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Essential Energy submission on review of Operating Environment Factors for Distribution Network Service Providers

Essential Energy appreciates the opportunity to comment on the draft report prepared by Sapere Research Group and Merz Consulting titled, 'Independent review of Operating Environment Factors used to adjust efficient operating expenditure for economic benchmarking' (the draft report). This submission provides a response to the specific consultation questions as well as further information to assist the AER improve its overall approach to benchmarking.

A collaborative approach to benchmarking

The current benchmarking model presents a large spread in efficiency scores for distribution network service providers (DNSPs) that cannot solely be attributed to managerial inefficiency. The AER recognises this and adjusts for variances between DNSPs operating conditions through the application of ex-post Operating Environment Factor (OEF) adjustments. The current model relies on a small set of explanatory factors to benchmark an extremely heterogenous sample of DNSPs. The overseas data included in the sample results in skewed cost relationships that cannot be adequately corrected by the current approach of ex-post OEF adjustments. In addition, the AER is placing too much confidence in the accuracy of the Regulatory Information Notice (RIN) data and the associated analysis underlying the benchmarking model. Until the robustness of the benchmarking approach is improved, a more cautious approach to interpreting the benchmarking results should be applied.

On this basis improving the approach to ex-post application of OEFs should only be considered a short-term solution until the benchmarking approach more generally is refined. This broader piece of work should be completed in collaboration with DNSPs and would necessarily entail a number of changes - development of an OEF assessment method; enhanced data collection and cleansing processes; consideration and reporting of results from a range of benchmarking models using various data inputs and outputs reflective of DNSP heterogeneity; and, a reassessment of the weight benchmarking results should hold in deriving operating expenditure allowances.

In summary, our concerns with the current benchmarking approach are:

1. The RIN data underlying the Economic Insights (EI) model and OEF calculations must improve before it can be relied upon.
2. The EI model used by the AER relies heavily on available overseas data that is not fully comparable with the Australian data. This skews the implied relationship between inputs and outputs towards the factors affecting overseas DNSPs, which necessarily impacts the efficiency scores of the Australian DNSPs.
3. It relies on a single model, for which the output weights have not been updated since 2014. The results of the four other econometric models used for 'sense checking' are driven by the same underlying data so suffer the same issues around data comparability and robustness.
4. The comparison point (target) could be widened to account for different types of costs.

5. We are concerned with the deterministic way in which the results are applied, especially given the infancy of the benchmarking process in Australia. Energy regulators in other countries, who have been utilising benchmarking techniques for years, generally apply less weight to benchmarking results in determining allowances.

These issues, along with suggested improvements, are described in more detail at Attachment A. We also attach a report by Frontier Economics at Appendix C that we hope the AER will find useful in developing a revised and improved approach to benchmarking. The report outlines the importance of OEFs in benchmarking; how a well-designed benchmarking methodology can adequately control for OEFs; the need for the data used to be robust and of high quality; and a constructive proposal as to how the AER could improve its benchmarking process.

We recognise that improving the comparability of the benchmarking data and enhancing the benchmarking methodology will not be a quick, nor easy, exercise. If it is to be done properly, it will require significant collaboration between the AER and DNSPs to address data discrepancies for both modelling and OEF adjustments. As part of this review, alternative data sources could be considered for assessing some OEFs, for example Bureau of Meteorology data on major storms. This would both reduce the regulatory burden on DNSPs and provide the AER with an independent source of reliable, comparable data. Given the important and useful role benchmarking provides, we are sure all DNSPs would be willing to work with the AER on these tasks. In the first instance, a focus on collecting the key 15 or 20 attributes needed for benchmarking would expedite the process.

Response to the draft report

Answers to the specific consultation questions are provided at Attachment B however, there are other issues that also need to be considered:

1. Data issues: As mentioned above, we believe the integrity, completeness and comparability of the underlying RIN data has yet to be fully assessed or tested. Incomplete and inaccurate data will lead to incorrect conclusions. For example:
   - The definition of Major Storm in the Category Analysis (CA) RIN Instructions is being interpreted in different ways by DNSPs and does not necessarily agree with its application in the draft report. The CA RIN Instructions define a Major Storm as “Tropical cyclones of Category 1 and above as classified by the Bureau of Meteorology” (BOM). Clearly, tropical cyclones do not affect most DNSPs, however, the OEF wording in the report indicates that the severe storms OEF applies to all geographical regions, and hence affects all DNSPS to some degree.

     Given six DNSPs report zero Major Storms data in most/all years, this definition is clearly being misapplied. It seems that some DNSPs have delved deeper into the definition of a category 1 tropical cyclone and perhaps applied the associated Beaufort wind scale in assess their Major Storms, whilst others have reported zero on the basis the storm was not related to a tropical cyclone. The AER needs to clarify the definition of a Major Storm, especially now that it is using the data in its benchmarking.
   - On a related note, the Major Storm section of the RIN was clarified in 2014. From this date, Essential Energy began to report the subsection of major event days that were the result of major storms accordingly. However, prior to 2014-15, these amounts were reported as zero. The data for earlier years was not recalculated following the reissued instructions, as it was not clear if this data was required. However, when assessing the major storm OEF, it must have been quite clear that the Essential Energy RIN data did not align with the Bureau of Meteorology storm information referenced in determining the use and materiality of the OEF.

     We have now back-cast the data and will formally provide this to the AER. When this seven years of additional data is included in the calculation, Essential Energy’s extreme weather storm OEF increases from $0.4 million to $2.7 million.
2. Operating costs (opex) / capital costs (capex) trade-offs

   The logic that ‘opex / capex trade-offs are within management control’ applies in theory, but is limited in practice for a number of reasons:

- The assets in existence today are the result of management decisions made decades ago. Unless the assets being replaced are nearing the end of their lives, it is unlikely to be in customer's best interests to bring forward capital investment simply to reduce opex costs;
- The underlying data is distorted by the variations in capitalisation policies between distributors and over time; and
- Opex / capex trade-off decisions are necessarily impacted by the weighted average cost of capital (WACC) rate prevailing at the time. Given the WACC rate varies from regulatory period to regulatory period, the long-term trade-off in opex /capex decisions is compromised.

Additionally, the use of average opex in the current benchmarking approach means the results may be difficult to observe in DNSPs with very large quantities of assets when regulatory periods are just five years in length. For example, it would take Essential Energy more than 40 years (nine regulatory periods) to change out all existing timber arms to composite. The use of average opex in the OEF calculations would see no discernible improvement in costs from one regulatory period to the next.

Extension of the OEF assessment

We also wish to highlight that we are currently undertaking a detailed assessment of OEFs and expect to raise additional OEFs and suggested means of evaluating them across all DNSPs as part of our regulatory proposal. At this stage, these will likely include:

- Timber decay zones - our modelling shows substantial differences in life based on decay zones and perhaps more critically the need for inspections and rectification work.
- Acid Sulphate and High Salinity Soils - these soil types are highly aggressive and attack metals leading to corrosion and failure. This means legacy steel and concrete structures in these areas are unlikely to achieve a reasonable service life and will require opex investment to maximise their life.
- Coastal Corrosion and in-ground and in-timber corrosion - coastal influenced corrosion varies around Australia depending on proximity to the coast and the coastal environment itself. Also, the corrosion occurs in timber so bolts corrode. Essential Energy has programs specifically designed to monitor and rectify coastal corrosion issues. Similarly, the rate of corrosion for in-ground assets varies based on soil and environmental conditions.

Should you wish to discuss any aspect of our submission, please don't hesitate to contact Natalie Lindsay on (02) 6589 8419.

Yours sincerely

Chantelle Bramley

General Manager Strategy. Regulation and Transformation

1. The Regulatory Information Notice (RIN) data underlying the EI model and OEFs must improve before it can be relied upon.

Why this is an issue and evidence of the flaw	Suggested improvement
Data underlying a benchmarking model must be robust if the results are to be fair and useful. A lack of comparable data undermines the results of the model. Much of the RIN data underlying the Economic Insights (EI) model is estimated. In addition, each DNSP records data differently, may have a slightly different interpretation of the data being requested, as well as applying different assumptions and methods in compiling the data. Not all DNSPs have back-cast data when the RIN instructions have changed. This is likely because there has been no perceived need to back-cast nor value in back-casting, when the AER has not yet used the data. At the receiving end, we feel there has been little data cleansing or clarification with the parties to ensure the data is comparable. For example: > Some Victorian DNSPs report no vegetation opex > Of the 13 DNSPs, for the period 2006 through to 2013: • 5 of the 13 estimated network services opex data; • 3 of the 13 estimated ratcheted maximum demand; • 6 of the 13 estimated circuit length; and • 2 of the 13 estimated SAIDI reliability data.	> Work closely with DNSPs as a group to define exactly what data should be included in each benchmarking category. > Once data is received, sense check for robustness and follow-up where results aren't logical. > Continue to 'check-in' with DNSPs over time to ensure processes have not changed and the data remains comparable. > Until the data is robust enough to be relied upon, apply less weight to the benchmarking data in determining opex levels. • Ofgem, that has been benchmarking for more a decade, recognises that benchmarking is not 100% reliable and places just 75% weighting on 'efficient costs' and 25% on actual costs • In Norway, 'efficient costs' are weighted at 60% with a 40% weighting placed on actual costs • OEB In Canada applies a stretch factors of 0% p.a. to 0.6% p.a. • In Germany, the most favourable to the DNSP of the DEA and SFA models is used.

2. The EI model used by the AER relies heavily on available overseas data that is not fully comparable with the Australian data.

Why this is an issue and evidence of the flaw	Suggested improvement
> 'Poolability' tests demonstrate that there are significant differences in the scale and spatial characteristics by country and DNSP as well as the underlying relationship between costs and cost drivers between the different jurisdictions. > The choice of output variables (ratcheted maximum demand, customer numbers and circuit length) have been determined by the data available and not what is likely to give the most reliable indicator of efficient costs. > There are numerous differences in the definitions used for collecting data that lowers comparability and undermines the EI model. For example, Ontarian DNSPs report non-coincident ratcheted maximum demand whereas the model uses coincident ratcheted maximum demand for Australian and New Zealand DNSPs. > The inclusion of country dummy variables does not change the 'slope' of the model i.e. the model incorrectly assumes that the underlying relationship between, say, customer numbers and opex is the same for a DNSP regardless of the country in which it is located.	> Consider normalising the data prior to modelling to remove unusual DNSP specific expenditure. > Consider using more appropriate overseas data, for example data from the United States. > Use data envelopment analysis (DEA) as outlined in the AER's Expenditure Forecast Assessment Guideline. > Use fixed effects or random effects SFA models which allow for heterogeneity at the DNSP level. > Include additional variables. > Consider running the model with just Australian data – as more Australian data becomes available, the need for additional data points from overseas will diminish.

3. There is reliance on a single 'flawed' model, for which the output weights have not been updated since 2014.

Why this is an issue and evidence of the flaw	Suggested improvement
> The sensitivity of the data used in the EI models has not been adequately tested. In the end, only DNSPs with >20,000 customers were used in the four econometric models used by EI. This reduces the subset to 69 DNSPs of which 37 are from Ontario and 18 from New Zealand, many of which are still very small, relative to the Australian DNSPs. > All four econometric models rely upon the same data and variables. Given they are all derived from the same data, they are missing the same wider review of factors and sense checks. > The output weightings in the EI model have not been updated since 2014. This is placing a higher weighting on customer numbers as a driver of opex. > The Translog model was rejected because of monotonicity violations i.e. negative relationships between costs and outputs, even though the negative elasticities are statistically highly insignificant. > DEA was not used by the AER despite its inclusion in the AER's Expenditure Forecast Assessment Guideline > Variable returns to scale (VRS) analysis confirms the vast heterogeneity of Australian DNSPs.	> Update the output weightings to encompass the additional two years of data now available. > Use a broader range of modelling and benchmarking against Australian businesses, including the use of bottom-up analysis. The two approaches complement each other. > Given the heterogeneity of Australian DNSPs, the characteristics and configuration of the network in question must be considered before the efficient and realistic input qualities and minimum unit costs required to operate such a network are identified. For example, the EI model places an excessive weight on customer numbers as a driver of opex when, in fact, it is the location of the new connection relative to the existing network that drives opex costs i.e. the spatial density of customers / km^2. > The Translog model has merit when it is considered that the model outputs tend to increase together over time, especially customer numbers and circuit length. As such, it is more appropriate to examine what happens when all three outputs increase by 1% rather than looking at the individual outputs one by one. Using this criterion removes the 'monotonicity' issue as a 1% increase in all the outputs leads to a close 1% increase in opex. > Use DEA – whilst not a statistical model, it extends simple ratio analysis (output per input) to cases where there are potentially many inputs and many outputs.

4. The comparison point (target) could be widened to account for different types of costs.

Why this is an issue and evidence of the flaw	Suggested improvement
> The lowering of the comparison point between the 2015 draft determinations and final determinations for NSW and ACT DNSPs would indicate that the AER has some unease about the reliability of the EI model. > The efficiency scores have not been rebased to rate the most efficient firm at 100% efficiency so, in theory, all DNSPS could be above or below the 75% threshold.	To increase confidence in the benchmarking results, apply a weighted average comparison point based on a variety of models and consider different comparison points for different types of costs. For example, in assessing electricity DNSPs Ofgem applies: > an upper quartile target based on a weighted average of three benchmarking models for indirect costs, on the basis they are less prone to year-to-year volatility, so are easier to benchmark; and > an upper third target based on a weighted average of three benchmarking models for network operating costs which are considered both volatile and less fully explained by the available cost drivers. When international data is included in the benchmarking, consider reducing the comparison point to allow for potentially incomparable data. For example: > the Competition Commission in the UK considered the upper quartile inappropriate when adding only a single extra comparator to the sample of 14 DNSPs regulated by Ofgem. > The slightly less onerous 5th best company, rather than the upper quartile, was used in the CMA's Northern Ireland Electricity against the DNSPs in Great Britain.

5. The heterogeneity of DNSPs could be better accounted for.

Why this is an issue and evidence of the flaw	Suggested improvement
> Whilst Australian distribution network service providers (DNSPs) all deliver electricity to consumers, their legacy network characteristics, customer density per kilometre (km) of line, customer spatial density (per km2) along with past and present jurisdictional obligations means they are by no means homogeneous. > The current application of ex post OEF adjustments: • Assumes the base results of the EI model are sufficiently robust and credible, when the efficiency scores have been affected by non-comparable data and the model is flawed. • Do not address the fact that the cost relationships within the model have been affected by non-comparable data and the skewed cost relationship cannot be corrected by post modelling OEF adjustments.	> Normalise the data at the input stage to ensure that the modelled relationships between input and outputs are not skewed. This is the best practice approach for benchmarking and is consistent with the approach used by Ofgem in the UK. > Consider whether all network opex should be assessed in the benchmark modelling or whether there are some aspects, for example vegetation management, that should be assessed outside of the main benchmarking model.

1. DNSP views are sought on the proposal to consider sub-transmission and licence conditions as a single OEF category, and the inclusion of transformer capacity as well as lines capacity in the quantification.

We do not believe that these two OEFs should be combined as Essential Energy was subject to variations in licence conditions that resulted in significant investment in the distribution network. These differences remain accounted for in the draft report's analysis.

For example, Clauses 14.1 and 14.2 of the licence conditions required Essential Energy to build the network to meet the requirements of N-1 for urban networks, but our radial network precluded reasonable financial investment in sub-transmission to deliver on the licence conditions. As a result, Essential Energy undertook significant investment in the distribution network to meet the licence requirements, at a lower cost than duplicating the sub-transmission network.

As part of meeting licence requirements, between 2008 to 2013 Essential Energy increased network capacity across its network. Of this capacity, 76% was directed to distribution substations whilst just 24% was directed to sub-transmission substations. This expenditure necessarily resulted in additional opex that is not accounted for in the current OEF assessment.

In addition, there are some broad statements made in the report that do not consider differences in DNSP's topography.

- Page 24 makes the following statement:

  "Distribution transformers, the low voltage system and, in part the high voltage system, offer a reasonable degree of flexibility in terms of relocations, alternations, modifications and new connections. This means that excess capacity resulting from historical licence conditions can be more readily relocated or diverted to areas where that capacity can be better utilised. On this basis, we consider that this suggests that higher OPEX attributable to licence conditions should not be sustained following removal of the licence condition and should therefore be reconsidered from time to time. "

  This statement only holds true in certain geographical areas and where there are significant low voltage interconnections, for example, the more meshed networks associated with urban utilities. The radial nature of Essential Energy's network means we have a much lower ability to shift loads around to utilise assets in the manner suggested.

- Page 28 incorrectly attributes reliability improvements to sub-transmission expenditure:

  "This reflects the basic 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."

  For rural and radial networks, like Essential Energy, the biggest improvement in reliability is attributable to segmentation of the high voltage distribution network i.e. reclosers, not sub-transmission work.

2. DNSP views are sought on proposals toward the future quantification of the vegetation candidate OEF (or set), encompassing the previous bushfire and division of responsibility OEF categories.

We support the view of Energy Networks Australia in relation to this question and believe that significant work is required in this area before any benchmarking can take place. The AER should work with DNSPs and undertake a series of workshops and one-on-one meetings to develop a fuller understanding of the differences in vegetation management obligations and associated work effort and then to develop appropriate RIN reporting measures.

We also disagree with several statements in the draft report:

- The implication that only Victorian DNSPs are subject to more onerous vegetation management clearances associated with bushfire regulations

- That only Victorian DNSPs have additional direct costs related to creating and maintaining records of vegetation management activities and outcomes. NSW DNSPs are similarly subject to audit by IPART and are required to maintain vegetation management records.
- We also note that NSW vegetation clearance envelopes are based on the length of the span and conductor blow out calculations. This requires NSW DNSPs to have span based clearance outcomes. For example, in NSW the clearance envelope around high voltage lines is five meters or more, dependent on the span, which contrasts to say, Queensland, where a three-metre corridor is typically required.

3. DNSP views are sought on apparent inconsistencies in RIN returns with respect to taxes and levies and options for quantification of this OEF category in future.

We believe that significant work is required in this area before any benchmarking can take place. NSW DNSPs are subject to taxes and levies. The data has not been separately reported in the RIN as there has never been a need to do so. We therefore agree with the draft report statement that this candidate OEF needs to be addressed by more consistent treatment of taxes and levies in the RIN returns.

4. DNSP views are sought on the proposals for modifying the quantification of the Termites OEF category.

Missing map reference

The draft report refers to a CSIRO termite map, but there is no reference given. There are many CSIRO termite maps available, some of which are out of date. The most relevant ones are those built from house infestation studies done by the CSIRO, however these results suffer from population density issues which the CSIRO acknowledge, so they must be considered in conjunction with climatic maps which the later CSIRO maps do. The reference should be clarified before we can fully consider this section of the report.

Incorrect statements

This section of the report also contains some statements that require modification.

- Untreated poles are referred to many times. Only legacy untreated poles remain in service as untreated poles have not been installed by Australian DNSPs for some decades. In addition, the use of treated poles does not eliminate termite attacks. The treatment layer only penetrates the sapwood, so the heartwood of the pole is still at risk of termites if the treatment barrier is compromised through barrel checking, cracks or termites eating their way through the treatment layer.
- We disagree with the statement that increasing compensation for termite opex potentially mutes the efficient investment in termite proof assets for the same reasons noted in the opex / capex trade-offs section of our submission letter, namely:
  - There is additional capital cost in using more termite resistant poles and the impact on customer prices arising from the opex/capex trade-off must be considered. In addition, such poles have technical, operational and environmental limitations and subsequent opex and capex costs that a simplistic material-based assessment, using termites as the driver, fails to consider.
  - It is unlikely to be cost-effective or in customers best interests to change poles that are not at the end or nearing the end of their useful lives.
  - The use of average DNSP opex in the benchmark modelling means that for DNSPs with large amounts of assets, the results will take many regulatory periods to be accurately reflected in the opex allowance. At Essential Energy's current pole replacement rate, it would take over 100 years to replace our 1.2 million timber poles.

Further areas for consideration

- DNSPs have differing treatment plans for termites so a direct comparison is not achievable.
- Market testing is unlikely to be significantly different as termite treatment costs are directly related to labour.
- We would not expect the average age of assets replaced because of termite infestation to tell a useful story, as termites are opportunists. Statistically, the breakup of pole types and median infection age will potentially be more useful.

  For example, the average age of Essential Energy's termite condemned poles is 36 years, but this is mostly comprised of untreated poles, which have not been installed since the 1970's. We have also condemned poles as young as three years of age due to termites. Our preliminary research suggests that the inception of timber decay is the major trigger for termites.

An alternative framework for accounting for operating environment factors (OEFs)

A REPORT PREPARED FOR ESSENTIAL ENERGY

February 2018

An alternative framework for accounting for operating environment factors (OEFs)

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An alternative framework for accounting for operating environment factors (OEFs)

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1 Introduction

1.1 Background

Since November 2014, the AER has used economic benchmarking to assess the relative efficiency of the Australian electricity distribution network service providers (DNSPs), and to inform its determination of expenditure allowances for DNSPs, as is required under the National Electricity Rules. The aim of the AER's benchmarking analysis is to estimate differences in managerial and operating efficiency between the DNSPs, thereby assessing the scope for making future efficiency improvements.

The AER has published four annual DNSP benchmarking reports so far, with the seminal report published in 2014. The annual benchmarking reports have presented economic benchmarking analysis using a range of techniques and models. However, to date, the AER's preferred benchmarking model, when setting operating expenditure (opex) allowances for DNSPs, has been a Cobb-Douglas Stochastic Frontier Analysis (SFA CD) model, which estimates the relationship between opex and a small set of explanatory factors. This preferred model has been used to estimate the relative efficiency scores of the Australian DNSPs.

The AER's benchmarking results identify a very large spread in performance across the businesses in its sample, ranging from approximately 45% to 96% for the Australian DNSPs in 2017 DNSP annual benchmarking report.[1] However, as is acknowledged in that report, the estimated 'raw' efficiency scores are only indicative of DNSP performance, as a number of important operating environment factors (OEFs) are not captured in the AER's econometric model. OEFs are important drivers of relative performance.[2]

> The econometric results are only indicative of the DNSPs' relative performance. Operating environment factors (OEFs) not captured in the econometric model can affect a DNSP's benchmarking performance and its relative performance.

The AER defines OEFs to be "factors beyond a DNSP's control that can affect its costs and benchmarking performance."[3]

Economic benchmarking analysis for regulatory purposes should seek to measure efficiency within the control of management. If OEFs are not accounted for properly when conducting the benchmarking analysis, the AER's efficiency

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1 AER, *Annual Benchmarking Report – Electricity Distribution Network Service Providers*, November 2017, Figure 18 p. 39.

2 *Ibid.*, p. 38.

3 *Ibid.*, p. 5.

estimates will not reflect solely the differences in opex efficiency between DNSPs, but rather differences in OEFs *and* efficiency.

On 11 December 2017, the AER initiated a review of its OEF adjustments for the DNSPs by publishing for consultation a draft OEFs report prepared by its economic and engineering consultants Sapere Research Group and Merz Consulting (Sapere-Merz).[4] The AER has indicated that it is seeking to refine its approach to OEFs as part of its continuous improvement of its economic benchmarking techniques.

Essential Energy has commissioned Frontier Economics to prepare this report outlining our recommended framework for accounting for OEFs in the AER's economic benchmarking analysis.

1.2 Our key findings

The AER's step of reviewing its approach to OEFs is important and welcome

Frontier Economics commends the AER's efforts to improve its approach to economic benchmarking, and its dedicated review of how OEFs should be accounted for when conducting economic benchmarking. In our view, it is not possible to draw meaningful conclusions about the relative efficiency of regulated DNSPs unless OEFs are controlled for appropriately. Failure to control properly for OEFs would defeat the objective of conducting economic benchmarking: namely, to identify the true scope for efficiency improvements by DNSPs. Therefore, we welcome the AER's attention towards this issue, and consider that this is an important opportunity to make lasting improvements to the way the AER conducts economic benchmarking, to promote the long-term interest of consumers.

The AER should adopt an ex-ante approach to adjusting for OEFs

In our view, the AER/Sapere-Merz proposed framework for incorporating OEFs into benchmarking is fundamentally flawed in one important respect: the accounting for OEFs only *after* the raw efficiency scores have been estimated (i.e., the *ex-post* adjustment approach).

To date, prior to determining efficiency adjustments in regulatory proceedings, the AER has attempted to adjust the raw efficiency scores generated by its benchmarking models using *ex-post* OEF adjustments. This has entailed adjusting

[4] Sapere-Merz, *Independent Review of Operating Environment Factors Used to Adjust Efficient Operating Expenditure for Economic Benchmarking*, December 2017.

the benchmark comparison point for each network to account for the AER's estimate of OEFs.[5]

If OEFs are not accounted for prior to estimating relative efficiency scores (for example, by excluding the costs associated with those factors from opex), then the estimated relative efficiency scores will be distorted by the inclusion of those factors. *Ex-post* adjustments for OEFs do not overcome this bias because the starting point from which *ex-posts* adjustments are made is likely to be distorted and, therefore, invalid.

In this report, we propose an alternative framework for accounting for OEFs in economic benchmarking. Our proposed framework involves including additional explanatory variables to reflect OEFs, to the extent possible, and making *ex-ante* adjustments to the data for OEFs not accounted for within the benchmarking model, before the data are used to estimate relative efficiency.

A clear process is needed to identify the most material OEFs and to agree how these should be quantified

We also note that, at present, there is little agreement on what OEFs should be accounted for within the benchmarking analysis. Whilst the AER's current consultation process takes a step towards addressing this question, in our view a much more extensive consultation and engagement process (between the AER and relevant stakeholders) is required in order to determine the most important factors that could be driving differences in DNSPs' opex that are not accounted for within the AER's benchmarking models.

Clearly, the factors not accounted for in the AER's benchmarking models will depend on *how* those models are specified. The AER itself has indicated that more work needs to be done to improve its benchmarking models and techniques. Therefore, the question of what OEFs should be quantified and adjusted for cannot be divorced from the process of reviewing and improving the AER's benchmarking models: these two processes need to occur together.

Once agreement is reached on the most important OEFs, a process will be required to decide how each of these OEFs should be quantified in a systematic and reliable manner. The range of OEFs that could be relevant may be quite varied, so there will not be a 'standard' approach to quantifying all (or even some) OEFs. It is more likely that the quantification of each OEF will require a bespoke calculation. The process for agreeing how each OEF should be quantified would entail:

- Developing an appropriate methodology for quantification;

5 The AER's *ex-post* process for adjusting for OEFs is described in greater detail in Section 3.1.

- Identifying the data required to apply each method;
- Agreeing on the sources of data that should be used; and
- Developing data templates and detailed, standardised data definitions if (as is likely) some of the data are to be collected from DNSPs.

More work needs to be done to collect, scrutinise and verify the data required to quantify the OEFs

Finally, we note that there are, at present, major gaps in the data required to quantify and adjust appropriately for the most material OEFs. Reliance on only the data presently available to the AER has two major disadvantages:

- Firstly, the data are limited in their scope and coverage, which in turn may limit considerably and unreasonably the OEFs that the AER can quantify. This could result in important OEFs being omitted from the analysis, or being adjusted for in an *ad hoc* fashion.
- Secondly, as the data currently available to the AER have not been tested thoroughly and corrected for errors, there can be little confidence that the data are reliable or reported consistently (e.g., if some DNSPs have misinterpreted the data that should be reported).[6] If the data are of poor quality or are unreliable, the resulting OEF adjustments will not provide a true indication of the DNSPs' relative efficiencies.

In order to overcome and avoid these problems, we recommend that the AER work closely with DNSPs to identify the data required, and undertake a rigorous process of checking and improving the veracity of the data, before making OEF adjustments.

Further, we recommend that this data collection and auditing process be undertaken in a collaborative way between the AER and the industry. This would:

- Ensure better consistency of data as all DNSPs develop a common understanding of the information the AER is seeking and the uses to which it will be put;
- Help the AER to identify early any potential inconsistencies in how data are being reported between DNSPs or over time; and
- Provide the AER with valuable opportunities to learn more about individual businesses and their operations, which would aid its regulatory determinations and its interpretation of the quantitative benchmarking analysis.

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6 As discussed in Section 5 of this report, Sapere-Merz has expressed reservations about the quality and consistency of the data available to quantify some OEFs.

Iterative and incremental improvements

As we have noted above, the AER's efforts to consult on its OEF approach, and its stated intention to make ongoing improvements to its benchmarking methodology, are encouraging and welcome. Our experience with regulatory regimes in other jurisdictions is that even regulators with extensive experience in conducting economic benchmarking make continual, incremental improvements by assessing periodically the techniques used for benchmarking, and refining the consistency and quality of the data. We observe that this process occurs best through constructive and ongoing engagement between the regulator, the industry and other stakeholders.

Therefore, we recommend that efforts to improve the AER's benchmarking analysis and approach to OEFs should not be viewed by DNSPs or the AER as a one-off investment but, rather, as an iterative process that improves gradually the quality of information and analysis available to the regulator, the businesses and consumers as a means of promoting better regulatory outcomes.

Due caution will still be necessary when interpreting benchmarking results

Finally, we note that even if the AER undertakes successfully a significant program of ongoing improvements to its approach to benchmarking and OEFs, along the lines we recommend, there will still be a need to treat its benchmarking results with appropriate caution. This is because it will never be possible to account perfectly for OEFs due to data and methodological limitations. However, this should not deter the AER from embarking on a program to improve significantly its existing approach to OEFs. It is clear to us that with cooperation between the AER, DNSPs and other stakeholders, the usefulness of the AER's economic benchmarking analysis can be enhanced greatly.

1.3 Structure of this report

The remainder of this report is structured as follows.

- In Section 2, we discuss why it is necessary to account for OEFs in economic benchmarking.
- In Section 3, we outline the options for designing a benchmarking methodology that accounts adequately for OEFs.
- In Section 4, we outline why there is a need for extensive further consultation prior to any quantification of OEFs, or the application of benchmarking analysis to set regulatory allowances for DNSPs.
- In Section 5, we summarise the key steps we consider the AER needs to take in order to develop a sound approach to OEFs, for application within its economic benchmarking analysis.

2 Why adjustments for operating environment factors are essential

Since November 2014, the AER has used economic benchmarking to assess the comparative efficiency of the Australian DNSPs. The AER's preferred econometric benchmarking model to date has been a Cobb-Douglas Stochastic Frontier Analysis (SFA CD) model, which estimates the relationship between opex and a small set of explanatory factors. The set of explanatory variables included in the AER's model are:

- customer numbers;
- circuit length;
- ratcheted maximum demand;
- the share of network that is underground;
- a time trend; and
- since the AER's SFA CD model makes use of data from overseas, dummy variables to identify DNSPs from New Zealand and from Ontario.

The AER's annual benchmarking reports and recent decisions present the results derived using other benchmarking techniques including Multilateral Partial Factor Productivity (MPFP) analysis, Multilateral Total Factor Productivity (MTFP) analysis and other econometric techniques. However, in its latest round of regulatory determinations for DNSPs, any efficiency adjustments to revealed base year opex levels were made using benchmarking results derived using the AER's SFA CD model.

The efficiency scores estimated using the SFA CD model, in the 2017 DNSP annual benchmarking report, are presented in Table 1 below. Table 1 shows that the highest efficiency score estimated by the AER is 95.8% and the lowest efficiency score estimated by the AER is 44.6%. The 51.2 percentage point difference between the highest and lowest scores represents a very large spread that, in our view, cannot plausibly be attributed solely to managerial efficiency.

Rather, the difference in efficiency scores is likely to be, to a considerable extent, due to genuine and intrinsic differences in the operating circumstances of the different DNSPs in the sample that are not captured by the set of explanatory variables included in the AER's model.

- In Section 2.1, we discuss the range of factors that might affect perceived differences in performance.
- In Section 2.2, we show that a number of these factors are not accounted for in the AER's preferred econometric benchmarking model.

Table 1: AER's SFA CD efficiency scores: Average over 2006–2016 period

	Efficiency score
ActewAGL	44.8%
AusNet Services	74.8%
Ausgrid	44.6%
CitiPower	89.7%
Endeavour Energy	57.4%
Energex	61.9%
Ergon Energy	51.0%
Essential Energy	**57.5%**
Jemena	70.2%
Powercor	95.8%
SA Power Networks	79.8%
TasNetworks	74.6%
United Energy	84.5%
Highest score	95.8%
Lowest score	44.6%
Spread in efficiency scores	**51.2%**

Source: Economic Insights, Economic Benchmarking Results for the Australian Energy Regulator's 2017 DNSP Benchmarking Report, 31 October 2017, Table 3.6, p. 21.

2.1 Factors affecting differences in performance

No two network businesses are exactly the same. Differences in the operating expenditures incurred by networks can arise from a number of potential sources, including (but not necessarily limited to) differences in:

- core cost drivers (e.g., network scale, demand);
- operating environment (e.g., density, climate, topography, soil properties, vegetation, and the urban/rural nature of certain areas);
- regulatory obligations;
- scope of activities (e.g., sharing of vegetation management roles with local councils);
- input prices (e.g., labour rates);
- cost allocation policies and reporting practices;
- past (legacy) network configuration decisions (e.g., ownership of subtransmission assets, historical choices in the way networks were

constructed) and planning constraints that cannot be altered easily or efficiently within a short period of time; and

- current managerial and operating efficiency.

All of these factors can influence (increase or reduce) a DNSP's actual or reported opex compared to other DNSPs, and therefore its raw efficiency score if not controlled for properly.

However, for the purposes of determining efficiency adjustments in regulatory proceedings, it is only excess cost due to the last type of underlying difference in the above list – genuine **differences in current managerial and operating efficiency** – that should be measured. Differences in measured performance due to the other factors mentioned above should not be used to justify the imposition of efficiency adjustments.

There is, by international standards, an unusually large degree of heterogeneity of circumstance within the Australian sample of DNSPs. We have documented some of the sources of this heterogeneity in a number of past reports.[7]

Given the very large inherent differences in circumstances between DNSPs operating in Australia, it is particularly important that significant effort is made to identify, quantify and control for the relevant OEFs not accounted for by the explanatory variables in the AER's benchmarking models.

2.2 Factors affecting perceived differences in performance not accounted for in the AER's preferred econometric benchmarking model

While the set of explanatory variables included in the AER's econometric benchmarking approaches may reflect some core cost drivers (e.g., customer numbers, circuit length, demand), other factors, such as differences in input costs, operating environment, and past (legacy) network configuration decisions (affected by planning constraints) are not accounted for at all, or not very well, in the AER's SFA CD model, or in the various other benchmarking models it uses (e.g., MPFP, MTFP, or other econometric models).

7 For a discussion of some of the very large differences between DNSPs in Australia, Ontario and New Zealand, see for example: Frontier Economics, *Review of the AER's Econometric Benchmarking Models and Their Application in the Draft Determinations for Networks NSW*, January 2015, Section 3.3. For a discussion of the material differences in operating circumstances between DNSPs in Australia alone, see for example: Frontier Economics, *Taking Account of Heterogeneity Between Networks When Conducting Economic Benchmarking Analysis*, February 2015, Section 2.

Furthermore, the explanatory variables presently included by the AER may reflect some cost drivers, such as network scale and customer or load density, only imperfectly.

It is therefore not possible to say conclusively whether the raw efficiency scores estimated by the AER are explained by:

- differences in current managerial and operating efficiency; or
- any of the other factors outlined above, which are presently unaccounted for.

Box 1 below provides a technical explanation of why this is the case. However, to illustrate more intuitively why it is necessary to control for all relevant factors, consider the following example.

Suppose we are interested in identifying the most effective wing design for a paper aeroplane, where effectiveness is measured by flight distance. We could run an experiment, whereby we test-fly several different designs and measure which design flies the furthest. However, there are several extraneous factors that could affect the flight distance of a paper aeroplane: wind direction and speed; air temperature; humidity; and the weight of the paper used to construct the aeroplane. If we fail to control for differences in these factors between test flights, we could not be sure whether it was the wing design of the aeroplane, or some other factor, that determined the distance that any particular aeroplane flew. As a result, we might erroneously identify an ineffective design as the most efficient one, simply because it happened to fly under more favourable conditions than the design that is inherently most effective.

Box 1: Example of impact of not accounting for OEFs in a benchmarking model

An econometric benchmarking model of operating expenditures attempts to estimate a relationship between opex, factors that affect opex, and managerial inefficiency. These factors consist of both core cost drivers and other factors that affect opex, such as operating environment factors. Let us assume that the true relationship between opex and these factors is the following:

$$\text{Opex} = f(\text{core cost drivers, OEFs}) + \text{residual term}$$

where statistical assumptions are made to split the residual term into inefficiency and an idiosyncratic error term.

However, suppose that we omit the OEFs from our econometric model and we estimate the following relationship:

$$\text{Opex} = f(\text{core cost drivers}) + \text{residual term}$$

As the estimated relationship between opex and factors that affect costs is misspecified by the exclusion of the OEFs, the model cannot fully explain costs. The OEFs will be incorporated into the residual term, which will confound the splitting of the residual term into inefficiency and idiosyncratic error. The estimates of the impact of the core cost drivers on opex will generally also be distorted.

Source: Frontier Economics

By analogy, consider two hypothetical DNSPs that are identical in all possible ways, except one: one DNSP is located in a region subject to frequent storm damage, whilst the other is not. On average, the DNSP operating in the storm-affected region would incur more operating expenditure to conduct maintenance and repairs than its peer. If this OEF – differences in weather events – were not accounted for in the benchmarking analysis, then the former DNSP would be judged incorrectly to be less efficient than the latter, even though both are equally efficient in an operational sense.

A failure to account for differences in OEFs between DNSPs will provide a distorted picture of relative efficiencies by identifying genuine variation in operating conditions as managerial inefficiency. Benchmarking analysis that does not account properly for heterogeneity of circumstances will tend to advantage systematically those networks that operate in particularly favourable circumstances, and disadvantage those networks that operate in particularly unfavourable circumstances. This argument applies not just to the AER's preferred benchmarking model, but to any benchmarking analysis.

The purpose of OEF adjustments, then, is to make DNSPs more comparable to one another, before assessing their efficiency, by removing (or controlling for) differences in factors that drive opex but are unrelated to managerial efficiency. By improving comparability between DNSPs in this way, the estimate of true relative efficiency is improved.

The AER itself recognises that not all the relevant drivers of DNSPs' opex are captured within its benchmarking models, so it is necessary to make adjustments for OEFs. This is evident from the fact that it has sought to make OEFs adjustments in past decisions.

Therefore, we and the AER are in agreement that in order to draw meaningful conclusions from any economic benchmarking analysis, it is essential to account for OEFs. The key question is how best to make the appropriate OEF adjustments. We address this question in the remainder of this report.

Why adjustments for operating environment factors are essential

3 How should OEFs be accounted for in benchmarking analysis?

In this section we summarise a number of different ways in which the AER's benchmarking framework might be modified to account adequately for differences in operating circumstance.

- In Section 3.1 we summarise why the AER/Sapere-Merz *ex-post* OEF approach is problematic.
- In Section 3.2 we recommend a number of alternative approaches that could be considered by the AER.
- In Section 3.3 we compare the advantages and disadvantages of the approaches outlined in Sections 3.1 and 3.2 and outline our recommended approach for the AER.

3.1 The AER/Sapere-Merz *ex-post* OEF approach

In its last round of determinations for the DNSPs, the AER accounted for differences in operating environment by applying *ex-post* OEF adjustments to the comparison efficiency scores obtained from its SFA CD model. The approach the AER took, with particular reference to Essential Energy, is illustrated in Figure 1 below.

The AER's approach involved the following steps:

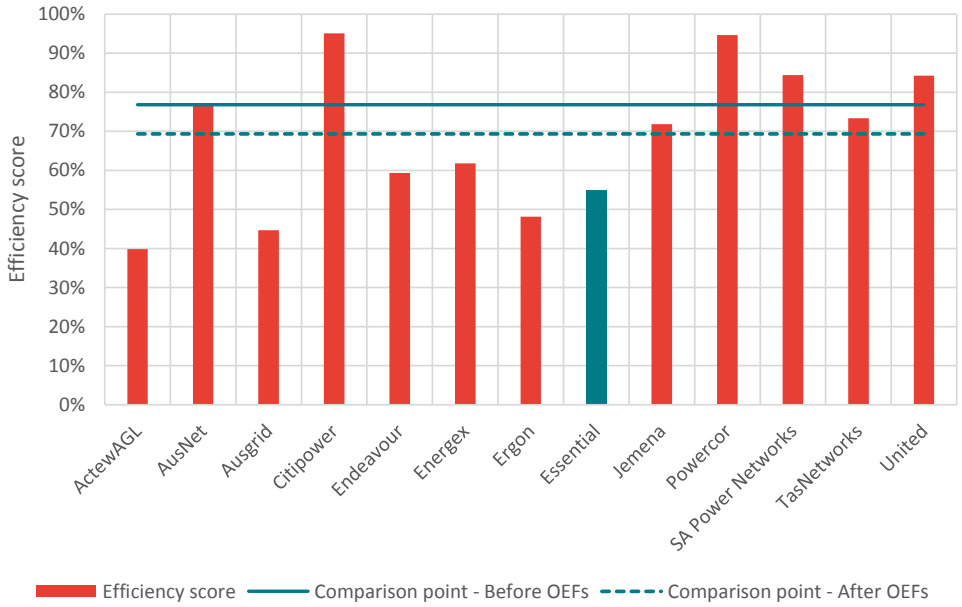
- In step 1, the AER's raw efficiency scores were obtained from its preferred SFA CD model. As can be seen from Figure 1, which presents the raw efficiency scores from the AER's final determination for Essential Energy for 2014-19, Essential Energy's raw efficiency score was 54.9%.
- In step 2, the AER determined the comparison point for each DNSP to be the efficiency score of the top 5th DNSP, which was 76.8%.
- In step 3, the AER provided an adjustment of 10.7% to Essential Energy to account for operating environment factors (OEFs) not accounted for in Economic Insights' SFA CD model.
- In step 4, the comparison point estimated in Step 3 (76.8%) was lowered by the OEF adjustment in Step 3 (10.7%). This was determined by the following formula:

  Comparison point after OEFs = Comparison point before OEFs / (1 + OEF)

  The adjusted comparison point for Essential Energy in the 2014–19 determination was 69.4% as shown below.

  69.4% = 76.8%/(1+10.7%)

Figure 1: Illustration of AER's ex-post OEF adjustments



Source: AER Final Decision Essential Energy Distribution Determination – Essential Energy 2015 – Opex Model – April 2015.xlsm

As can be seen from steps 1 – 4 above, the AER's OEF adjustments were applied *ex-post*, after its raw efficiency scores were estimated, and after the comparison point efficiency score was determined, using the SFA CD model. While the Sapere-Merz OEFs framework differs slightly from the AER's approach described above, it too is based on *ex-post* OEF adjustments.[8]

The key disadvantage of the *ex-post* approach is that the data to which the benchmarking model is applied is not made more comparable between DNSPs before the raw efficiency scores are estimated. As a result, the true relationship between the DNSPs' costs and cost drivers will be distorted by the inclusion of non-comparable opex data.[9] As a consequence the estimates of raw relative efficiency (including the efficiency of the comparison point) will be distorted. *Ex-post* adjustments for OEFs do not address the fact that the true cost relationship

8 Sapere-Merz also consider an alternative approach in which, instead of adjusting the comparison point, an equivalent adjustment is made to the raw efficiency score for each DNSP while leaving the comparison point unchanged. In our view, this alternative approach is preferable to adjusting the comparison point, since the adjusted efficiency scores provide a more like-for-like comparison of the relative efficiencies of the DNSPs. However, this slight difference in approach does not alleviate the more fundamental concern we have about the use of ex-post adjustments.

9 Technically, the omission of relevant explanatory variables leads to inconsistent estimates of the coefficients of the model. As a result, the raw estimates of efficiency will also be biased.

How should OEFs be accounted for in benchmarking analysis?

by the benchmarking model will have been mis-estimated by the inclusion of non-comparable data.

In Section 3.2 we describe a number of alternative approaches that could be considered, which do not suffer from the weakness associated with the application of *ex-post* adjustments discussed above.

3.2 Alternative approaches that could be considered

In principle, the following alternative approaches to making OEF adjustments could be considered.

- Include additional explanatory variables in the benchmarking model to control for differences in OEFs.
- Make *ex-ante* adjustments for OEFs to the data, before those data are applied to the benchmarking model.
- Make second-stage adjustments for OEFs after efficiency scores are estimated.

We discuss each of these options in turn below.

3.2.1 Inclusion of additional explanatory variables in the benchmarking model to control for differences in OEFs

Ideally, regulators would control for *all* the drivers of opex – including all OEFs – within a single econometric benchmarking model.[10] This would entail identifying a variable that measures/proxies each of the relevant OEFs, and then including all those variables as additional explanatory variables in its econometric model.

However, the number of variables that can be feasibly included in a single benchmarking model is limited by the sample size of the dependent variable. The larger the sample size (i.e., the number of DNSPs in the sample, multiplied by the number of years for which data are available), the more 'degrees of freedom' are available to control directly in the model for a large number of OEFs by adding more variables. At the present time, only 143 independent observations of the dependent variable (i.e., opex for each DNSP) are available for the Australian DNSPs.[11] This is a relatively small sample, particularly for an estimation technique such as SFA. However, with the passage of each year, new observations can be added to the sample, increasing the scope to include new explanatory variables. Further, the eventual addition of a 14th DNSP, Power and Water Corporation, to the sample would boost the number of observations.

10 After uncontrollable costs and other costs that are unsuitable for benchmarking are first excluded.

11 10 years of historical data × 13 DNSPs.

Of course, the sample size may be increased substantially, as the AER has done when estimating its SFA CD model, by including within the sample data overseas DNSPs. However, the trade-off is that the ability to control properly for differences in OEFs faced by DNSPs within this expanded sample falls sharply, because the detailed and consistent information required to identify and quantify the OEFs relevant to all the overseas DNSPs may not be readily available.

For the same reason it is inappropriate to ignore relevant OEFs related to the Australian DNSPs, it would be inappropriate to not account for the OEFs of any overseas DNSPs included within the sample. This is because, if the overseas DNSPs face very different operating environments to some Australian DNSPs, then the benchmarking model would interpret those differences in OEFs as inefficiency—unless those OEFs were accounted for in the benchmarking analysis explicitly.

Including overseas DNSPs within the sample used to benchmark Australian DNSPs restricts considerably the OEFs that the AER can account for in a robust and consistent way in its benchmarking model using the data that are readily available to the AER at the present time. Should the AER choose to continue to include the overseas DNSPs in its sample in the future, it would need to collect a considerable amount of additional data (i.e., over and above the data currently available to the AER) on those DNSPs to ensure that they are compared with the Australian DNSPs on a like-for-like basis.

Alternatively, the AER should seek to develop benchmarking models or approaches that rely exclusively on data for Australian DNSPs. This would allow the AER greater flexibility to account for the OEFs necessary to make meaningful comparisons between Australian DNSPs, without undertaking the onerous task of collecting new data on the overseas DNSPs. This approach would also allow the AER greater control over the quality and consistency of the data used to make OEF adjustments because it could concentrate on obtaining reliable data on just the DNSPs it regulates.

As the collection of additional (hitherto unavailable OEF) data on the Ontarian and New Zealand DNSPs is unlikely to be practicable, we recommend that the AER develop new benchmarking models or approaches that exclude the overseas data.

As the exclusion of the overseas sample would lead to a significant reduction in benchmarking sample size, we recommend two alternative approaches for the AER to consider in Sections 3.2.2 and 3.2.3 below. These approaches have been adopted previously by European regulators to account for OEFs.

3.2.2 *Ex-ante* adjustments for OEFs

To the extent that some OEFs cannot be accounted for through the inclusion of additional explanatory variables within the benchmarking model, the AER could

How should OEFs be accounted for in benchmarking analysis?

consider 'normalising' the opex data of the Australian DNSPs to make the opex data more like-for-like across DNSPs.

This would entail excluding from the measure of opex any costs, or legitimate cost variances, associated with each relevant OEF, prior to the estimation of an econometric benchmarking model or alternative benchmarking analysis.

Such *ex-ante* adjustments are commonly adopted by regulators in Europe in order to ensure that the costs that enter the benchmarking exercise are assessed across the DNSPs on a like-for-like basis, while using a small set of cost drivers in the model or analysis, such as those currently used by the AER.

For example, *ex-ante* adjustments are an integral part of Ofgem's benchmarking analysis of the 14 DNSPs in Great Britain. Ofgem has in the past made a wide range of adjustments to its measure of costs in order to ensure it minimises the extent to which differences between DNSPs in costs that are unrelated to efficiency confound its benchmarking results. The evolution of Ofgem's approach is described in detail in our February 2015 report for Ergon Energy.[12]

Ofgem's adjustments are in the form of pre-modelling adjustments to costs to account for differences between DNSPs. As its techniques have evolved, in the light of its own experiences and feedback from the sector and beyond, so have the type and scale of adjustments. Ofgem sought to place more structure on its approach at the start of the DPCR5 price control period, which ran from 2010–15, and developed a set of criteria to determine which costs should be included in its benchmarking models.[13] These principles were reinforced by Ofgem at the start of RIIO-ED1 (2015–23), the latest electricity distribution regulatory control period in Great Britain. For costs to be included in Ofgem's benchmarking exercise, they needed to meet certain criteria:

- The DNSPs should have influence over the cost, and non-controllable costs should be excluded.
- The activity associated with the cost should be undertaken by most of the DNSPs, rather than being geographically specific.
- The costs should be relatively stable, rather than one-off or 'lumpy'.[14]
- The cost should provide appropriate coverage of the operational activities.

12 Frontier Economics, *Taking Account of Heterogeneity Between Networks When Conducting Economic Benchmarking Analysis*, February 2015. See Section 5.1.

13 Ofgem (2009), *Electricity Distribution Price Control Review – Initial Proposals – Allowed Revenue – Cost Assessment*, August, Para 4.27.

14 This criterion prevents anomalous, non-recurring costs that are unlikely to arise again in the near term from distorting the measure of relative efficiency.

- Boundary (cost allocation) issues associated with the costs should be well understood.

In instances where Ofgem identified costs that did not meet all the criteria above, it sought to improve the comparability of the data it used when conducting its benchmarking analysis in two main ways:

- In some cases, Ofgem included these costs in its benchmarking, but only after adjusting the costs to ensure that its comparison across DNSPs was as like-for-like as possible. This was the approach that Ofgem took to non-controllable costs, for example.
- In other cases, Ofgem excluded these costs from its benchmarking analysis altogether, and dealt with them on a case-by-case basis. For example, if one DNSP faced particularly unusual operating circumstances, Ofgem first estimated the costs associated with that OEF and normalised the cost data by removing those OEF-related costs, before estimating its benchmarking model. However, Ofgem recognised that those costs may still be partially or substantially within management control so should be subject to some form of efficiency assessment. Therefore, the efficiency of those OEF-related costs were tested separately (e.g., through bottom-up assessments), rather than through the application of econometric benchmarking analysis.

We recommend that the AER consider this approach of adjusting the opex data for OEFs before estimating its economic benchmarking model. This approach has the following benefits.

- **Benefit relative to the approach described in Section 3.2.1 (including additional explanatory factors variables in the AER's model to control for differences in OEFs).** *Ex-ante* adjustments are feasible even with relatively small samples. As the opex data would be adjusted for OEFs before it enters the econometric benchmarking model, additional explanatory variables would not need to be included in the benchmarking model to account for those OEFs.
- **Benefit relative to approach described in Section 3.1 (the AER/Sapere-Merz ex-post OEFs approach).** The *ex-ante* approach is superior to the *ex-post* approach as it ensures that the DNSPs' costs and relative efficiencies are compared on like-for-like basis. Consequently, the estimated cost relationship will not be distorted by the inclusion of non-comparable data, and the resulting efficiency scores are more likely to be a better estimate of true relative efficiency. Adoption of an *ex-ante* approach to OEFs would bring the AER more in line with overseas regulatory practice, such as Ofgem's approach in Great Britain.

How should OEFs be accounted for in benchmarking analysis?

3.2.3 Second-stage adjustments for OEFs after efficiency scores are estimated

An alternative way of accounting for additional factors that has been suggested in the benchmarking literature would be to apply a two-stage approach. After estimating a benchmarking model, the efficiency scores derived from the benchmarking model are regressed on additional relevant operating environment variables that cannot be incorporated within the benchmarking model (due to the small sample size problem, for example).

The two-stage process is commonly used to adjust for operating environment factors when undertaking efficiency analysis using Data Envelopment Analysis (DEA) or MPFP/MTFP analysis. Coelli et al (2005) provide an explanation of the approach in the context of DEA:[15]

> In the second stage, the efficiency scores from the first stage are regressed upon the environmental variables. The signs of the coefficients of the environmental variables indicate the directions of the influences, and standard hypothesis tests can be used to assess the strength of the relationships. The second–stage regression can be used to "correct" the efficiency scores for environmental factors by using the estimated regression coefficients to adjust all efficiency scores to correspond to a common level of environment (e.g. the sample means).

After assessing a number of other possible approaches for taking into account the impact of operating environment variables, Coelli et al conclude:[16]

> [W]e recommend the two–stage approach in most cases. It has the advantages that:
>
> - it can accommodate more than one variable;
> - it can accommodate both continuous and categorical variables;
> - it does not make prior assumptions regarding the direction of the influence of the environmental variable;
> - one can conduct hypothesis tests to see if the variables have a significant influence upon efficiencies;
> - it is easy to calculate; and
> - the method is simple and therefore transparent.

An example of this approach in a regulatory context is the analysis undertaken by the Norwegian regulator (NVE). In stage one, NVE benchmarks total costs using DEA analysis controlling for eight cost drivers. In the second stage, NVE corrects

15 Coelli et al (2005), *An Introduction to Efficiency and Productivity Analysis (2nd ed)*, Springer, pp 194 - 195.

16 *Ibid.*, p. 195.

these DEA efficiency scores for differences in environmental factors considered to be outside of management control.

An analogous two-stage approach has been adopted by Economic Insights in an international benchmarking study of postal service productivity for Australia Post,[17] the main difference being that Economic Insights used MTFP rather than DEA to determine the efficiency scores in the first stage.

The two-stage approach can also be used when the first stage efficiencies are estimated using stochastic frontier analysis (SFA); see, for example, Kumbhakar and Lovell (2000).[18] This is not often done in practice, since, in most situations, one can incorporate the second stage environmental variables in the first stage SFA model directly (as described in Section 3.2.1), or in the efficiency term in the model.[19]

Whilst this two-stage approach may work well in some circumstances, it is unlikely to be implementable when benchmarking DNSPs in Australia. The AER's benchmarking models produce a single estimate of efficiency for each DNSP. This means, after running the first-stage, the DNSP would have 13 data points (one for each Australian DNSP included in its sample). There are potentially a large number of OEFs that would need to be accounted for. This means the second-stage, which would involve regressing a large number of OEF variables on just 13 data points, is unlikely to produce statistically meaningful results.

The approach is also affected by the fact that the raw efficiency scores estimated in the first stage are likely to be distorted as discussed in Section 3.1.

Whilst the second-stage adjustment approach is an approach used in the academic literature to control for OEFs, for the reasons discussed above, we recommend that this approach not be pursued by the AER.

3.3 The approach we recommend to the AER

In Table 2 below we compare the relative advantages and disadvantages of the different approaches outlined in this section, as potential methods that the AER could use in order to account for OEFs when it benchmarks DNSPs.

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17 Lawrence, D. and J. Fallon (2009), *International Benchmarking of Postal Service Productivity – A Report for Australia Post*, Economic Insights, p.23.

18 Kumbhakar, S. and C. Lovell (2000), *Stochastic Frontier Analysis*, Cambridge U.P., pp. 263 – 264. Kumbhakar and Lovell point out some statistical issues when using the two-stage approach with SFA. However, most of these issues also apply when using DEA or TFP in the first stage.

19 *Ibid.* Section 7.3.

Table 2: Advantages and disadvantages of different approaches that the AER could potentially investigate

	Advantages	Disadvantages
A) The AER/Sapere-Merz *ex-post* OEF approach	Feasible with a small sample	*Ex-post* approach - involves biased raw efficiency scores, as these are estimated *before* OEFs are accounted for Bias not corrected by *ex-post* adjustments
B) Including additional explanatory factors variables in the AER's model to control for differences in OEFs	All factors accounted for within a single model	Unlikely to be feasible due to practical limitations such as small sample size and the potentially large number of OEFs that would need to be controlled for
C) Making *ex-ante* adjustments for OEFs before efficiency scores are estimated	Efficiency scores can be estimated *after* OEFs are removed from costs *ex-ante* Feasible with a small sample	Higher regulatory cost - OEFs that are removed from costs *ex-ante* need to be efficiency tested separately
D) Making second-stage adjustments for OEFs after efficiency scores are estimated	Methodology more systematic and robust than AER's *ex-post* approach	*Ex-post* approach - involves biased raw efficiency scores, as these are estimated *before* OEFs are accounted for Second-stage regressions not practicable with the small number of DNSPs available within the AER's sample

Source: Frontier Economics

As summarised in Table 2, a key disadvantage of the AER/Sapere-Merz ex-post OEF approach, and the approach of making second-stage adjustments is that these are both *ex-post* approaches. Estimated efficiency scores under both approaches are distorted because the estimated relationship between costs and cost drivers used to derive the raw efficiency scores are based on data that cannot be compared on a like-for-like basis between DNSPs. Between the two approaches, in our view second-stage adjustments would be preferable as it accounts in a more systematic way for the relationship between the raw efficiency scores and OEFs, and has been applied more widely in previous studies, as shown in Section 3.2.3, than has the *ex-post* approach used by the AER/Sapere-Merz.

In our view, the ideal approach, in principle, would be to include additional explanatory factors variables in the AER's model to control for differences in OEFs, as discussed in Section 3.2.1. However, controlling for all the drivers of

opex within a single benchmarking model is unlikely to be feasible owing to limited sample size.

Therefore, our recommended approach for the AER is a combination of:

- Investigating the inclusion of some additional cost driver variables in its model, which should become more feasible over time as the sample size increases; and
- Making *ex-ante* adjustments for any costs associated with OEFs that are unexplained, or poorly explained, by the cost driver variables that are included in the model—as Ofgem does.

Second-stage adjustments could be considered as the next available option to account for any additional factors not accounted for through the combination of approaches above. In our view, all three of these approaches are superior to the AER/Sapere-Merz *ex-post* OEF approach.

As discussed in Section 3.2.1, in order to make like-for-like comparisons and avoid bias in the estimation of the raw efficiency scores, the AER would need to consider the OEFs of not only the Australian DNSPs, but also the DNSPs in Ontario and New Zealand that are currently included in the AER's sample. This would involve the collection of additional data on the Ontarian and New Zealand DNSPs. To the extent that this is not practical, or to the extent that the reliability and consistency of the overseas data on the OEFs cannot be assured, we recommend the development of benchmarking models that rely only on Australian data. Once again, this should become more feasible over time as the size of the domestic sample increases.

Importantly, the assessment of efficiency scores and the assessment of OEFs should be seen as part of a single benchmarking framework, rather than as separate exercises. This might require significant modifications to the AER's current approach to benchmarking; it will require the collection of additional data on OEFs, and may require the exclusion of the overseas DNSPs from the AERs sample (if the relevant OEFs for those DNSPs cannot be accounted for appropriately). This suggests the need for extensive further consultation between the AER, the DNSPs and other stakeholders prior to any quantification of OEFs, as discussed in the next section.

How should OEFs be accounted for in benchmarking analysis?

4 Need for extensive further consultation and data collection prior to quantification of OEFs

In Section 3 we discussed a number of alternative options for accounting for OEFs within the AER's economic benchmarking framework.

Designing a benchmarking methodology that accounts adequately for all of the OEFs that are likely to be relevant to DNSPs in Australia is not, in our view, possible with the data currently available to the AER.

When the AER initially started collecting RIN data from the networks for benchmarking purposes, it apparently did not foresee the large role that OEFs would play in the analysis. As a result (and as the AER itself has acknowledged) very little usable data on OEFs has been collected to date.

There are presently two sources of Regulatory Information Notice (RIN) data that are available to the AER.

- Data from the Economic Benchmarking RINs; and
- Data from the Category Analysis RINs.

In this section we discuss some of the limitations of each of these datasets and outline the need to collect further information before any robust assessment of OEFs can be made.

4.1 Data from the Economic Benchmarking RINs

In Table 3.7 of the Economic Benchmarking RINs, the AER collected data on a number of factors – density, terrain and service area – that could in principle be used to quantify OEFs (see Figure 2 below).

We agree that these are important drivers of DNSP costs, and support the AER's efforts to collect these data. However, as we discuss below, the quality/consistency and coverage of the data is presently too poor to use these data to make robust OEF adjustments.

Figure 2: Data on operating environment factors available from the Economic Benchmarking RINs

3.7.1 - DENSITY FACTORS

	Units	(0's) 2015-16
Customer density	Customer / km	4.8
Energy density	MWh/customer	14.0
Demand density	kVA / customer	2.8

3.7.2 - TERRAIN FACTORS

		(0's) 2015-16
Rural proportion	%	77.46%
Urban and CBD vegetation maintenance spans	Number of spans	26,309.5
Rural vegetation maintenance spans	Number of spans	281,637.7
Total vegetation maintenance spans	Number of spans	307,947.2
Total number of spans	Number of spans	1,318,341.0
Average urban and CBD vegetation maintenance span cycle	Years	1.4
Average rural vegetation maintenance span cycle	Years	2.8
Average number of trees per urban and CBD vegetation maintenance span	Trees	2.4
Average number of trees per rural vegetation maintenance span	Trees	3.7
Average number of defects per urban and CBD vegetation maintenance span	Defects	1.4
Average number of defects per rural vegetation maintenance span	Defects	1.3
Tropical proportion	Spans	191,352.0
Standard vehicle access	km	111,752.2
Bushfire risk	Spans	1,021,250.8

3.7.3 - SERVICE AREA FACTORS

		(0's) 2015-16
Route Line length	km	181,699.8

Source: Essential Energy EB RIN data for 2016.

4.1.1 Issues with quality and consistency of the data

We have investigated the quality and consistency of the data reported in the Economic Benchmarking RIN Table 3.7 for the assessment of OEFs in economic benchmarking. To do so, we have plotted the information reported over time and across DNSPs. It is evident from an examination of the information available, that there are inconsistencies (some of them material) in the way different DNSPs report RIN data on these variables. To illustrate the issue, we use the example of data reported on rural proportion (see Table 3 below).

Need for extensive further consultation and data collection prior to quantification of OEFs

Table 3: Rural proportion from Economic Benchmarking RINs - unadjusted

DNSP	Units of measurment	2009	2010	2011	2012	2013	2014	2015	2016
ACT	km	0.21	0.20	0.20	0.21	0.20	0.34	0.36	0.38
AGD	proportion	0.34	0.36	0.38	0.40	0.42	0.41	0.42	0.45
CIT	%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
END	km/%	9,255	9,321	9,419	9,523	9,655	0.34	0.56	0.56
ENX	km	0.42	0.41	0.41	0.40	0.40	0.37	0.37	0.37
ERG	km	0.82	0.82	0.82	0.82	0.82	0.90	0.98	0.98
ESS	km	0.79	0.79	0.79	0.79	0.79	0.85	0.78	0.77
JEN	km	26.73	27.32	27.46	26.78	23.99	0.25	0.26	0.25
PCR	%	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
SAP	%	71.22	71.01	70.88	70.76	70.69	0.74	0.73	0.73
SPD	km	0.95	0.93	0.94	0.95	0.93	0.93	0.94	0.93
TND	km	0.88	0.88	0.88	0.88	0.88	0.91	0.92	0.92
UED	km/%	1,275	1,279	1,277	1,284	1,279	0.17	0.17	0.12

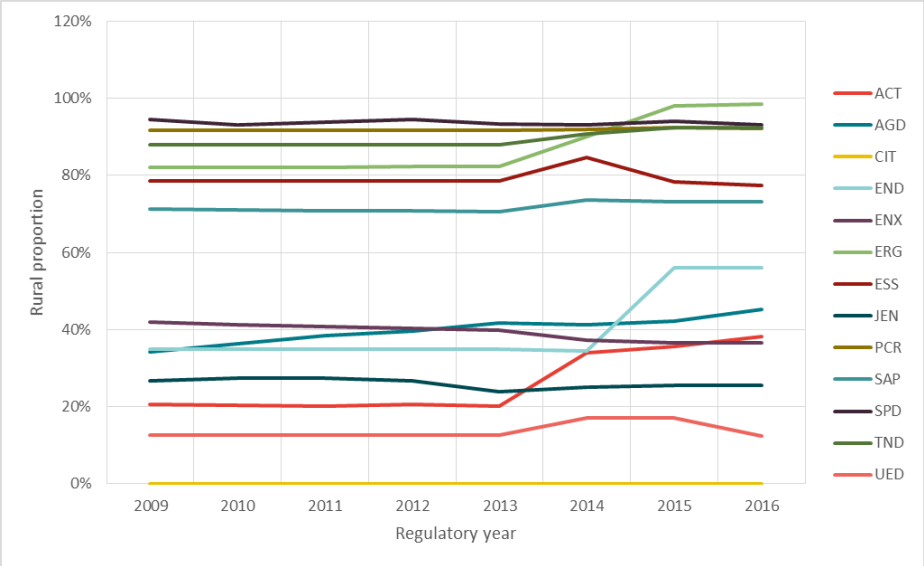
Source: Economic Benchmarking RIN data.Table 3 shows that DNSPs report the rural proportion of their network in various units of measurement, some reporting kilometres, others reporting the proportion of kilometres. It can also be seen that the unit of measurement sometimes changes over time (e.g., the data reported by Endeavour Energy and United Energy). This inconsistency in reported units of measurement limits the ability to compare across DNSPs.

In Figure 3 we illustrate the rural proportion after converting the data to a common unit of measurement. To do this, we had to make certain assumptions about the data reported in the RINs. As the figure shows, after conversion we find for several DNSPs that there are implausibly large changes in the resulting measure of rural proportion over time. The reasons for the large changes shown for some DNSPs are unclear. For example:

- Have the data in some years simply been reported incorrectly?
- Has the DNSP in question reclassified part of its network as rural? If so, was the reclassification justified?
- Has the DNSP misinterpreted the specification of this variable?
- Is there some other explanation for the change?

Need for extensive further consultation and data collection prior to quantification of OEFs

Figure 3: Rural proportion from Economic Benchmarking RINs – adjusted to same unit of measurement



Source: Frontier Economics, Economic Benchmarking RIN data.
Note: As the DNSPs did not use a consistent unit of measurement, some assumptions were required to convert the variable in a common unit.

The analysis above raises questions about the reliability of at least some of the data available in the Economic Benchmarking RINs that could in principle be used to identify and make adjustments for certain OEFs.

In 2014, when Economic Insights attempted to make adjustments for a number of OEFs, it also found that, in a number of instances, the data available were not sufficiently reliable or consistent to be used in economic benchmarking:[20]

> Economic Insights (2013) identified a range of operating environment factors which may impact DNSP efficiency levels. These included a range of network density variables, the extent of undergrounding, climatic factors and terrain measures. The AER economic benchmarking RIN commenced the collection of operating environment data covering density measures, a range of vegetation management measures, climatic variables and network dispersion measures. DNSPs provided complete and consistent data for the network density variables. However, because the other variables are relatively new, DNSPs appear to have interpreted some of the variables in different ways. Because of this, and because these variables were only requested for a shorter period, more refinement and extension of these variables is required before they could be used in economic benchmarking.

Similarly, Sapere-Merz find evidence of inconsistencies in the reported RIN data. For example, when attempting to quantify the required adjustment for differences in jurisdictional taxes and levies. In the process, Sapere-Merz identified that some

[20] Economic Insights, *Economic Benchmarking Assessment of Operating Expenditure for NSW and ACT Electricity DNSPs*, November 2014, p. 14.

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DNSPs had reported zero taxes and levies, and concluded that this was unlikely to be accurate:[21]

> Table 17 below provides a preliminary quantification of a taxes and levies OEF. Note, however, that we consider some of the zero estimates are unlikely to be accurate, for the reasons explained below. Similarly, the reference point may not be accurate.
>
> Our preliminary assessment is this OEF may partly relate to differences in treatment of taxes and levies in RIN returns. This reflects the AER's previous finding that for some DNSPs levies are addressed in annual pricing variations and excluded from historical RIN data. The available RIN data appears to reflect some inconsistencies between DNSPs within jurisdictions where regulations around taxes and levies could be expected to be applied consistently between DNSPs. We suggest there is room for discussion on whether this candidate OEF could be addressed in part by more consistent treatment of taxes and levies in RIN returns.

In our view, these examples point to the need for much clearer guidance on precisely how data—intended for the identification and quantification of OEFs—should be reported, as well as the need for ongoing monitoring/testing of the data by AER in order to check for consistency and errors.

4.1.2 Gaps in information

We also note that there are, at present, gaps in the Economic Benchmarking RIN data that means certain OEFs cannot be quantified reliably without further data collection and testing.

By way of example, Sapere-Merz concluded that there was insufficient reliable data at the present time in the Economic Benchmarking RIN data to quantify an OEF adjustment related to vegetation management—as denoted by the 'Nil' entries in Table 4 below (reproduced from the Sapere-Merz report)—even though vegetation management is likely to represent a material OEF. For example, Sapere-Merz note that:[22]

> 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.
>
> …
>
> No quantification of a candidate vegetation management OEF candidate (or set of OEF candidates) has been able to be estimated at this time.

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21 Sapere-Merz, *Independent review of Operating Environment Factors Used to Adjust Efficient Operating Expenditure for Economic Benchmarking*, December 2017, p. 45.

22 *Ibid.*, p. ix.

Need for extensive further consultation and data collection prior to quantification of OEFs

…

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 in the future…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.

Table 4: Sapere-Merz summary of preliminary findings on OEF adjustments

DNSP	actewAGL	Cyclones	Extreme weather storms	OH&S regulations	Sub-transmission (Licence conditions)	Taxes and levies	Termite exposure	Vegetation Management	Total
ActewAGL	$3,555	NA	$0	$5.2	$510	Nil	$0	Nil	$4,071
Ausgrid	NA	NA	$2	$1.8	$23,728	Nil	-$205	Nil	$23,200
Citipower	NA	NA	$0	-$0.6	$1,914	$643	-$41	Nil	$2,516
Endeavour	NA	NA	$2,321	$3.5	$15,436	Nil	$517	Nil	$18,278
Energex	NA	NA	$3,081	$2.5	$18,200	$7,932	$1,014	Nil	$30,229
Ergon	NA	$12,828	$755	$3.2	$9,482	Nil	$2,684	Nil	$25,752
Essential	NA	NA	$354	$2.7	$10,271	Nil	$2,713	Nil	$13,341
Jemena	NA	NA	$2	-$0.7	-$186	$718	-$56	Nil	$476
Powercor	NA	NA	$0	-$1.9	-$1,660	$1,086	$330	Nil	-$245
SAPN	NA	NA	$0	$3.1	$373	Nil	-$271	Nil	$105
Ausnet	NA	NA	$0	-$2.1	-$2,347	Nil	$49	Nil	-$2,300
TasNetworks	NA	NA	$192	$5.0	-$1,425	Nil	-$68	Nil	-$1,296
United Energy	NA	NA	$0	-$1.2	$406	Nil	-$60	Nil	$345

Source: Sapere-Merz, Independent review of Operating Environment Factors Used to Adjust Efficient Operating Expenditure for Economic Benchmarking, December 2017, Table 2, p. 4.

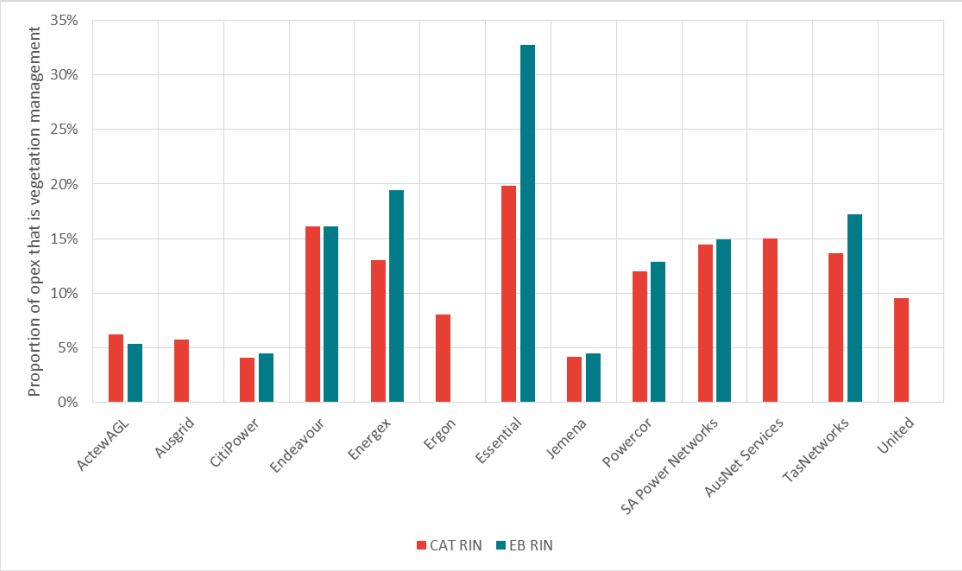
4.2 Data from the Category Analysis RINs

The Category Analysis RIN data includes information on a large number of variables. However, the quality of the Category Analysis RIN data is generally poorer than the quality of the Economic Benchmarking RINs.

Below we illustrate some issues with the reporting of information of vegetation management costs. Figure 4 compares the proportion of total opex that is vegetation management opex, as reported in both the Economic Benchmarking and Category Analysis RINs. We compare the information reported by all DNSPs in the most recent year in both templates.

Need for extensive further consultation and data collection prior to quantification of OEFs

Figure 4: Comparison of proportion of total opex due to vegetation management as reported in Economic Benchmarking RIN data and Category Analysis RIN data



Source: Frontier Economics analysis of Economic Benchmarking RIN data and Category Analysis RIN data for calendar year 2016 (for the Victorian DNSPs) and financial year 2015/2016 for the remaining DNSPs.

It is clear from Figure 4 that, for some DNSPs, vegetation management expenditures represent a large proportion of opex. For example, Essential Energy's vegetation management costs contribute over 30% to its opex as reported in the Economic Benchmarking RINs. As these expenditures are driven by OEFs that are largely outside of the control of the DNSPs, it would be important to account for them in the AER's benchmarking. However, there are clearly a number of issues with the how this information is reported in the RINs.

- **Vegetation management costs are not reported by all DNSPs in the Economic Benchmarking RIN data.** The businesses are not required to report vegetation management costs as a separate category in the Economic Benchmarking RINs. For those businesses that do report these costs, a number of different naming conventions are adopted. For example, vegetation management related expenditures are reported under the following different headings: 'Vegetation', 'Vegetation Control', and 'Vegetation Management'. It is unclear if the definition of vegetation management adopted is consistent across DNSPs and over time.
- **Vegetation management costs reported in the Category Analysis RIN data are unlikely to be comparable across DNSPs** as there are no clear guidelines on how vegetation management costs should reported in the Category Analysis RINs, including how expenses should be allocated between overheads and direct vegetation management costs.

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- **Vegetation management costs are not reported consistently between the Economic Benchmarking RIN and the Category Analysis RIN.** The considerable differences between vegetation management costs reported in the Economic Benchmarking RIN and in the Category Analysis RIN suggests that there is little consistency in how this cost category is being reported by different businesses, and that the data cannot be relied on at the present time to quantify a vegetation management OEF.

We have used vegetation management as just one example to illustrate how data on a potentially important OEF are currently not available or sufficiently reliable to use for the purposes of quantifying robust OEF adjustments. This points to the need for:

- Much greater clarity in the guidance issued by the AER on how data necessary for the quantification of important OEFs should be reported; and
- A collaborative and ongoing process between the AER and the DNSPs to ensure that the required data is collected properly, tested and verified.

By contrast to the situation in Australia, regulators in Europe (and in particular Great Britain) issue detailed guidelines for the reporting of costs, specifying exactly how to allocate costs between opex and capex, and exactly which costs are controllable and uncontrollable (and therefore included or excluded from the benchmarking of controllable opex). Ofgem issues clear and detailed regulatory reporting guidelines to the DNSPs in Great Britain.

The degree of detail in Ofgem's definition of each cost category for cost reporting is illustrated using the example of Ofgem's definition of tree cutting costs summarised in

Table 5 below.

The inclusions and exclusions associated with the reporting of tree cutting, as identified by Ofgem, are informative and revealing, as they provide an indication of the kinds of discrepancy in reporting practice that may have been present during the initial stage of regulatory reporting in Great Britain (and may also be so in Australia), and which have been identified and resolved through experience and iteration.

The AER's regulatory reporting guidance is far less detailed and prescriptive than that published by Ofgem. Whilst we commend the AER for going through the process of developing RIN templates, when set against Ofgem's experience, it is clear that the RIN data collected so far is not yet in a mature enough state to enable credible quantification of a number of relevant OEFs.

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Table 5: Ofgem's definition of tree cutting in the UK

Includes…	Excludes…
The felling or trimming of vegetation as part of a Capital Scheme	General inspection costs relating to wires that are subject to vegetation and not performed solely as part of a tree cutting contract or to ensure vegetation has been cut appropriately (include under Inspections & Maintenance)
The felling or trimming of vegetation to meet ESQCR requirements	Costs of assessing and reviewing the tree cutting policy (include under Network Policy)
The inspection of vegetation cut for the sole purpose of ensuring the work has been undertaken in an appropriate manner	Data collection and manipulation relating to vegetation (include under Network Design & Engineering)
Inspection of tree-affected spans where included as part of a tree cutting contract.	The cost of managing the tree cutting contract, except as stated under included costs
	The cost of procuring the tree cutting contract except as stated under included costs (include under Finance & Regulation)

Source: Ofgem Price Control Reporting Rules: Instructions and Guidance; RF 58/10.

4.3 Need to collect further information before any assessment of OEFs can robustly be made

We have not had the opportunity to undertake an exhaustive audit of the RIN data on OEFs within the very limited time available to prepare this report. However, it is clear from the reported data on a number of variables – e.g., the number of poles, number of spans, and vegetation management costs – that significant problems of comparability exist, across DNSPs, across time and across templates.

It appears that the AER's processes for checking the RIN data on operating environment factors, and resolving any potential inconsistencies in the data reported by the DNSPs, are not yet well developed. The processes of verifying the accuracy and consistency of data intended for benchmarking purposes needs to be careful, unrushed and undertaken collaboratively between the AER, the industry and other stakeholders. Because the robustness of benchmarking analyses is so dependent on the quality and consistency of the data used, unless a careful and considered due diligence process is undertaken, it is difficult to be confident in the benchmarking results.

The challenges involved in the preparation by DNSPs of data for benchmarking – and the amount of work that is required to create a consistent dataset – should be acknowledged in the AER's consultation process on OEFs and benchmarking.

Need for extensive further consultation and data collection prior to quantification of OEFs

5 Our recommended process for developing a suitable approach to OEFs

The AER has committed to an ongoing program to review and refine its benchmarking methodology and data, and has stated that a review of its approach to OEFs is an important part of that program.[23]

Whilst the AER has initiated a consultation process on its approach to OEFs, it appears that the current review is premised on the idea that only incremental improvements to the AER's existing OEF approach are necessary. For example, the analysis conducted by Sapere-Merz:

- Adopts the AER's existing approach of conducting *ex-post* OEF adjustments without considering whether this is appropriate, or whether alternative approaches (such as those investigated in section 3 of this report) would be preferable.
- Is restricted to only those OEFs considered by the AER in recent decisions. However, in its most recent decisions, the AER has considered OEF adjustments for only *some* DNSPs. Therefore, the OEFs that Sapere-Merz has focussed on do not necessarily represent the full list of all OEFs that ought to be considered.
- Adopts the AER's criteria for selecting the OEFs that qualify for adjustment without considering whether those criteria are appropriate.[24] These criteria are: "exogeneity", "materiality" and "duplication".
- Makes use of only the data that are currently available, when attempting to quantify individual OEFs, even though Sapere-Merz expressed reservations about the quality and reliability of some of these data.

As explained in the earlier sections of this report, unless OEFs are accounted for properly when conducting economic benchmarking, the benchmarking results can be distorted greatly, resulting in erroneous conclusions about the relative efficiency of different DNSPs. Such distortions are potentially very large in a country such as Australia, where the DNSPs being benchmarked face very different operating circumstances in many dimensions.

Given the scope for very material errors to arise from the use of an insufficiently robust approach to OEFs, in our view the AER should embark on a much more

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23 AER, *Annual Benchmarking Report – Electricity Distribution Network Service Providers*, November 2017, Section 2.4.

24 Sapere-Merz, *Independent Review of Operating Environment Factors Used to Adjust Efficient Operating Expenditure for Economic Benchmarking*, December 2017, section 2.2.3.

fundamental reconsideration of its approach to OEFs than is the subject of the present consultation.

In this section we explain the key steps we consider the AER should undertake in order to develop a more robust approach to OEFs.

5.1 Identification of relevant OEFs

5.1.1 Materiality

Sapere-Merz has only investigated in its report those OEFs that the AER has considered in a number of recent decisions. Further, Sapere-Merz adopts the "materiality" criterion used by the AER for identifying material OEFs and, consequently, Sapere-Merz accepts the AER's list of material OEFs for the Queensland, NSW and ACT DNSPs as the starting point for its work. In other words, if an OEF was deemed in a recent decision by the AER to be material for at least one of the Queensland, NSW or ACT DNSPs, that OEF is treated by Sapere-Merz as material for the purposes of its analysis.

In our view, there are a number of problems with this approach:

- Firstly, neither the AER nor Sapere-Merz have evaluated the OEFs that might be relevant or unique to DNSPs in Victoria, South Australia, Tasmania or the Northern Territory. Therefore, the OEFs identified by Sapere-Merz as being material do not necessarily represent all of the OEFs that the AER ought to account for when conducting its benchmarking analysis. Accounting for the genuine OEFs of some DNSPs, and not others, would introduce its own distortions into the benchmarking analysis by eliminating cost advantages/ disadvantages of some DNSPs while leaving in place cost advantages/ disadvantages faced by other DNSPs.
- Secondly, the process used by the AER to assess the materiality of individual OEFs has been challenged recently through an appeal process. In light of the outcome of that appeal decision (and the upholding of that decision by the Full Federal Court), it would seem appropriate for more work to be conducted to develop an appropriate process for determining the materiality of individual OEFs.
- Thirdly, Sapere-Merz has not considered a long list of "immaterial" OEFs that the AER accounted for in some recent decisions. Even if each of these OEFs is not material on its own, they may collectively exert a material influence. The question of how to treat the joint impact of a large number of such OEFs has not been resolved. In addition, the analysis by Sapere-Merz has not resolved how to deal with OEFs that are difficult to quantify reliably or those that are directionally-ambiguous.

- Finally, whether or not an OEF meets the AER's materiality criterion can only be determined *after* the impact of the OEF is quantified. In the past the AER seems to have made this decision prior to quantification.

5.1.2 Exogeneity

One of the three criteria used by the AER to select OEFs that are to be adjusted for in its benchmarking analysis is "exogeneity" – namely, that "an OEF should be outside the control of service providers' management."[25]

In the AER's latest annual benchmarking report, it defines OEFs as follows:[26]

> Operating environment factors are factors beyond a DNSP's control that can affect its costs and benchmarking performance.

Whilst we agree that factors that are beyond a DNSP's control should be accounted for through OEF adjustments in the benchmarking analysis, we consider that the AER's current definition of OEFs is too narrow because it would exclude factors that DNSPs have some influence over, that ought to be controlled for within the benchmarking analysis, but are not accounted for within the benchmarking model.

In our view, the AER should account for any factor that affects opex that is:

- Unexplained (or explained poorly) by the available cost drivers in the benchmarking model;
- Unique to only one DNSP, or relevant to only some DNSPs;
- One-off or atypical;
- Driven by differences in cost allocation principles between companies; and
- Large and uncontrollable.

Only the last of these factors relates to costs that are exogenous and therefore beyond the control of the DNSP.

Expenditures should be normalised for the first four types of factors in order to ensure that like-for-like comparisons can be made between DNSPs through the benchmarking analysis. Note that this does *not* mean that costs related to those factors should simply be passed through to consumers. To the extent that DNSPs have influence over these costs, they should be efficiency-tested by means other than the benchmarking model. (As discussed in Section 2, this is the approach adopted by other regulators overseas, such as Ofgem.) We simply mean that these

25 AER, *Ausgrid Distribution Determination 2015−16 to 2018−19*, April 2015, Attachment 7, p. 180.

26 AER, *Annual Benchmarking Report – Electricity Distribution Network Service Providers*, November 2017, p. 5.

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costs should be excluded from the benchmarking analysis so as to not distort the measurement of relative efficiency by the inclusion of non-comparable data.

We therefore recommend that the AER broaden its definition of OEFs to include *any factor that affects the opex of a DNSP that is not accounted for within its benchmarking model.*

Clearly, the factors not accounted for in the AER's benchmarking models will depend on *how* those models are specified. The AER itself has indicated that more work needs to be done to improve its benchmarking models and techniques. Therefore, the question of what OEFs should be quantified and adjusted for cannot be divorced from the process of reviewing and improving the AER's benchmarking models – these two things need to occur together.

The AER would also need to:

- Make clear that any costs relating to OEFs that are within a DNSP's control will be subject to efficiency testing through other means; and
- Set out in advance the process it would follow to efficiency-test the costs associated with controllable OEFs that have been excluded from the benchmarking analysis.

5.1.3 Need for further consultation on how relevant OEFs should be identified

We recommend that the AER start by consulting afresh on:

- The list of OEFs it should potentially account for when benchmarking DNSPs. In our view, any such consultation should:
  - set aside past decisions the AER has made about the relevance or materiality of individual OEFs and begin with a blank slate;
  - consider the potential OEFs relevant to *all* DNSPs rather than just a subset of DNSPs; and
  - take account any changes to the specification of the AER's benchmarking model because the OEF adjustments the AER makes should reflect factors that influence DNSPs' opex that are not already accounted for within its benchmarking model.
- The criteria that should be used to select the most relevant or material OEFs; and
- How immaterial OEFs, or OEFs that cannot be quantified reliably, should be accounted for within the benchmarking analysis. These are undoubtedly challenging issues to address. One option would be to recognise that, since it is difficult to account for such factors properly within the benchmarking analysis, this adds to the uncertainty of the benchmarking results, so less weight

should be placed by the AER on the empirical estimates of relative efficiency, particularly when setting regulatory allowances.

Given the complexity and importance of identifying the relevant OEFs for use within the AER's benchmarking analysis, it is unlikely that this consultation can be concluded within a few short months. In the interest of developing a sound approach that all stakeholders can have confidence in, we recommend that the AER take the time necessary to consult fully and comprehensively with all stakeholders on this issue.

5.2 Development of a methodology for quantifying OEFs

Once agreement has been reached on the most important OEFs, a process will be required to decide how each of those OEFs should be quantified in a systematic and reliable manner.

The range of OEFs that could be relevant may be quite varied in nature, in which case there will not be a 'standard' approach that can be used to quantify all (or even some) OEFs. It is more likely that the quantification of each OEF will require a bespoke calculation.

The process for agreeing how each OEF should be quantified would entail:

- Developing an appropriate methodology for quantification of each OEF;
- Identifying the data required to apply each method; and
- Agreeing on the sources of data that should be used. Whilst DNSPs may be best placed to provide certain data, it may be more practical or cost-effective to obtain the relevant data from reliable third-party sources—in which case it would not be necessary for DNSPs to report these data. Additionally, there may be multiple sources providing data on the same variables. In these circumstances, it may be necessary to select which source or sources are most reliable.

Each of these steps is non-trivial so should not be rushed. Rather, the AER should consult with stakeholders on each of these steps. The development of methodologies to quantify individual OEFs could be facilitated through collaborative working groups comprised of experts from the AER, DNSPs and consumer groups.

At this point, it will be essential to consider whether, and to what extent, data on overseas DNSPs should be used to undertake the benchmarking analysis. The AER currently uses data on DNSPs in New Zealand and Ontario to estimate its SFA CD model. In just the same way that it is important to control for the OEFs faced by the Australian DNSPs, it is necessary to control for the OEFs faced by all the overseas DNSPs included within the benchmarking sample. Failure to do

Our recommended process for developing a suitable approach to OEFs

so could result in inherent differences in the operating circumstances of the Australian and overseas DNSPs being identified incorrectly as inefficiency, thereby distorting the benchmarking analysis.

However, identification of the OEFs, and then the collection of consistent and reliable data for overseas DNSPs necessary to adjust for those OEFs, is likely to be a complex and ultimately infeasible task, given that there would be no requirement for the overseas DNSPs to respond to the AER's information requests. As such, the AER would be limited to using any OEF data already collected and published by the regulators in those two jurisdictions, and the AER would have little control over the scope or quality of those data. The task would become even more infeasible if the AER were to include additional jurisdictions in order to capture businesses that are more comparable to the Australian DNSPs than those in the current international sample.

To avoid all these difficulties, we recommend that the AER develop benchmarking models and techniques that rely exclusively on Australian data.[27] Each year, the size of the domestic sample grows, and the addition of a 14th DNSP, Power and Water Corporation, to the sample would also boost the number of observations. Therefore, it will gradually become easier for the AER to rely only on Australian data to conduct its benchmarking analysis.

5.3 Collection and testing of data on OEFs

The benchmarking analysis undertaken by the AER will only be as reliable as the data used to undertake the analysis. Unless the data are reliable, it will not be possible to discern whether the differences in measured performance between DNSPs are due to true differences in efficiency or simply due to reporting errors or inconsistencies. Therefore, careful attention should be given to the reliability of the data used in the benchmarking analysis – including the data used to quantify and adjust for OEFs.

In its report, Sapere-Merz raises reservations about the completeness, quality or consistency of some of the data presently available to the AER.[28] Sapere-Merz also relies on Category Analysis RIN data to quantify some OEFs.[29] As explained in Section 4 of this report, the lack of guidance on how data in the Category Analysis

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27 This underscores the need for further review and improvement of the AER's benchmarking models and development of a workable approach to OEFs to occur as part of a single work program rather than through separate, parallel programs that do not intersect.

28 For example, Sapere-Merz recommends that improvements be made to the data used to quantify OEFs related to subtransmission assets, termite exposure, severe storms, taxes and levies, and vegetation management.

29 For example, subtransmission assets and termite exposure.

RIN are to be reported means that these data are often not reported consistently across DNSPs (and in some cases, over time by the same DNSP).

In order to ensure that the data used for the quantification of OEFs is as reliable as possible, we recommend that the AER:

- Develop in consultation with stakeholders detailed guidance on the definition of each of the variables to be collected. This would ensure that any data to be obtained from DNSPs is reported as consistently as possible. These definitions would need to be reviewed periodically to ensure that they are sufficiently clear and fit-for-purpose. If data definitions are revised, it would be necessary for the AER to adjust (with assistance and input from the relevant DNSPs) any historical data so that data over time are measured on as comparable a basis as possible.
- Develop standardised data templates for the collection of required OEF data. These templates could be incorporated within the Economic Benchmarking RIN templates so that all the data to be used for economic benchmarking purposes are available from one source. If data are to be obtained from independent third-party sources, the AER could consider obtaining and publishing these data in standard data tables. This would promote transparency and consistency, since all stakeholders would have access to the same data.
- Undertake regular verification of the reported data to identify and address any recording errors or inconsistencies. This verification could involve, among other techniques, trend analysis (to identify any anomalous changes that may be indicative of reporting errors) and regular discussions between AER staff and individual DNSPs to understand how the data have been reported. Once the AER has completed its verification exercise, it could issue a brief determination notice that confirms its satisfaction with the data, or instructions to the DNSPs to revise and resubmit any erroneous data.

The process of data collection and testing should, in our view, be both collaborative and iterative. This would afford DNSPs an opportunity to understand more clearly the information the AER is seeking. Further, regular discussions between the AER and the DNSPs about how the data have been reported would:

- Help the AER to identify early any potential inconsistencies in how data are being reported between DNSPs or over time; and
- Provide the AER with valuable opportunities to learn more about individual businesses and their operations, which would aid its regulatory determinations and its interpretation of the quantitative benchmarking analysis.

Our recommended process for developing a suitable approach to OEFs

5.4 Consultation on benchmarking methodology that most appropriately accounts for OEFs

Next, the AER should consult on the most appropriate method for adjusting for OEFs.

As explained in section 3, a major weakness with the AER's existing *ex-post* approach is that the raw efficiency scores are estimated using non-comparable data (i.e., data that have not been corrected or controlled for differences in OEFs between the DNSPs). This will tend to distort the estimated relationship between opex and the associated cost drivers, and the resulting efficiency raw efficiency scores for individual DNSPs will be mis-estimated. The larger the differences in OEFs between DNSPs, the larger will be these estimation errors. *Ex-post* adjustments of the kind applied by the AER in some of its most recent regulatory decisions do not address this problem.

To avoid this problem, we recommend that the AER:

- Explore the possibility of adding further explanatory variables to the benchmarking model as a way of accounting for important OEFs. This should become more feasible over time as the sample size expands; and
- The AER normalise the opex data, on an *ex-ante* basis, to account for any OEFs that cannot be controlled for by adding new explanatory variables to the benchmarking model. This would entail subtracting from the measure of opex being benchmarked any OEF-related costs not controlled for directly in the model.

5.5 Iterative and incremental improvement

The AER's efforts to consult on its OEF approach, and its stated intention to make ongoing improvements to its benchmarking methodology, are both encouraging and welcome. Our experience with regulatory regimes in other jurisdictions is that even regulators with extensive experience in conducting economic benchmarking make continual, incremental improvements by assessing periodically the techniques used for benchmarking, and refining the consistency and quality of the data.

We observe that this process occurs best through constructive and ongoing engagement between the regulator, the industry and other stakeholders.

Therefore, we recommend that efforts to improve the AER's benchmarking analysis and approach to OEFs should not be viewed by DNSPs or the AER as a one-off investment but, rather, an iterative process that improves gradually the quality of information and analysis available to the regulator, the businesses and consumers as a means of promoting better regulatory outcomes.

Our recommended process for developing a suitable approach to OEFs

5.6 Due caution when interpreting benchmarking results

Finally, we note that even if the AER undertakes successfully a major exercise to improve its approach to OEFs along the lines outlined above, there will still be a need to treat its benchmarking results with due caution. This is because:

- It may be impossible to adjust for all OEFs, either because there may be too many to account for systematically (e.g., the very many 'immaterial' OEFs considered by the AER), or because some may be difficult to quantify reliably;
- There are always likely to be limitations with the data used to quantify the OEFs (e.g., due to human error in reporting, or because perfect consistency across DNSPs and over time is difficult to achieve, or because the ideal data needed are not available); and
- Even those variables that can be accounted for directly within the benchmarking model may be imperfect measures of a DNSP's true cost drivers. For example, all the varied dimensions of network scale and density that affect a DNSP's costs are difficult to capture adequately through a few simple variables.

Therefore, in our view, the AER should recognise that undertaking a significant program of ongoing improvements to its approach to benchmarking and OEFs does not obviate the need for caution when interpreting its benchmarking results.

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