operate alongside **econometric benchmarking** undertaken by **Economic Insights**.
Econometric benchmarking results (EI)	The results of **econometric benchmarking** modelling of OPEX by **Economic Insights'** Cobb Douglas Stochastic Frontier Analysis (SFA) production model.
Efficiency target	The efficiency target for a DNSP, obtained by comparison (over the **benchmark period**), between a DNSP's own **productivity score** and the **comparison point**. Together with **base OPEX**, the efficiency target is used to derive **ideal Optimised OPEX**.
Economic Insights (EI) model	The set of **econometric benchmarking** models used by **Economic Insights** to derive **productivity scores**. In particular, the AER preferred production model employs a parametric approach, Stochastic Frontier Analysis (SFA), using a log-linear Cobb-Douglas form, commonly known as a Cobb Douglas stochastic frontier model.
Exogeneity (OEF)	Whether a **OEF candidate** is considered to be outside the control of the relevant DNSP. One of three **OEF criteria** for an **OEF adjustment**.
HILP events	High impact, low probability events
Historical OPEX	This report provisionally uses historical OPEX for 2015 used in the AER's 2016 benchmark report as **base OPEX** to derive **ideal optimised OPEX** for the purpose of expressing OEF estimates in percentage terms.
Ideal optimised OPEX	Ideal optimised OPEX is derived from applying the **efficiency target** to **historical OPEX**.

[88] AER, Ausgrid Final Decision, p 7-269ff

Incremental OPEX (OEF)	The additional **efficient OPEX** attributable to an **OEF**, above **ideal optimised OPEX**.
Materiality threshold	A threshold (expressed as a percentage of **ideal optimised OPEX**), below which the AER has decided it would not make an **OEF adjustment**. One of three **OEF criteria** for an **OEF adjustment**.
Non-assessed firms/DNSPs	DNSPs for which **OEF assessments** have not previously been made by the AER.
Non-reference group	The group of DNSPs that are not members of the **reference group** in the **reference year.** These can in turn be split into **assessed DNSPs** for which OEF decisions have been made and **non-assessed DNSPs**.
OEF	An operating environment factor that is **non-systemic** (see **systemic operating environment** factor) that is necessary to explain variations in efficient OPEX between equally efficient DNSPs (all other things being equal). For current purposes assessment of the efficient OPEX is made employing **econometric benchmarking**.
OEF assessment	A previous determination of the AER of **OEF adjustments** for **assessed DNSPs.** This can refer either to a class of OEFs (e.g. bushfires) or to the **OEF adjustment** for a class of OEFs for a specific DNSP.
OEF adjustment	An change from **ideal optimised OPEX** for the DNSP to account for an OEF, expressed as a dollar value or percentage of ideal optimised OPEX, equal to the difference in the OEF estimate compared with the **reference point** for that OEF.
OEF assessed DNSP	A DNSP for which the AER has previously determined **OEF adjustments** (Ergon, Energex, Essential, Endeavour, Ausgrid, ActewAGL/Evoenergy).
OEF adjustment	A supplement to **econometric benchmarking,** and the second step in the AER's **economic benchmarking** of **DNSPs,** to address differences in operating environment factors not fully accounted for in **econometric benchmarking**.
OEF candidate	A candidate for consideration as an **OEF**.
OEF criteria	The OEF criteria form a three part test used by the AER for assessing the eligibility of **candidate OEFs**, being the OEF is **non-duplicative**, **exogenous** and **material**.
OEF estimate	An estimate of the efficient **incremental OPEX** for a **candidate OEF** meeting the **OEF criteria**, measured from the **zero point**. Not to be confused with the **OEF adjustment**.
OEF optimised OPEX	The sum of **ideal optimised OPEX** and aggregate **OEF adjustments.**
OH&S	Occupational health and safety laws and regulations, a **Work Health Safety** law that applies only to Victoria.

OPEX	Operating and maintenance expenditure relating to services delivered by **DNSPs** that have been classified by the AER as relating to standard control services, and not capitalised (i.e. not **CAPEX**).
Optimisation (OPEX)	Depending on the **comparison point** chosen, the difference between actual and estimated efficient OPEX, excluding OEFs – historical **OPEX** minus **ideal optimised OPEX.**
Productivity score	The output of the **EI model** for each DNSP, used as an input into the **efficiency target** to derive **an ideal optimised OPEX**.
Reference group	The group of top five DNSPs ranked by **productivity scores** used to set the **reference point**. For the **reference year**, this included CitiPower, Powercor, AusNet, SAPN and United Energy
Reference point	The OEF estimate reference value selected by the AER for calculating **OEF adjustments** from **OEF estimates,** currently obtained by a weighted average of the **OEF estimates** of the **reference group**. Not to be confused with the **comparison point** or the **zero point**.
Reference year	The year for which **productivity scores** are utilised to identify the **reference group**, and the **historical OPEX** year (2015). For the purposes of illustration in this report, we use the same reference year and hence the same **reference group** as the AER's ACT/NSW/Qld decisions (although the composition of the **reference group** can change between different reference years.
RIN	Regulatory Information Notice. Economic benchmarking RIN data submitted by DNSPs to the AER is used for **econometric benchmarking**. Category analysis RIN data was not used for econometric benchmarking but is used in some aspects of OEF analysis.
Service output measures	Differences in output measures in **econometric benchmarking** that allow assessments of **OEF candidates** – e.g. customer density and line length. Relevant to applying the non-**duplication** criterion.
SFA model	Stochastic Frontier Analysis model. See Economic Insights model.
Standard control (OPEX)	The component of total **DNSP OPEX** of concern for **economic benchmarking** of DNSP services classified by the **AER** as being Standard Control for price regulation purposes.
Sub-transmission	All assets operating above 33kV. See **distribution assets**.
Sub-transmission density	A measure of the proportion of sub-transmission classified assets, above the threshold for **distribution assets**, relative to total assets including distribution assets.
Systemic operating environment	All firms including **DNSPs** operate under less than ideal conditions. Systemic variables apply to all firms including DNSPs and are not candidate OEFs as they have been fully accounted for in the **econometric benchmarking**.
WHS model laws	Work Health Safety model laws that apply outside Victoria and WA.

Zero point	For each individual OEF assessment/DNSP, the minimum expression of the **candidate OEF** across all DNSPs. This may be a complete absence of the OEF for one or more DNSPs. For some OEFs, this may represent the minimum expression of the environmental variable among the DNSPs assessed that, while non-zero, is used to define the zero point. Not to be confused with **comparison point** or **reference point**.

Appendix 2 Terms of reference

The terms of reference for the project are set out below.

The AER seeks an independent technical advice about material differences in operating environments between the Australian electricity distribution service providers.

The consultant will be required to provide a written report that:

- *identifies the most material factors driving apparent differences in estimated productivity and operating efficiency between the distribution networks in the NEM, and*
- *quantifies the likely effect of each factor on operating costs in the prevailing conditions.*

The consultant is expected to only focus on those operating environment factors that contribute to a material difference in relative costs between businesses. As noted in the Appendix below, the AER has previously defined material as a 0.5 per cent difference in relative costs. The consultant may wish to consider the level and appropriateness of this materiality threshold.

The consultant should initially conduct a desktop review of the AER's existing OEF analysis and methodology for the distribution networks, including the relevant submissions and consultants' reports from the Australian distribution service providers. This desktop review is expected to reduce the scope of work and information requirements necessary to identify the most material OEFs.

Following this desktop review, the consultant may need additional information about the Victorian, South Australian, Tasmanian and Northern Territory networks. The consultant may need to consult with, or seek additional information from, the relevant distribution network services providers.

For Northern Territory, the consultant can use as a starting point previous benchmarking analysis for Power and Water Corporation and the Northern Territory Utilises Commission from 2005.[89] *This analysis suggested that Power and Water Corporation has a number of cost disadvantages when compared to other Australian distributors, including high transport and construction costs, extreme weather, climate conditions and termites.*[90]

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89 Meyrick and Associates, *Benchmarking Power and Water Corporation's Power Networks O$M Costs — A Report Prepared for Power and Water Corporation & Utilities Commission*, 7 January 2003. Available online at https://www.erawa.com.au/cproot/5427/2/AMENDED%20ACCESS%20ARRANGEMENT%20INFORMATION%20-%20APPENDIX%201%20-%20Meyrick%20Benchmarking.pdf

90 Meyrick and Associates, *Benchmarking Power and Water Corporation's Power Networks O$M Costs — A Report Prepared for Power and Water Corporation & Utilities Commission*, 7 January 2003, pp. 36-42

Appendix 3 Consultations

Table 25 Summary of participation in consultation

DNSP	Non-assessed group invited submission	Draft submission	Workshop attendance	Post workshop data/ submission
Evoenergy		✓	✓	
Ausgrid		✓	✓	✓
Endeavour				✓
Essential		✓	✓	✓
Energex		✓	✓	
Ergon		✓	✓	
CitiPower	✓	✓	✓	✓
Jemena	✓	✓	✓	✓
Powercor	✓	✓	✓	✓
SAPN	✓	✓	✓	✓
AusNet	✓	✓	✓	
TasNetworks	✓	✓	✓	✓
United Energy	✓	✓	✓	✓

Appendix 4 Overview of potential OEFs raised in submissions

Table 26 below summarises potential OEFs raised through the review process including consultation submissions and discussions, including their potential proponents and summaries of relevant AER determinations on these potential OEFs.

Table 26 Overview of potential OEF candidates

References provide the DNSP and page number of Attachment 7 – Operating expenditure from AER determinations for Ausgrid distribution determination 2015−16 to 2018−19, ActewAGL distribution determination 2015−16 to 2018−19 and Ergon Energy determination 2015−16 to 2019−20.

Potential OEF	OEF category	Potential proponents
Customer density (Rural/radial network topology)	**Customer factor**	**Jemena, Citi/Powercor, SAPN, AusNet, TasNetworks, United Energy, Energex, Ergon, Essential**
Ausgrid 7-187	We are not satisfied that linear density is insufficient to capture the effects of customer density. This is because opex will be driven by the length of line that must be maintained rather than the area that the service provider nominally covers. Using a measure of spatial density may cover nominally servicing areas in which a service provider has no assets or customers. An example of this, provided by Economic Insights, is the Northern Territory distributor: Power and Water Corporation. Nominally, Power and Water Corporation's service area is all of the Northern Territory. In reality, Power and Water Corporations electricity distribution network covers Darwin and Katherine (with a transmission line between the two) on its main network with smaller networks around the Territory serviced mostly by isolated, diesel generator–based systems. Therefore measuring customer density using Power and Water Corporations nominal service area would provide a misleading picture of the customer density of Power and Water Corporation's network. We are not satisfied that the variables in Economic Insights benchmarking SFA model are insufficient	

Potential OEF	OEF category	Potential proponents
	to account for differences in costs between meshed and radial network designs. Lower density areas will tend to be serviced by radial hub and spoke networks. Higher density areas will tend to be serviced by meshed networks. As Economic Insights SFA model accounts for linear density we consider that it does account for differences in radial and mesh network designs.	
Asset Inspection Regimes	**Jurisdictional factors**	**Jemena, Citi/Powercor, SAPN, AusNet, TasNetworks, Energex, Ergon**
NA	This potential OEF emerged in the workshop from the discussion of vegetation management, bushfires and cyclones/storms. It does not appear to have been previously considered, either recognised within or separately from existing OEFs.	
Asset age (Replacement of 6.6kV by 22kV lines)	**Network factors**	**Jemena, TasNetworks**
Ausgrid 7-250	Asset age is not likely to lead to material differences in opex between the NSW service providers and the comparison firms. Asset age is only likely to affect some opex categories. The opex categories that will generally be affected by differences in asset age are emergency response and routine preventative maintenance on high value assets. The amount of maintenance opex does not increase with age for all assets. Asset age will not greatly affect maintenance opex for most assets. Low value assets, such as distribution lines and transformers make up the bulk of service providers' assets. Low value assets like these are inspected on a regular basis but they will generally not incur routine maintenance interventions in the way higher voltage	

Potential OEF	OEF category	Potential proponents
	assets do. Asset age will more often affect routine maintenance intervals for high value, strategically important, assets such as subtransmission lines and zone substations. However, maintenance on zone substations and assets operating above subtransmission lines generally only accounts for a small part of service providers' opex.	
Ausgrid 7-261	Operating a network using a 22 kV high-voltage distribution system rather than an 11kV high-voltage distribution system is unlikely to create material differences in opex between service providers. The comparison firms include service providers with both 22kV and 11kV network configurations. If this factor were material to the costs of the service providers, we would expect this to be most apparent when comparing these four [benchmark] service providers.	
Corrosive environments	**Geographic factors**	**Citi/Powercor, TasNetworks, Essential Energy**
Ausgrid 7-228	All service providers have assets that corrosive elements affect. In our draft decision we did not provide an OEF adjustment for corrosive elements. This was on the basis that all service providers are affected by corrosive elements. While salts affect assets in coastal areas, dusts affect assets in inland areas. While all service providers will be affected to some extent, the differences in the corrosive elements in each area will lead to differences in design and operational considerations that may affect opex. However, sufficient evidence was not provided to show that these differences would be material.	

Potential OEF	OEF category	Potential proponents
Network accessibility	**Network factors**	**AusNet, TasNetworks**
Ausgrid 7-259	We estimate access track maintenance does not contribute to material differences in opex between the comparison firms and the NSW service providers.	
Proportion of wood poles	**Network factors**	**Jemena, TasNetworks**
Ausgrid 7-262	The decision on whether to use wooden, concrete, steel, or fiberglass poles is a trade-off between capex, opex and service levels. This is because higher capital cost poles are generally less opex intensive. For example concrete poles do not require the inspection drillings and anti-fungal treatments that wooden poles do. However concrete poles are more costly to install. Service providers face many of these trade-offs.	
Service classification	**Jurisdictional factors**	**Citi/Powercor, TasNetworks**
Ergon 7-238	An adjustment for service classification would not satisfy the duplication OEF adjustment criterion. Our economic benchmarking RIN data takes into account differences in service classifications across jurisdictions by using data on network services. However, while service classification will not affect the SFA model, service classification must be considered when applying the results to produce our opex forecast. This is because if we do not	

Potential OEF	OEF category	Potential proponents
	provide an OEF adjustment for service classification, some service providers that provide standard control services that are not network services, such as connection services and metering services, will be penalised.	
Solar uptake	**Network factors**	**SAPN, TasNetworks, ,**
Ausgrid 7-264	The penetration rate for small scale solar installations is similar for Victoria and NSW. However, as the PV penetration rate is higher in SA and slightly higher in Victoria than in NSW, it is likely that the comparison firms will have a cost disadvantage relative to the NSW service providers due to differences in PV uptake. An adjustment for differences in PV penetration would meet the exogeneity and materiality OEF adjustment criteria. The decision to install PV is a customer's choice and there are no variables to account for differences in PV penetration rates in Economic Insights' SFA model.	
Terrain (Topography)	**Geographic factors**	**Jemena, AusNet, TasNetworks**
Ausgrid 7-235	Differences in topography between the service providers are not likely to lead to material differences in opex. Adverse topographical conditions affect many NEM service providers. For example, the Great Dividing Range runs through some distribution network areas. Operating in mountainous regions may lead to higher costs in some operating areas such as maintenance, emergency response, and vegetation management due to access issues, even if this is not likely to be a material cost. We note that AusNet Services, the comparison service provider at the benchmark comparison point, has a similarly mountainous operating environment to Ausgrid and Endeavour, but a more mountainous	

Potential OEF	OEF category	Potential proponents
	operating area than Essential.	
Traffic management	**Jurisdictional factors**	**Jemena, Citi/Powercor**
Ausgrid 7-248	Traffic management requirements across Australia are based on a nationally consistent standard. State and territory road authorities generally base their traffic control at roadwork sites requirements on AS1742 Part 3: Guide to traffic control devices for works on roads. Therefore cost differences due to jurisdictionally differences will be immaterial. Traffic management costs generally correlate with the volume of traffic near the worksite. We consider that traffic management will have a greater overall impact on expenditure in higher density areas than in lower density areas. Economic insights' SFA model accounts for differences in customer density. In response to our draft decision we received no evidence to suggest that differences in traffic management practices in the ACT, Victoria, and SA lead to material differences in opex.	
Advanced metering infrastructure	**Network factors**	**Jemena**
Ausgrid 7-249	The ability to share overheads between network services and metering services are not likely to lead to material differences in network services opex. AMI costs are excluded from network services opex. As discussed in the unregulated services section above the extent to which service providers can share overheads across services is the result of business decisions on service diversification. Therefore an OEF adjustment for differences in AMI programs would not satisfy the exogeneity OEF adjustment criterion. Additionally, fixed overheads are only a part of total overheads. As service providers increase in scale	

Potential OEF	OEF category	Potential proponents
	and scope they will incur more overheads. As a result, although the Victorian service providers are able to share fixed costs between network services and its AMI programs, the AMI programs also add to the pool of shared overheads. As a result an OEF adjustment for differences in AMI programs would not meet the materiality OEF adjustment criterion.	
Communication networks	**Endogenous factors**	**TasNetworks**
Ausgrid 7-196	The need for two way communication in areas where there are limited commercial alternatives will be correlated with customer density. This is because the fewer customers there are in a service area, the less likely it is to be covered by a commercial communications network. As Economic Insights' SFA model accounts for customer density, as discussed above, we are not satisfied that it does not appropriately account for the availability of commercial communications networks. Also an adjustment for differences in communication networks is not likely to meet the materiality OEF adjustment criterion. The necessity to provide an extensive two way communication system between control room and field staff, where there are limited commercial options, is not unique to Essential Energy.	
Cultural heritage	**Jurisdictional factors**	**TasNetworks**
Ausgrid 7-237	We do not see evidence to suggest that differences in cultural heritage management requirements would lead to material differences in opex. Specifically Ergon Energy identified staff training and awareness, special alert and management processes and additional operational precautions for native title cultural heritage. Ergon Energy	

Potential OEF	OEF category	Potential proponents
	provided a map showing areas where native title has been found to exist and where claims have been made. Ergon Energy did not quantify the costs it incurs for its native title or other cultural heritage programs. Many service providers have cultural heritage obligations. For example, the Victorian service providers most comply with the Planning and Environment Act 1987, the Heritage Act 1995, and the Aboriginal Heritage Act 2006 in providing services. The NSW service providers have not provided evidence to suggest the costs they incur to meet their obligations will be materially different to comparison firms..	
Demand management	**Network factors**	**SAPN**
Ausgrid 7-257	Demand management is the use of various strategies to change customers' electricity use. By changing energy use, service providers can avoid the need for large investments in network upgrades to meet a peak demand that only occurs for a small part of the year. In this way service providers can reduce their capex by using opex. The decision to undertake demand management is a capex opex trade-off. Service providers face many of these trade-offs. Other examples include the choice to rent or buy depots, to run lines over or underground, to replace or maintain.	
Economies of scale	**Customer factor**	**TasNetworks**
ACTew 7-185	An adjustment for economies of scale is unnecessary because the Cobb Douglas functional forms, which is used in Economic Insights' SFA model, accounts for economies of scale.	

Potential OEF	OEF category	Potential proponents
	Advisian submitted that because ActewAGL is geographically isolated it does not have the ability to pursue mergers and cooperative arrangements with other service providers. Advisian submitted that this affects ActewAGL's ability to access economies of scale in primarily two ways: it prevents ActewAGL from being able to share management functions and share operational functions. However, Advisian did not provide evidence to suggest the Cobb Douglas functional form does not account for economies of scale.	
Planning regulations	**Jurisdictional factors**	**TasNetworks**
Ausgrid 7-244	Differences in planning regulations are not likely to create material differences in opex across jurisdictions. This was on the basis of the findings of a Productivity Commission review of the impact of planning regulations on businesses across Australia. The finding of this review was that given the extent of differences, it is a challenge to compare the planning systems of the states and territories: individual indicators are often heavily qualified and thus so are comparisons between jurisdictions. As a result, the Productivity Commission did not attempt to construct an overall 'league table' of state and territory performance. This suggests that although planning regulations differ across jurisdictions, and are therefore likely to create some differences in costs, that differences in planning regulations are not likely to lead to material differences in costs.	
Private power poles	**Customer factor**	**TasNetworks**
Ergon 7-235	Ergon Energy stated that many of its customers own power poles. It is required to perform a brief inspection of first-in poles (at the connection boundary point) to help ensure the pole is serviceable.	

Potential OEF	OEF category	Potential proponents
	We note the service providers in Victoria are required to inspect private electric lines up to the point at which the line connects to a building or other structure (not including a pole). Consequently, the requirement for the Queensland service providers to inspect only first-in poles will reduce their inspection costs relative to Victorian service providers, all else equal. However, there is not sufficient evidence to conclude that these differences will lead to material differences in opex.	
SWER	**Network factors**	**TasNetworks**
ACTew 7-247	The proportion of SWER included in a network is a result of past management decisions and it will be correlated with customer density, which is captured in Economic Insights' SFA model. Advisian and CEPA submitted that SWER is cheaper to operate than other lines. Synergies on the other hand submitted that it is more expensive to operate because it is less reliable, which results in greater network restoration costs. SWER is a mature technology that has been available to network service providers for decades. SWER systems are low capital and maintenance cost distribution systems, which have been installed and operated in many rural parts of the world. An OEF adjustment for SWER does not meet the exogeneity OEF adjustment criterion. There was nothing preventing NSW service providers from using SWER in low demand low density areas of their networks. SWER has been available for use in Australia since the first half of the 20th century. To the extent that SWER is a cheaper method to distribute electricity, its use or absence, is a reflection of past managerial efficiency or inefficiency.	

Potential OEF	OEF category	Potential proponents
Geographic isolation (Material and labour costs)	**Geographic factors**	**TasNetworks, PWN**
	While the AER has previously some variety of personnel skills between rural and urban DNSPs in NSW and Queensland, it has not been previously considered labour and material costs resulting from geographical isolation from Australia's major population centres.	