Annual Benchmarking Report

Electricity distribution network service providers

November 2020

AUSTRALIAN ENERGY REGULATOR

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Executive Summary

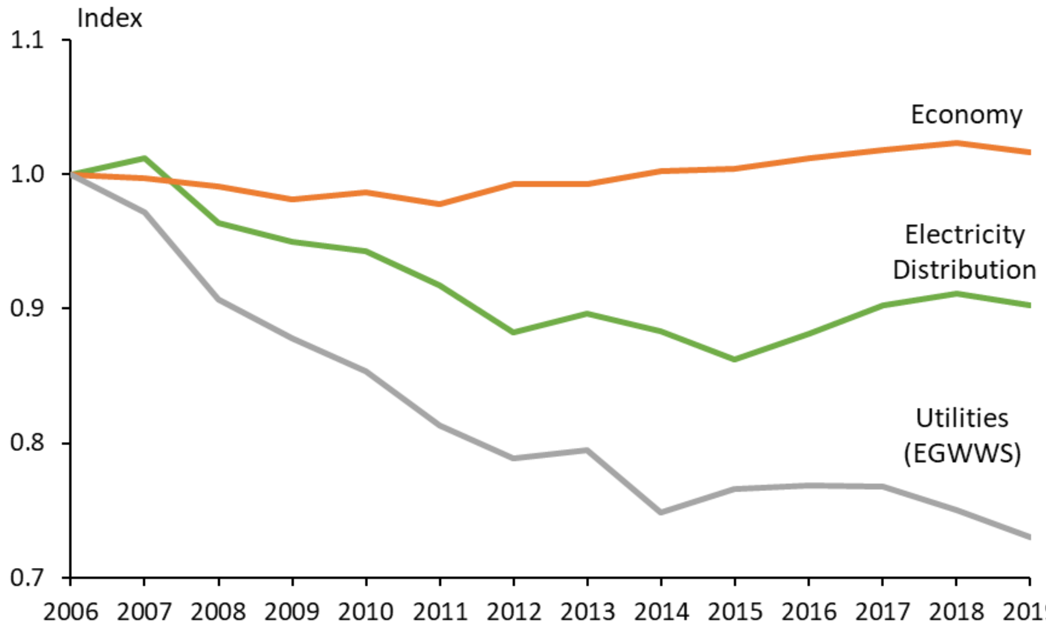
We report annually on the productivity growth and efficiency of distribution network service providers (DNSPs), individually and as an industry as a whole, in the National Electricity Market (NEM). These service providers operate transformers, poles and wires to deliver electricity from the transmission network to residential and business customers. Distribution network costs typically account for between 30 and 40 per cent of what customers pay for their electricity (with the remainder covering generation costs, transmission and retailing, as well as regulatory programs).

We use economic benchmarking to measure how productively efficient these networks are at delivering electricity distribution services over time and compared with their peers. Where distribution networks become more efficient, customers should benefit through downward pressure on network charges and customer bills. We draw on this analysis when setting the maximum revenues networks can recover from customers.

Distribution network industry productivity has declined in 2019 following improvement over three consecutive years

Electricity distribution productivity as measured by total factor productivity (TFP) decreased by 1 per cent over the 12 months to 2019 after improving over the three years from 2015. The decrease in distribution network productivity in 2019 is primarily due to lower network reliability. The decrease is consistent with lower productivity growth for the overall economy and the utility sector (electricity, gas, water and waste services (EGWWS)) over the same period.

Figure 1 Electricity distribution, utility sector, and economy productivity, 2006–19

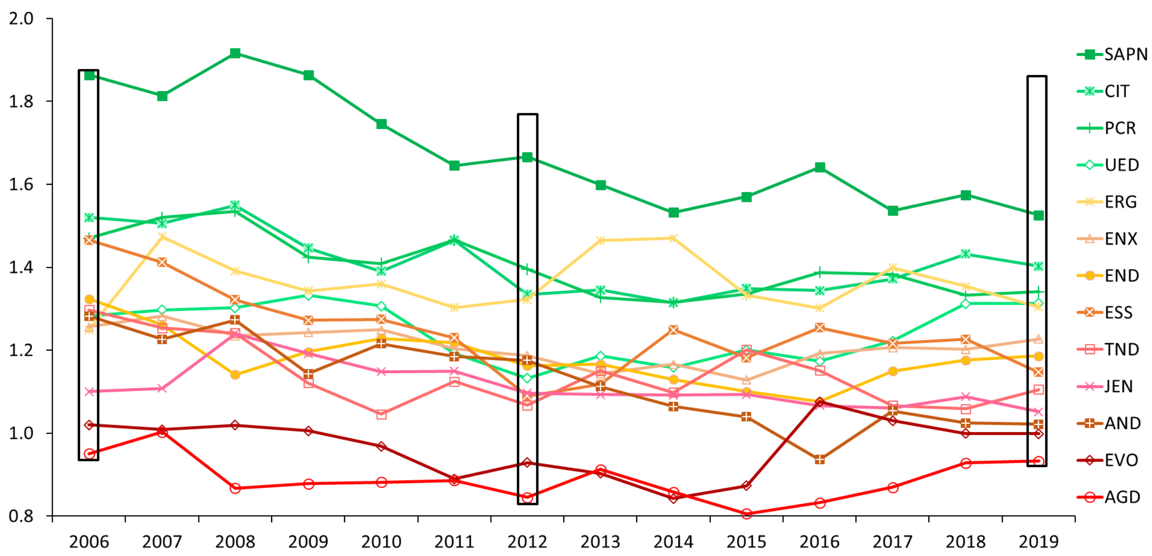


Changes in DNSP productivity over 2019

Over the 12 months to 2019, six of the 13 DNSPs improved their productivity as measured by multilateral total factor productivity (MTFP). TasNetworks and Energex increased their productivity the most, by 4.4 per cent and 2.1 per cent respectively. Endeavour Energy, Powercor, Ausgrid and United Energy also increased their productivity, but by less than one per cent. Increased opex productivity was generally the main source of these productivity improvements.

Over the same period seven DNSPs became less productive in terms of their MTFP results. Essential Energy (6.8 per cent), Ergon Energy (3.8 per cent), Jemena (3.4 per cent), SA Power Networks (3.2 per cent) and CitiPower (2.1 per cent) experienced notable decreases in productivity. The productivity of AusNet and Evoenergy also decreased but by less than one per cent. Decreased opex productivity and reliability were generally the main sources of the lower productivity of these DNSPs.

Figure 2 Electricity distribution MTFP indexes by DNSP, 2006–2019



DNSP productivity levels have converged over time

Since 2006 there has been some convergence in the productivity levels of DNSPs as measured by MTFP. This can be seen from the three equal-sized black columns placed in 2006, 2012 and 2019 in Figure 2. This reflects a number of factors, including:

- Those DNSPs which have been the least productive over time have been improving their performance since 2012. In particular, Ausgrid and Evoenergy have increased their overall productivity, largely as a result of improvements in opex efficiency levels.
- Several middle-ranked DNSPs have also improved their relative MTFP performance to be closer to the top-ranked DNSPs. In recent years this includes

United Energy, Endeavour Energy and Energex, again reflecting improved opex efficiency.

- Further, while Powercor, SA Power Networks and CitiPower have consistently been the most productive DNSPs in the NEM as measured by MTFP they have also experienced a gradual decline in productivity. As a result, relatively their productivity is now much closer to the DNSPs that are middle-ranked.

Updates in this year's report

We operate an ongoing transparent program to review and incrementally refine elements of the benchmarking methodology and data. The TFP and MTFP indexes presented in this report reflect three revisions to the methodology we use to measure productivity. As a result, the past year's results for these indexes differ from the TFP and MTFP results reported in our previous annual benchmarking reports.

The most substantive update applied this year relates to the weights that are used to aggregate the non–reliability outputs in the productivity equation. These weights were changed because an error was identified in the way they were determined in previous reports which impacted the benchmarking results. All of the TFP and MTFP results presented in this report (including the historical time series results) reflect the corrected output weights. The remaining updates applied this year relate to adopting the most up-to-date data estimates (e.g. AER's value of customer reliability (VCR) estimates) and refining the indexing approach for TFP.

Contents

1 Our benchmarking report

The National Electricity Rules (NER) require the AER to publish benchmarking results in an annual benchmarking report.[1] This is our seventh benchmarking report for distribution network service providers (DNSPs). This report is informed by expert advice provided by Economic Insights.[2]

National Electricity Rules reporting requirement

6.27 Annual Benchmarking Report

(a) The AER must prepare and publish a network service provider performance report (an annual benchmarking report) the purpose of which is to describe, in reasonably plain language, the relative efficiency of each Distribution Network Service Provider in providing direct control services over a 12 month period.

Productivity benchmarking is a quantitative or data driven approach used widely by governments and businesses around the world to measure how efficient firms are at producing outputs over time and compared with their peers.

Our benchmarking report considers the productive efficiency of DNSPs. DNSPs are productively efficient when they produce their goods and services at least possible cost given their operating environments and prevailing input prices. We examine the change in productivity in 2019, compared to 2018, and trends in productivity over the full period of our benchmarking analysis (2006–19).[3]

Our benchmarking report presents results from three types of 'top-down' benchmarking techniques:[4]

- **Productivity index numbers (PIN)**. These techniques use a mathematical index to determine the relationship between multiple outputs and inputs, enabling comparisons of productivity levels over time and between networks.
- **Econometric operating expenditure (opex) cost function models**. These model the relationship between opex (as the input) and outputs to measure opex efficiency.

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1 NER, cl 6.27.

2 The supplementary Economic Insights report outlines the full set of results for this year's report, the data we use and our benchmarking techniques. It can be found on the AER's benchmarking website.

3 Throughout this report references to calendar years for non-Victorian DNSPs refer to financial years (that is, 2019 refers to 2018–19 for non-Victorian DNSPs).

4 Top-down techniques measure a network's efficiency based on high-level data aggregated to reflect a small number of key outputs and key inputs. They generally take into account any synergies and trade-offs that may exist between input components. Alternative bottom up benchmarking techniques are much more resource intensive and typically examine very detailed data on a large number of input components. Bottom up techniques generally do not take into account potential efficiency trade-offs between input components of a DNSP’s operations.

- **Partial performance indicators (PPIs)**. These simple ratio methods relate one input to one output.

Being top-down measures, each benchmarking technique cannot readily incorporate every possible exogenous factor that may affect a DNSP's costs. Therefore, the performance measures are reflective of, but do not precisely represent, the underlying efficiency of DNSPs. For this benchmarking report, our approach is to derive raw benchmarking results and where possible, explain drivers for the performance differences and changes. These include those operating environment factors that may not have been accounted for in the benchmarking modelling.

The PIN techniques we use in this report to measure the relative productivity of each DNSP in the NEM are multilateral total factor productivity (MTFP) and multilateral partial factor productivity (MPFP). The relative productivity of the DNSPs reflects their efficiency. MPFP examines the productivity of either opex or capital in isolation.

What is multilateral total factor productivity?

Total factor productivity is a technique that measures the productivity of businesses over time by measuring the relationship between the inputs used and the outputs delivered. Where a business is able to deliver more outputs for a given level of inputs, this reflects an increase in its productivity. MTFP allows us to extend this to compare productivity levels between networks.

The inputs we measure for DNSPs are:

- Five types of physical capital assets DNSPs invest in to replace, upgrade or expand their networks.
- Opex to operate and maintain the network.

The outputs we measure for DNSPs (and the relative weighting we apply to each) are:

- Customer numbers. The number of customers is a driver of the services a DNSP must provide. (about 19 per cent weight)
- Circuit line length. Line length reflects the distances over which DNSPs deliver electricity to their customers. (about 39 per cent weight)
- Ratcheted maximum demand (RMD). DNSPs endeavour to meet the demand for energy from their customers when that demand is greatest. RMD recognises the highest maximum demand the DNSP has had to meet up to that point in the time period examined. (about 34 per cent weight)
- Energy delivered (MWh). Energy throughput is a measure of the amount of electricity that DNSPs deliver to their customers. (about 9 per cent weight)
- Reliability (Minutes off-supply). Reliability measures the extent to which networks are able to maintain a continuous supply of electricity. (Minutes off-supply enters as a negative output and is weighted by the value of consumer reliability).

The November 2014 Economic Insights report referenced in Appendix A details the rationale for the choice of these inputs and outputs. Economic Insights updated the weights applied to each output in November 2018 and again in November 2020 as set out below. We also discuss the outputs and inputs used further in Appendix B.

Appendix A provides reference material about the development and application of our economic benchmarking techniques. Appendix B provides more information about the specific models we use and the data required. Our website also contains this year's benchmarking report from our consultant Economic Insights and the benchmarking data and results.

1.1 Updates in this benchmarking report

This benchmarking report includes three updates to the benchmarking methodology, and a number of updates in the benchmarking data. These changes mean that the productivity results (for past years) presented in this report are different to those previously reported.

Corrected non-reliability output weights

The PIN techniques we use aggregate a range of outputs into an aggregate output index by allocating weights to each output. In our distribution benchmarking the non-reliability output weights are taken from an estimated cost function. We last updated these output cost weights in 2018 and planned to leave these weights unchanged for a period of around 5 years.[5]

However, for this year's report we have made a further change to the non-reliability output weights reflecting the advice of our consultant Economic Insights.[6] This is because an error was identified in the way the output weights were calculated in previous reports. In estimating the cost function that the output weights are taken from, the time trend (which is included to represent technological change over time) was incorrectly incorporated, which in turn impacted the estimated output weights. See Appendix C for further details. We consider that having identified the error it should be corrected and all of the PIN results presented in this report (including for the historical time series results) reflect the corrected output weights. This means the PIN results in this report cannot be compared to the results in previous year's reports. The results from the econometric opex cost function and PPI benchmarking are not impacted by this correction.

We use the PIN benchmarking, including the MTFP and MPFP results, in conjunction with other benchmarking techniques (such as econometric opex model results and PPIs), to inform the opex efficiency assessments in our assessment of network expenditures in revenue determinations.[7] We have not used PIN results deterministically to make an efficiency adjustment in a regulatory determination (to date we have used our econometric opex models to inform the magnitude of any

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5 Economic Insights, *Economic Benchmarking Results for the Australian Energy Regulator's 2020 DNSP Annual Benchmarking Report*, 13 October 2020, p. 4.

6 Economic Insights, *Economic Benchmarking Results for the Australian Energy Regulator's 2020 DNSP Annual Benchmarking Report*, 13 October 2020, pp. 3–6.

7 See section 2 for further discussion in relation to how we use benchmarking.

efficiency adjustments). Further, although there have been movements in the PIN rankings as a result of this correction, and noting how we use PIN results in our efficiency assessments, there are no changes in scores or rankings material enough to suggest any of our efficiency assessments in previous determinations would have been materially different if the error did not exist.

As can be seen in Table 1.1, the impact of this correction is that less weight is placed on the customer numbers and energy throughput outputs and more weight on circuit length and ratcheted maximum demand.

Table 1.1 Corrected and previous output weights

Output	Previous weights	Corrected weights
Energy throughput	12.46%	8.58% ↓
Ratcheted maximum demand	28.26%	33.76% ↑
Customer numbers	30.29%	18.52% ↓
Circuit length	28.99%	39.14% ↑

Note: Previous weights reflect those used in the 2018 and 2019 Annual Benchmarking Reports.

Source: Economic Insights, *Economic Benchmarking Results for the Australian Energy Regulator's 2020 DNSP Annual Benchmarking Report*, October 2020, p. 4.

We and our consultant Economic Insights consider that from an economic and engineering perspective these revised weights are more reflective of the drivers of total cost for DNSPs than the previous weights. In particular, the reallocation of weight away from energy throughput and customer numbers towards circuit length and ratcheted maximum demand better reflects the main function of the distribution network, which is to transport electricity from bulk supply points to end users. As such, we would expect circuit length and ratcheted maximum demand to be the most important outputs when considering the allocation of total cost among the included outputs. This is because total costs are significantly influenced by the fixed costs of holding long-lived assets in this industry. Similarly, the capacity of the lines the DNSP has to provide can be expected to be primarily influenced by ratcheted maximum demand with energy throughput playing a secondary role. The customer numbers output is included to capture the fixed costs associated with having a customer connected such as service lines and local street access. By contrast, opex can be expected to be associated primarily with customer numbers, as reflected in the econometric opex models. For example, opex such as some repairs and maintenance activities can be expected to be responsive to complaints by customers and to action customer requests for service.

This correction impacts the PIN benchmarking results, including the ranking of individual DNSPs under the MTFP benchmarking. While the identification of the error reduces the comparability of results between reports, the transparency of the benchmarking information and review processes mean we are continuously improving to enable the benchmarking results to become more robust.

Under the corrected weights, DNSPs which are relatively intensive (i.e. produce relatively more of an output per unit of total input compared to other DNSPs) in producing outputs that are given more weight under the correction benefit the most from the output weight change. Conversely, the DNSPs which are relatively intensive in producing outputs given less weight under the correction are worse off. The corrected output weights for customer numbers (lower weight) and circuit length (higher weight) have the biggest impact on the MTFP results. This means that largely rural businesses such as Essential Energy and Ergon Energy, which are more intensive with regard to circuit length, have higher MTFP results after the correction. Largely urban businesses such as Ausgrid and Evoenergy, which are more intensive with regard to customer numbers, have lower MTFP results. This is shown in Appendix C for 2019, along with the impact on the TFP results.[8]

We received submissions from some DNSPs that were are supportive of the new weights and considered they are more reflective of distribution network cost drivers (Essential Energy, TasNetworks, SA Power Networks and Energy Queensland).[9] Other DNSPs were concerned about the change in output weights and questioned whether the corrected output weights reflect cost drivers of distribution networks (Ausgrid, AusNet and CitiPower, Jemena, Powercor and United Energy).[10] In particular, they considered customer numbers are the most significant driver of opex and should be the output with the highest weighting. Some submissions were also concerned that the estimated cost functions that the output weights are taken from do not produce statistically significant results and questioned the differences between the corrected MTFP weights and those in our econometric opex cost function models. [11]

Most DNSPs that were concerned about the change in output weights considered that the benchmarking report should place less reliance on the PIN techniques. CitiPower, Powercor and United Energy suggested to instead place more emphasis on the econometric opex cost functions.[12] Their consultant, NERA, has proposed the PIN techniques be replaced with alternative methods based on extensions of the econometric opex cost function modelling.[13]

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8 This sets out the impact in 2019 using the corrected output weights (from this year's report) and the previous output weights (from the 2019 Annual Benchmarking Report).

9 Essential Energy, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 1; SA Power Networks, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 1; Energy Queensland, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 1; TasNetworks, *Submission on Economic Insights' 2020 draft benchmarking report*, 3 September 2020 (email).

10 Ausgrid, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, pp. 6–7; AusNet, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 2; CitiPower, Powercor and United Energy, *Submission on Economic Insights' 2020 draft benchmarking report*, 9 September 2020, p. 1.

11 Ausgrid, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, pp. 7–9; CitiPower, Powercor and United Energy, *Submission on Economic Insights' 2020 draft benchmarking report*, 9 September 2020, p. 1–2; Jemena, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 4.

12 CitiPower, Powercor and United Energy, *Submission on the AER's 2020 draft benchmarking report*, 30 October 2020, p. 2.

13 NERA, *Review of the AER's use of MPFP modelling*, 23 October 2020, pp. 43–49.

Ausgrid noted the magnitude of the changes in efficiency results undermines the confidence in MTFP benchmarking.[14] Endeavour Energy also considered the changes inhibit a DNSP’s ability to establish long term plans and organisational change and noted that there is a trade-off between accuracy and stability in results, with it favouring stable results.[15] Energy Networks Australia also emphasised the benefits of consistency and stability in benchmarking, particularly given its use in revenue determinations.[16] Some submissions suggested an independent review of the PIN benchmarking approach and results was appropriate and would be beneficial.[17]

As outlined above, we consider that from an economic and engineering perspective these revised weights are more reflective of the drivers of total cost for distribution networks than the previous weights. Further, that it is important to distinguish between the distribution of total costs across all outputs under the PIN/MTFP frameworks as opposed to the distribution of opex across outputs under the econometric opex model results. In examining the issues raised in submissions, Economic Insights notes the PIN techniques cover a wider and more detailed range of information compared to the econometric opex cost function models, which only examine opex efficiency.[18] We also note that under the NER, this benchmarking report must consider the relative efficiency of DNSPs, taking account of all inputs and overall productivity.[19] Further, as outlined above, and discussed further in section 2, when assessing opex efficiency in revenue determinations our main tools for determining opex efficiency adjustments are the econometric opex cost function models, with the PIN techniques providing supplementary information.

Economic Insights welcomed NERA’s constructive suggestions on extensions of the econometric opex cost function modelling to replace the MTFP annual benchmarking results and will examine them in greater detail. However, it considered the proposed methods only relate to opex efficiency and its decomposition, and do not provide information on total productivity. Because of this, in their current form they do not appear to be substitutes for the PIN techniques used in this report, although Economic Insights considered they could be included as supplementary analyses.[20]

Economic Insights also set out the context in which the cost functions that the output weights are taken from are estimated, with only Australian data available and needing to take into account total costs. It considers that the statistical performance of the

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[14] Ausgrid, *Submission on the AER’s 2020 draft benchmarking report*, 10 November 2020, p. 2.

[15] Endeavour Energy, *Submission on the AER’s 2020 draft benchmarking report*, 10 November 2020, pp. 3–4.

[16] Energy Networks Australia, *Submission on the AER’s 2020 draft benchmarking report*, 10 November 2020, p. 1.

[17] CitiPower, Powercor and United Energy, *Submission on the AER’s 2020 draft benchmarking report*, 30 October 2020, p. 2; Ausgrid, *Submission on the AER’s 2020 draft benchmarking report*, 10 November 2020, p. 2; Jemena, *Submission on the AER’s 2020 draft benchmarking report*, 10 November 2020, p. 1; Energy Networks Australia, *Submission on the AER’s 2020 draft benchmarking report*, 10 November 2020, p. 2.

[18] Economic Insights, *Advice on selected issues raised in DNSP ABR submissions*, 20 November, pp. 3–4.

[19] NER, cl 6.27.

[20] Economic Insights, *Advice on selected issues raised in DNSP ABR submissions*, 20 November, p. 9.

estimated cost functions is at least as good as it would expect and has substantially improved with the correction of the error.[21]

We acknowledge the benefits of stability in our use of benchmarking, as demonstrated by our plan to only revisit output weights about once every five years. However, we consider that having identified the error it must be corrected and the benefit of this outweighs the stability of results that would be incorrect. We can see the merit in undertaking an independent review of the MTFP benchmarking, and in particular of the output weights. As noted in section 7.2, this is something we will consider going forward as a part of our development work, including in the context of any review of the output specification to understand the potential impact of distributed energy resources, and the suggestions noted above from NERA.

Updated values of customer reliability estimates used to proxy the cost of reliability

We have updated the value of customer reliability (VCR) which is used to proxy the cost of reliability and determine the weight applied to the reliability output. In previous reports we have used the VCR estimates compiled by the Australian Energy Market Operator (AEMO) in 2014. In 2019 the AER updated the VCR estimates[22] and this updated data is used in this report.[23]

This change has a very minor effect on the PIN results, as the impact is less than one per cent for all DNSPs.[24] Ergon Energy is the most negatively affected, as the change decreased its average MTFP score over the 2006–19 period by 0.6 per cent. TasNetworks is the most positively affected DNSP, as its average MTFP score over the 2006–19 period increased by 0.9 per cent. Together with Ergon Energy, Essential Energy (decrease of 0.1 per cent) is the only other DNSP that is on average negatively affected by this change.

Change to the indexing method

We have updated the indexing method used in the TFP benchmarking reflecting the advice of our consultant Economic Insights.[25] We have done this to be consistent with our transmission network service provider (TNSP) annual benchmarking report. The new method ensures the impact of large percentage changes in inputs or outputs, particularly the reliability output, are more accurately captured than under the previous

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[21] Economic Insights, *Advice on selected issues raised in DNSP ABR submissions*, 20 November, pp. 1–2.

[22] AER, *Values of Customer Reliability Review,* December 2019.

[23] Economic Insights, *Economic Benchmarking Results for the Australian Energy Regulator's 2020 DNSP Annual Benchmarking Report*, 13 October 2020, p. 6. The AER's 2019 VCR estimates have been indexed back to 2006 using an appropriate price index.

[24] Economic Insights, *Economic Benchmarking Results for the Australian Energy Regulator's 2020 DNSP Annual Benchmarking Report*, 13 October 2020, pp. 136–139, 144–147; AER analysis.

[25] Economic Insights, *Economic Benchmarking Results for the Australian Energy Regulator's 2020 DNSP Annual Benchmarking Report*, 13 October 2020, pp. 6–7.

indexing method.[26] More detail on this change can be found in the supplementary Economic Insights report.[27]

Updated data

There have been some revisions to the network services opex reported and analysed in our previous benchmarking reports.

Jemena advised that it had identified costs in its 2018 opex that were incorrectly allocated from its parent company (Jemena Asset Management) to the electricity DNSP business (Jemena Electricity Networks). The corrected opex was lower than previously reported. Jemena also made minor corrections to its 2016 and 2017 opex.

Corrections were also made to CitiPower's and Powercor's opex for 2016 and 2019. Previously these businesses removed a service classification adjustment related to metering when recasting their opex to reflect their CAM applying in 2014.[28] We believe this should not have been removed and we have added it back to their opex for the affected years. Similarly, we have added opex for metering to AusNet's opex from 2016 to 2019. Jemena also advised following a review of its 2019 Regulatory Information Notice (RIN) response that it had identified amendments to its customer numbers for the period 2011–19. Jemena considered these reflect a better way of reporting customer numbers that should be applied retrospectively.

There have been some other more minor refinements to the historical Australian DNSP dataset, consistent with previous years benchmarking reports. These refinements are set out in the consolidated benchmarking dataset published on our website.[29]

1.2 Benchmarking development program

We seek to progressively review and incrementally refine elements of the benchmarking methodology and data. The aim of this work is to maintain and continually improve the reliability of the benchmarking results we publish and use in our network revenue determinations.

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26 The reliability output is the component most likely to have large percentage changes each year.

27 Economic Insights, *Economic Benchmarking Results for the Australian Energy Regulator's 2020 DNSP Annual Benchmarking Report*, 13 October 2020, pp. 6–7.

28 In recasting their opex to reflect their previous CAM for the four years since 2016, CitiPower and Powercor had removed in 2016 and 2019 service classification costs in relation to metering costs. This adjustment was based on the adjustment we made in their previous regulatory determination (2016–20 regulatory period). However, based on our review, CitiPower and Powercor re-added this amount to its recast opex series in 2016 and 2019, to be consistent with their 2017 and 2018 recast opex, and to reflect that this adjustment was not linked to the CAM change. We do not consider that it should be "frozen" for benchmarking purposes. See AER, Final Decision, *CitiPower distribution determination 2021–26 - Attachment 6 - Operating Expenditure*, May 2016, p. 38; AER, Final Decision, *Powercor distribution determination 2021–26 - Attachment 6 - Operating Expenditure*, May 2016, p. 38.

29 Refinements are outlined in the 'Data revisions' sheet of the consolidated benchmarking data file.

Section 7 outlines some of our recent benchmarking developments and our priorities for future development work, including submissions from stakeholders on key issues. Our main area of focus in the year since the 2019 Annual Benchmarking Report was published has been to examine the impact of different operating environment factors (OEFs), in particular the impact of different cost allocation and capitalisation approaches and improved ways to measure differences in vegetation management requirements.

1.3 Consultation

In developing the 2020 Annual Benchmarking Report for distribution we consulted with DNSPs and a wider group of stakeholders including Energy Networks Australia, the Public Interest Advocacy Centre and the AER's Consumer Challenge Panel. This is the first time we have consulted beyond the DNSPs and was welcomed by some submissions.[30] Some submissions considered that beyond the annual consultation process for the preliminary benchmarking results and draft reports there should be separate consultation on specific development issues.[31] Energy Networks Australia considered that development work is best addressed in conjunction with service providers through the formation of an industry benchmarking working group.[32] Another submission noted that in order to consult effectively the benchmarking results need to be presented clearly and that this should extend to how the benchmarking is used.[33]

In developing the 2021 Annual Benchmarking Report we will review our engagement and consultation approach taking into account this feedback.

30 Consumer Challenge Panel (CCP), *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 1; Endeavour Energy, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 4.

31 Endeavour Energy, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 4

32 Energy Networks Australia, *Submission on the AER's 2020 draft benchmarking report*, 1 November 2020, p. 2.

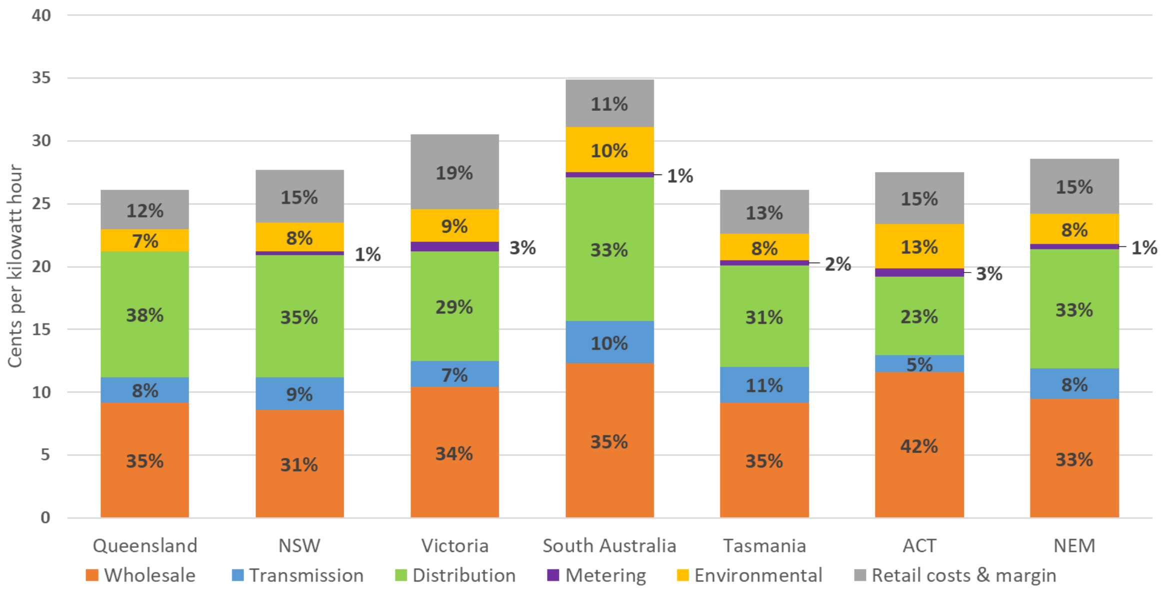
33 Ausgrid, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, pp. 14–16.

2 Why we benchmark electricity networks

Electricity networks are 'natural monopolies' that do not face the typical commercial pressures experienced by firms in competitive markets. They do not need to consider how and whether or not rivals will respond to their prices. Without appropriate regulation, network operators could increase their prices above efficient levels and would face limited pressure to control their operating costs or invest efficiently.

Consumers pay for electricity network costs through their retail electricity bills. Distribution network costs typically account for between 30 and 40 per cent of what consumers pay for their electricity. The remainder covers the costs of generating, transmitting and retailing electricity, as well as various regulatory programs. Figure 2.1 provides an overview of the typical electricity retail bill.

Figure 2.1 Network costs as a proportion of retail electricity bills, 2019



Source: ACT data from AEMC, *Residential Price Trends,* 9 December 2019; AER, *State of the Energy Market,* July 2020; ACCC, *Inquiry into the National Electricity Market,* 29 November 2019.

Note: Queensland metering costs omitted due to data quality issues. Figures may differ slightly from source due to rounding.

Under the National Electricity Law (NEL) and the NER, the AER regulates electricity network revenues with the goal of ensuring that consumers pay no more than necessary for the safe and reliable delivery of electricity services. Because network costs account for such a high proportion of consumers' electricity bills, AER revenue determinations have a significant impact on consumers.

The AER determines the revenues that an efficient and prudent network business require at the start of each five-year regulatory period. The AER determines network revenues through a 'propose-respond' framework.[34] Network businesses propose the costs they believe they need during the regulatory control period to provide safe and reliable electricity and meet predicted demand. The AER responds to the networks' proposals by assessing, and where necessary, amending them to reflect 'efficient' costs.

The NER requires the AER to have regard to network benchmarking results when assessing and amending network capital expenditure (capex) and opex, and to publish the benchmarking results in this annual benchmarking report.[35] The AEMC added these requirements to the NER in 2012 to:

- reduce inefficient capex and opex so that electricity consumers would not pay more than necessary for reliable energy supplies, and
- to provide consumers with useful information about the relative performance of their electricity Network Service Provider (NSP) to help them participate in regulatory determinations and other interactions with their NSP.[36]

Economic benchmarking gives us an important source of information on the efficiency of historical network expenditures (opex and capex) and the appropriateness of using them in forecasts. We also use benchmarking to understand the drivers of trends in network efficiency over time and changes in these trends. This can help us understand why network productivity is increasing or decreasing and where best to target our expenditure reviews.[37]

When assessing network's opex proposals, we have regard to all of the benchmarking information in this report. However, to date in determining the magnitude of any opex efficiency adjustments we have relied on our econometric opex cost function models (which are discussed in section 5.1). They provide useful information on the opex efficiency of a DNSP, including relative performance, and inform the magnitude of any opex efficiency adjustments. We use the other benchmarking approaches (MTFP, MPFP and the PPIs) to qualitatively cross check and confirm the results from the econometric opex cost function models.

[34] The AER assesses the expenditure proposal in accordance with the Expenditure Forecast Assessment Guideline which describes the process, techniques and associated data requirements for our approach to setting efficient expenditure forecasts for network businesses, including how the AER assesses a network business's revenue proposal and determines a substitute forecast when required. See: https://www.aer.gov.au/networks-pipelines/guidelines-schemes-models-reviews/expenditure-forecast-assessment-guideline-2013.

[35] NER, cll. 6.27(a), 6.5.6(e)(4) and 6.5.7(e)(4).

[36] AEMC, Rule Determination, *National Electricity Amendment (Economic Regulation of Network Service Providers) Rule 2012; National Gas Amendment (Price and Revenue Regulation of Gas Services) Rule 2012*, 29 November 2012, p. viii.

[37] AER, *Explanatory Statement Expenditure Forecast Assessment Guideline,* November 2013, pp. 78–79.

We have been encouraged to use all of our benchmarking techniques as they provide different insights[38] but also to give further consideration to how benchmarking results are applied to ensure the benchmarking framework is achieving outcomes that are in the interests of consumers.[39]

The benchmarking results also provide network owners and investors with useful information on the relative efficiency of the electricity network businesses they own and invest in. This information, in conjunction with the financial rewards available to businesses under the regulatory framework, and business profit maximising incentives, can facilitate reforms to improve network efficiency that can lead to lower network costs and retail prices.

Benchmarking also provides government policy makers (who set regulatory standards and obligations for networks) with information about the impacts of regulation on network costs, productivity and ultimately electricity prices. Additionally, benchmarking can provide information to measure the success of the regulatory regime over time.

Finally, benchmarking provides consumers with accessible information about the relative efficiency of the electricity networks they rely on. The breakdown of inputs and outputs driving network productivity allow consumers to better understand what factors are driving network efficiency and network charges that contribute to their energy bill. This helps to inform their participation in our regulatory processes and broader debates about energy policy and regulation.

Since 2014, the AER has used benchmarking in various ways to inform our assessments of network expenditure proposals. Our economic benchmarking analysis has been one contributor to the reductions in network costs and revenues for DNSPs and the retail prices faced by consumers.

Figure 2.2 shows that network revenues (and consequently network charges paid by consumers) have fallen in all jurisdictions in the NEM since 2015. This reversed the increase seen across the NEM over 2007 to 2013, which led to the large increases in retail electricity prices.[40] This highlights the potential impact on retail electricity charges of decreases in network revenues flowing from AER network revenue determinations, including those informed by benchmarking.

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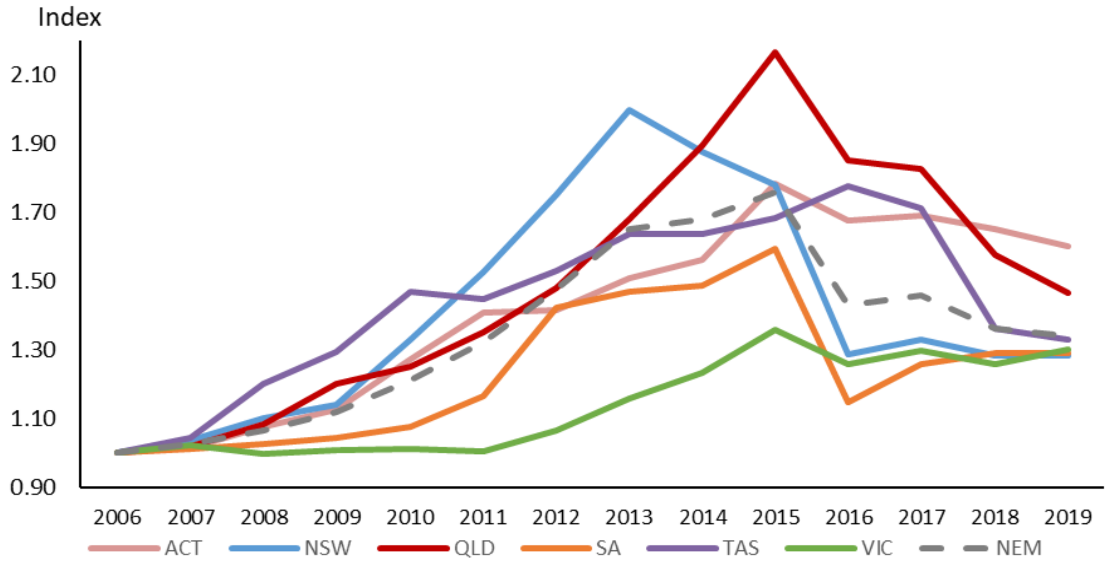
38 Consumer Challenge Panel (CCP), *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 2.

39 Energy Networks Australia, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 1.

40 AER, *State of the Energy Market,* 2018, p. 151.

Figure 2.2 Indexes of network revenue changes by jurisdiction, 2006–19



Source: Economic Benchmarking RIN; AER analysis.

3 The productivity of the electricity distribution industry

Key points

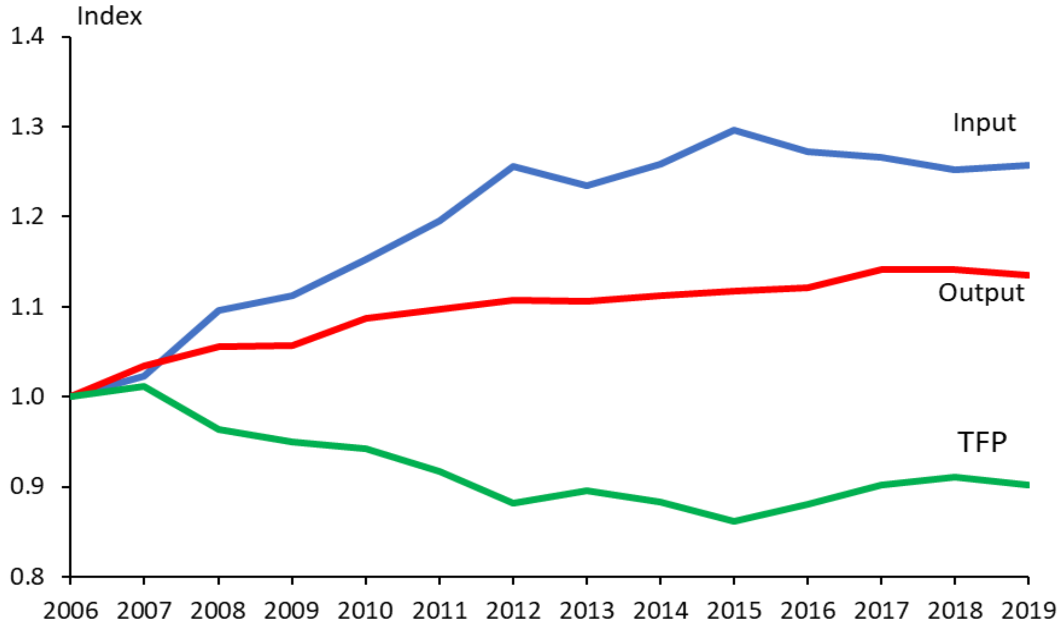
- Productivity in the electricity distribution industry, measured by total factor productivity, decreased by one per cent in 2019. A decrease in reliability was the main driver of this fall in productivity.
- Electricity distribution productivity fell for the first time since 2015, consistent with the reduction in productivity in the Australian economy, although the decline was not as large as in the electricity, gas, water and waste services utilities sector.
- These results reflect the corrected output weights discussed in section 1.1.

This chapter presents total factor productivity (TFP) results at the electricity distribution industry level. This is our starting point for examining the relative productivity and efficiency of individual DNSPs (which we cover in section 4).

As outlined in section 1.1, in this year's report we have updated the non-reliability output weights used to determine the TFP and MTFP results. This is because an error was identified in the way the output weights used in previous reports were estimated. See Appendix C for further details. The analysis and results presented below (including the historical time series results) use the corrected weights as well as the other updates noted in section 1.1.

Figure 3.1 presents TFP for the electricity distribution industry over the 2006–19 period. This shows that industry-wide productivity decreased by one per cent in the 12 months to 2019. This decline occurred as a small rise in industry inputs was combined with a slight fall in industry output. It followed three years of consecutive growth in productivity.

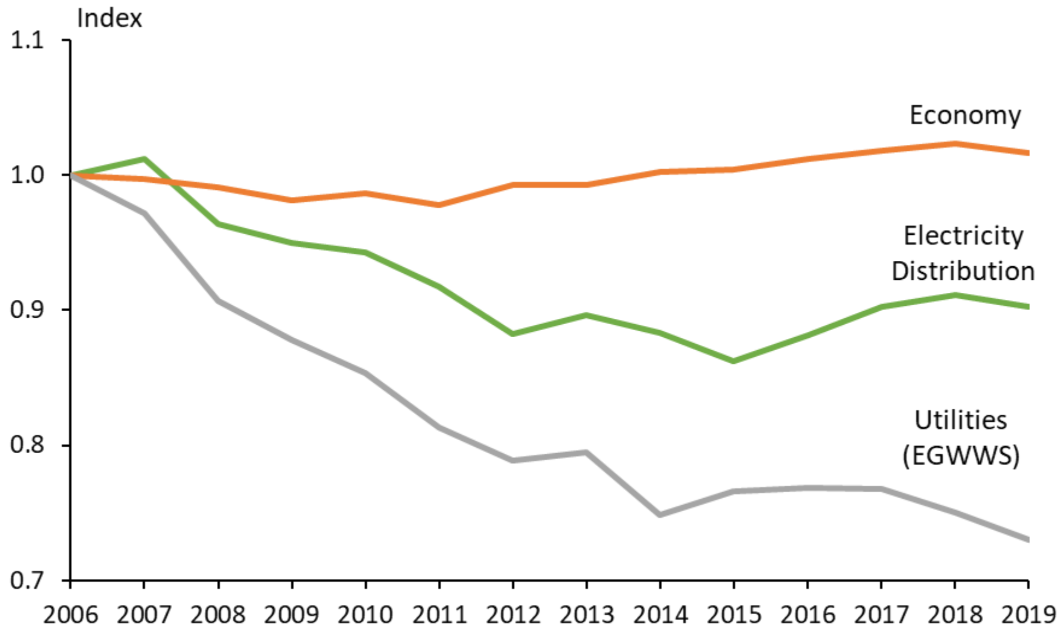
Figure 3.1 Electricity distribution TFP, 2006–19



Source: Economic Insights.

Figure 3.2 compares the TFP of the electricity distribution industry over time relative to estimates of the overall Australian economy and utility sector (electricity, gas, water and waste services (EGWWS)) productivity.

Figure 3.2 Electricity distribution and economy productivity indices, 2006–19



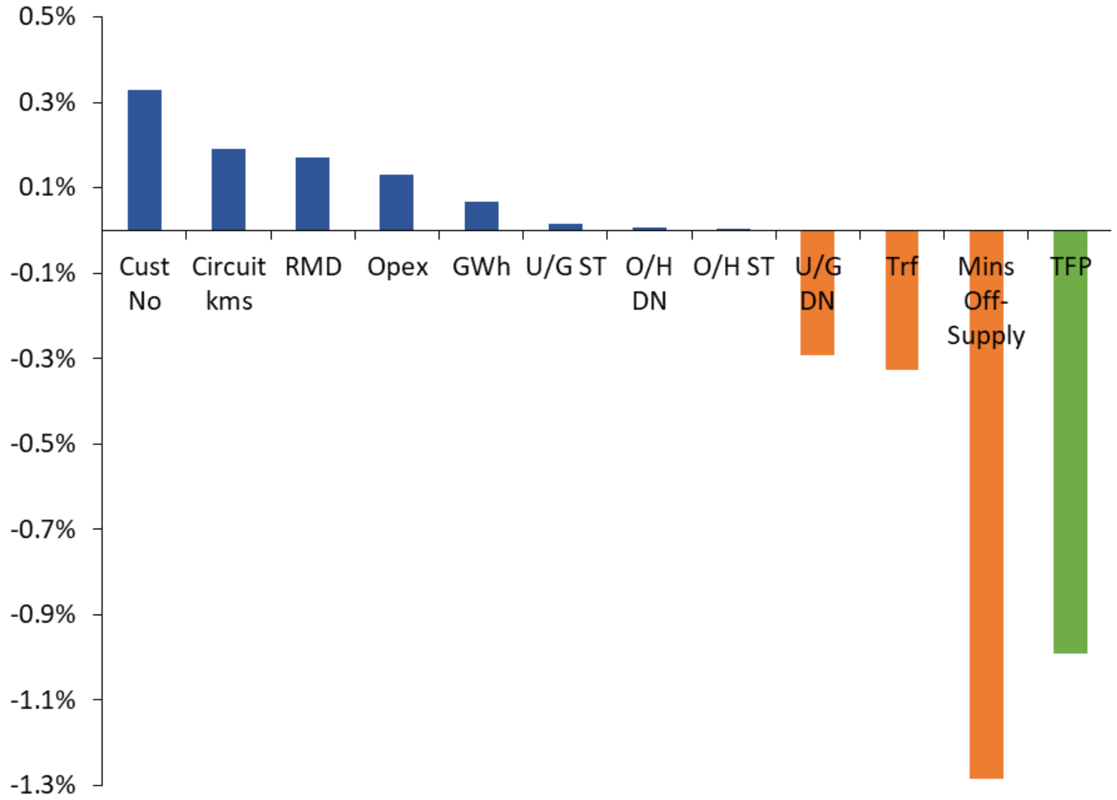
Source: Economic Insights; Australian Bureau of Statistics.

Note: The productivity of the Australian economy and the EGWWS industry is from the ABS indices within 5260.0.55.002 Estimates of Industry Multifactor Productivity, Australia, Table 1: Gross value added based multifactor productivity indexes (a). We have rebased the ABS indices to one in 2006.

The fall in electricity distribution industry productivity over the past year is broadly consistent with the TFP movements in the broader economy and slightly less than the utilities sector. Electricity distribution industry productivity fell in 2019 for the first time since 2015 alongside the wider productivity of the Australian economy. Growth in electricity distribution productivity has been larger on average than that of both the Australian economy and the utilities sector since 2015, noting the comparatively lower base this was achieved off compared to the Australian economy.

Figure 3.3 helps us understand the drivers of change in electricity distribution productivity over the past 12 months by showing the contributions of each output and each input to the average annual rate of change in total factor productivity in 2019. Outputs consist of customer numbers, circuit length, RMD, energy throughput and reliability, with an increase in output increasing TFP, everything else held constant. Inputs consist of opex and capital (for example, the length and capacity overhead of distribution lines), with an increase in inputs decreasing TFP, everything else held constant. Figure 3.3 shows that the decrease in electricity distribution productivity in 2019 was primarily driven by worsening reliability (measured as increases in the number of customer minutes off-supply) as well as increases in the quantity of transformers and underground distribution cables. This was offset by growth in customer numbers, circuit length and RMD and reductions in opex.

Figure 3.3 Electricity distribution output and input percentage point contributions to average annual TFP change, 2019



Source: Economic Insights.

Note: The inputs and outputs in this chart are minutes off-supply (mins off-supply), operating expenditure (opex), customer numbers (cust no), ratcheted maximum demand (RMD) , circuit line length (circuit kms), overhead distribution lines (O/H DN), energy delivered (GWh), underground sub-transmission cables (U/G ST), overhead sub-transmission lines (O/H ST), transformers (Trf), underground distribution cables (U/G DN).

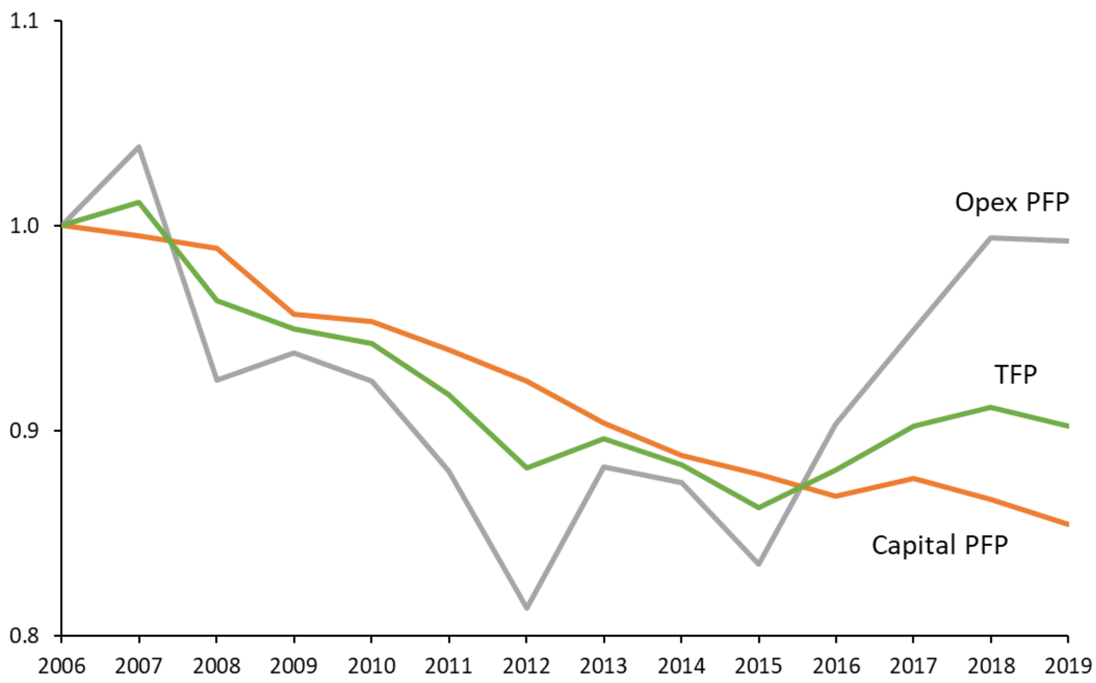
Compared to 2019, opex reductions played a larger role in driving electricity distribution productivity over the 2012–19 period, contributing 0.9 percentage points on average to the average annual electricity distribution productivity change of 0.3 per cent.[41] Relatively less of a reduction in opex and significantly worse reliability are the key differences in 2019 compared to the factors driving the positive TFP result over the 2012–19 period.

Figure 3.4 displays TFP, opex PFP and capital PFP in the electricity distribution industry from 2006–19. Consistent with the above observations, since 2012, opex has

[41] Economic Insights, *Economic Benchmarking Results for the Australian Energy Regulator's 2020 DNSP Annual Benchmarking Report*, 13 October 2020, pp. 24–25.

been the most significant contributor to TFP growth, with opex productivity increasing on average by 2.8 per cent each year. However, capital PFP has declined consistently over time, largely due to network inputs (particularly transformers and underground cables) growing at a faster pace than key outputs such as customers and maximum demand. We can also see in Figure 3.4 that reductions in capital PFP were the most significant factor driving the decline in TFP during 2019 while opex productivity decreased slightly by 0.1 per cent due to worsening reliability.

Figure 3.4 Electricity distribution, total capital and opex productivity, 2006–19



Source: Economic Insights.

4 The relative productivity of distribution network service providers

Significant changes in productivity in 2019

- Six DNSPs became more productive in 2019 as reflected by their MTFP results:
    - TasNetworks (4.4 per cent) and Energex (2.1 per cent) increased their productivity the most.
    - Endeavour, Powercor, Ausgrid and United Energy also increased their productivity, but by less than one per cent.
    - Increased opex productivity as a result of opex reductions was generally the main driver of increased productivity for these DNSPs.
- Seven DNSPs became less productive in 2019 as reflected by their MTFP results:
    - Essential Energy (6.8 per cent), Ergon Energy (3.8 per cent), Jemena (3.4 per cent), SA Power Networks (3.2 per cent) and CitiPower (2.1 per cent) experienced notable decreases in productivity. The productivity of AusNet and Evoenergy also decreased but by less than one per cent.
    - Increasing opex and deteriorating reliability were generally the main drivers of decreased productivity for these DNSPs.

Productivity trends observed over time

- SA Power Networks, CitiPower and Powercor have consistently been amongst the most productive distributors in the NEM since 2006, although their productivity declined from 2006 to 2019. Ergon Energy has also been one of the more productive distributors since 2006, however its productivity has declined since 2017. United Energy has shown strong increases in productivity since 2016 and became one of the more productive distributors in 2019.
- South Australia had the highest distribution total productivity level, as measured by MTFP, in 2019 and over the period 2006 to 2019. In 2019 this was followed by distribution productivity levels in Queensland and Victoria. Tasmania's distribution productivity improved in 2019 and was slightly higher than distribution productivity in New South Wales. The distribution productivity level in the ACT was the lowest of the states in 2019.
- These results reflect the corrected output weights discussed in section 1.1.
- It is desirable to take into account operating environment conditions not included in the benchmarking models that can affect the benchmarking results. Our benchmarking report includes information about the most material operating environment factors (OEFs) driving apparent differences in estimated productivity and operating efficiency between the distribution networks in the NEM. These are set out in section 6.

This section presents economic benchmarking results as measured by MTFP (and opex and capex MPFP) at a state and DNSP level and provides our key observations on the reasons for changes in relative productivity of each DNSP in the NEM.

4.1 Economic benchmarking results

MTFP is the headline technique we use to measure and compare the relative productivity of states and individual DNSPs. This is supported by the corresponding partial productivity measures of opex and capital inputs.

As noted in sections 1.1 and 2, we use the MTFP and MPFP benchmarking results, among other benchmarking techniques, to inform the opex efficiency assessments in revenue determinations. While they are a part of our considerations we have not used these results deterministically to make opex efficiency adjustments in a revenue determination, to date we have used our econometric opex models to inform the magnitude of any efficiency adjustments.

As outlined in section 1.1, in this year's report we have updated the non-reliability output weights used to determine the MTFP results. This is because an error was identified in the way the output weights were calculated in previous reports. See Appendix C for further details. The analysis and results presented below (including the historical time series results) use the corrected weights.

Figure 4.1 presents the relative distribution productivity levels by state, as measured by MTFP over the period 2006 to 2019. This shows that South Australia is the most productive state in the NEM in both 2019 and over the period 2006 to 2019, although its productivity has declined over this timeframe. In 2019 the next most productive state is Queensland, followed by Victoria, Tasmania[42] and New South Wales. ACT's distribution total productivity level is the lowest of the states in NEM in 2019, which also reflects its general performance over the period 2006 to 2019. Queensland is the only state that has a slightly higher productivity level in 2019 than in 2006.

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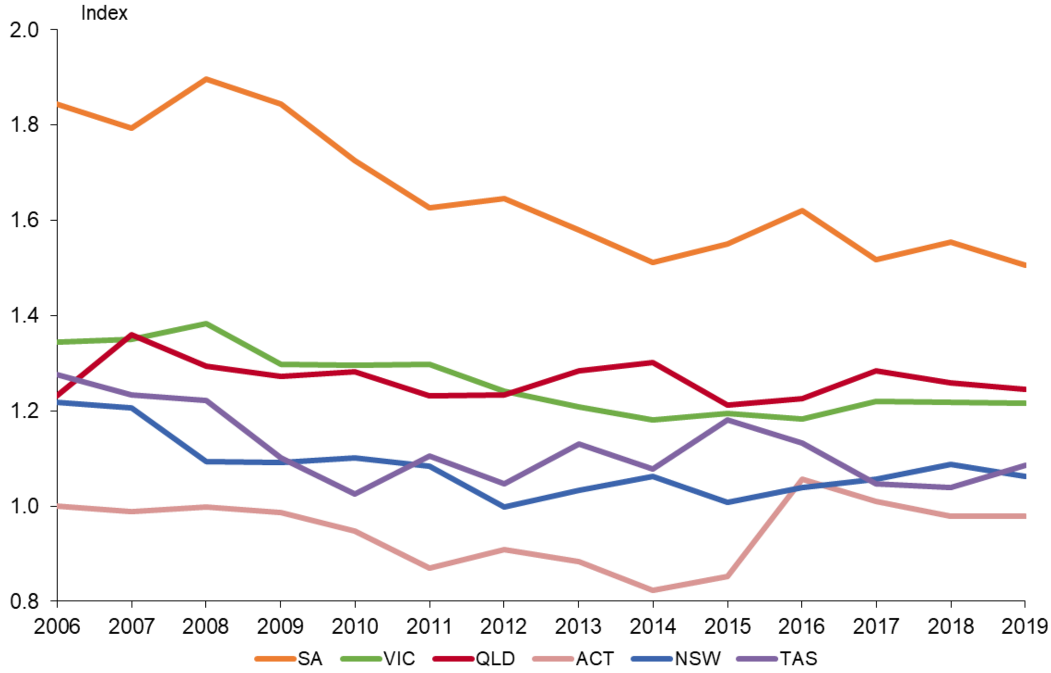
[42] TasNetworks could be considered an outlier compared to its peers in terms of system structure. Compared to other DNSPs, TasNetworks operates substantially less high voltage sub-transmission assets and has a comparatively high proportion of lower voltage lines. This disadvantages TasNetworks' MTFP ranking because low voltage assets generally receive the highest capital input weighting under our benchmarking models. Economic Insights advises that some caution is required in interpreting TasNetworks' MTFP score given its comparatively unusual system structure (see Economic Insights, *Memorandum – DNSP MTFP and Opex Cost Function Results*, 13 November 2015, p. 4).

Figure 4.1 Electricity distribution MTFP levels by state, 2006–19



Source: Economic Insights, AER analysis

The remainder of this section examines the relative productivity of individual DNSPs in the NEM. Table 4.1 presents the MTFP rankings for individual DNSPs in 2019 and 2018[43], the annual growth in productivity in 2019 (column four) and the annual growth between 2012–19, and 2006–19 (columns five and six).

Table 4.1 Individual DNSP MTFP rankings and growth rates

DNSP	2019 Rank	2018 Rank	Annual Change 2018 to 2019	Annual Change 2012 to 2019	Annual Change 2006 to 2019
SA Power Networks	1	1	–3.2%	–1.3%	–1.6%
CitiPower (Vic)	2	2	–2.1%	0.7%	–0.6%
Powercor (Vic)	3↑	4	0.6%	–0.6%	–0.7%
United Energy (Vic)	4↑	5	0.1%	2.1%	0.2%
Ergon Energy (QLD)	5↓	3	–3.8%	–0.2%	0.3%

43 Both the 2019 and 2018 rankings reflect the MTFP results under the corrected weights. As discussed in section 1.1, to see a comparison of the 2019 rankings under the corrected and previous weights see Appendix C.

DNSP	2019 Rank	2018 Rank	Annual Change 2018 to 2019	Annual Change 2012 to 2019	Annual Change 2006 to 2019
Energex (QLD)	6↑	7	2.1%	0.5%	–0.2%
Endeavour Energy (NSW)	7↑	8	0.9%	0.3%	–0.9%
Essential Energy (NSW)	8↓	6	–6.8%	0.7%	–1.9%
TasNetworks	9↑	10	4.4%	0.5%	–1.3%
Jemena (Vic)	10↓	9	–3.4%	–0.6%	–0.4%
AusNet (Vic)	11	11	–0.3%	–2.0%	–1.8%
Evoenergy (ACT)	12	12	0.0%	1.1%	–0.2%
Ausgrid (NSW)	13	13	0.5%	1.4%	–0.2%

Source: Economic Insights, AER analysis.

Note: All scores are calibrated relative to the 2006 Evoenergy score which is set equal to one.

Figure 4.2 presents MTFP results for each DNSP from 2006 to 2019.

In addition to MTFP, we also present the results of two MPFP models:

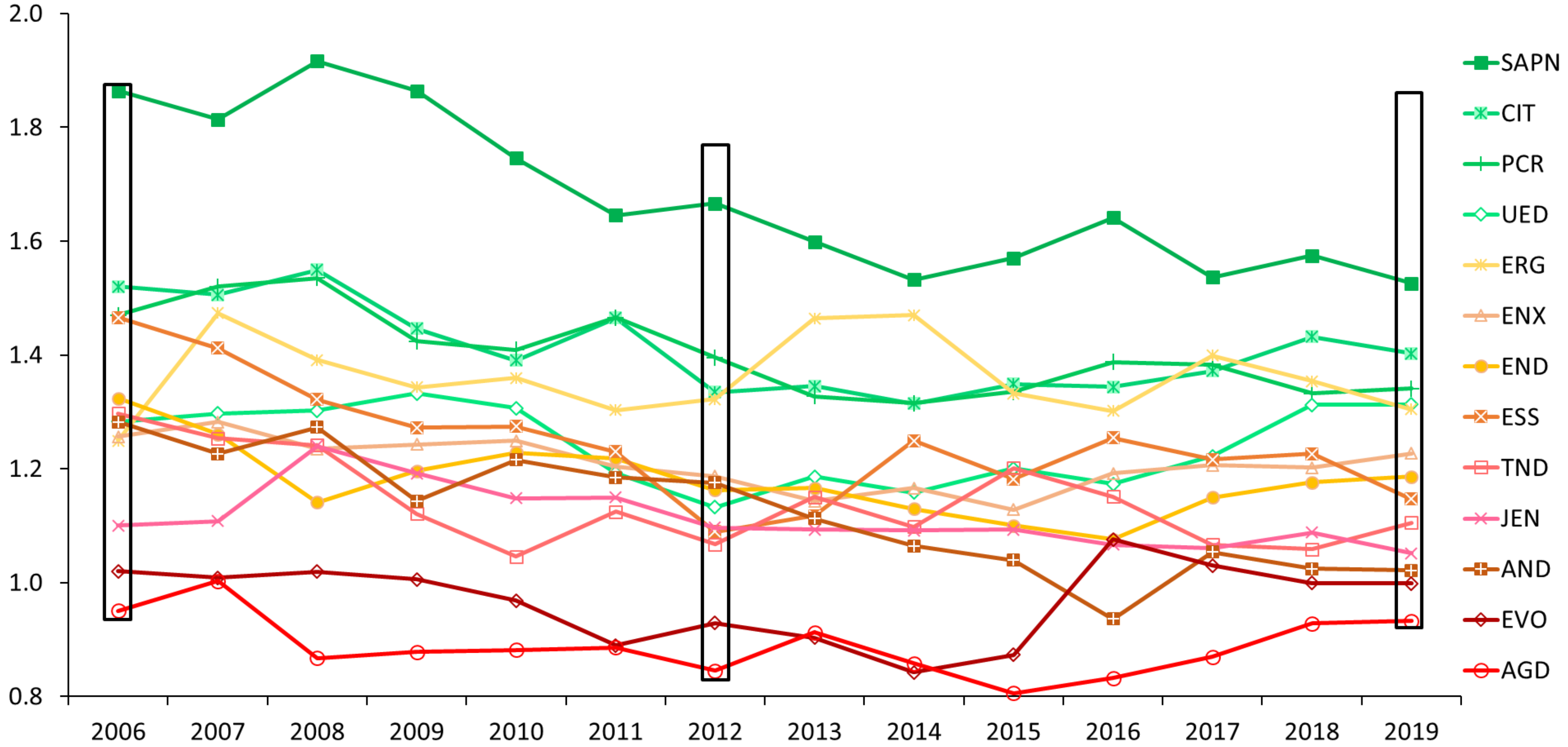
- Opex MPFP is shown in Figure 4.3. This considers the productivity of the DNSPs' opex.
- Capital MPFP is shown in Figure 4.4. This considers the productivity of the DNSPs' use of capital inputs, namely overhead lines and underground cables (each split into distribution and sub-transmission components) and transformers.

These partial approaches assist in interpreting the MTFP results by examining the contribution of capital assets and opex to overall productivity. They use the same output specification as MTFP but provide more detail on the contribution of the individual components of capital and opex to changes in productivity. However, we note these results do not account for synergies between capital and opex like the MTFP model.

Being top-down analysis, these results are only indicative of the DNSPs' relative performance. While the analysis accounts for some factors that are beyond a DNSP's control, such as the impact of network density and some system structure factors, additional environmental factors can affect a DNSP's costs and benchmarking performance. Section 6 provides more information about some of these additional factors.

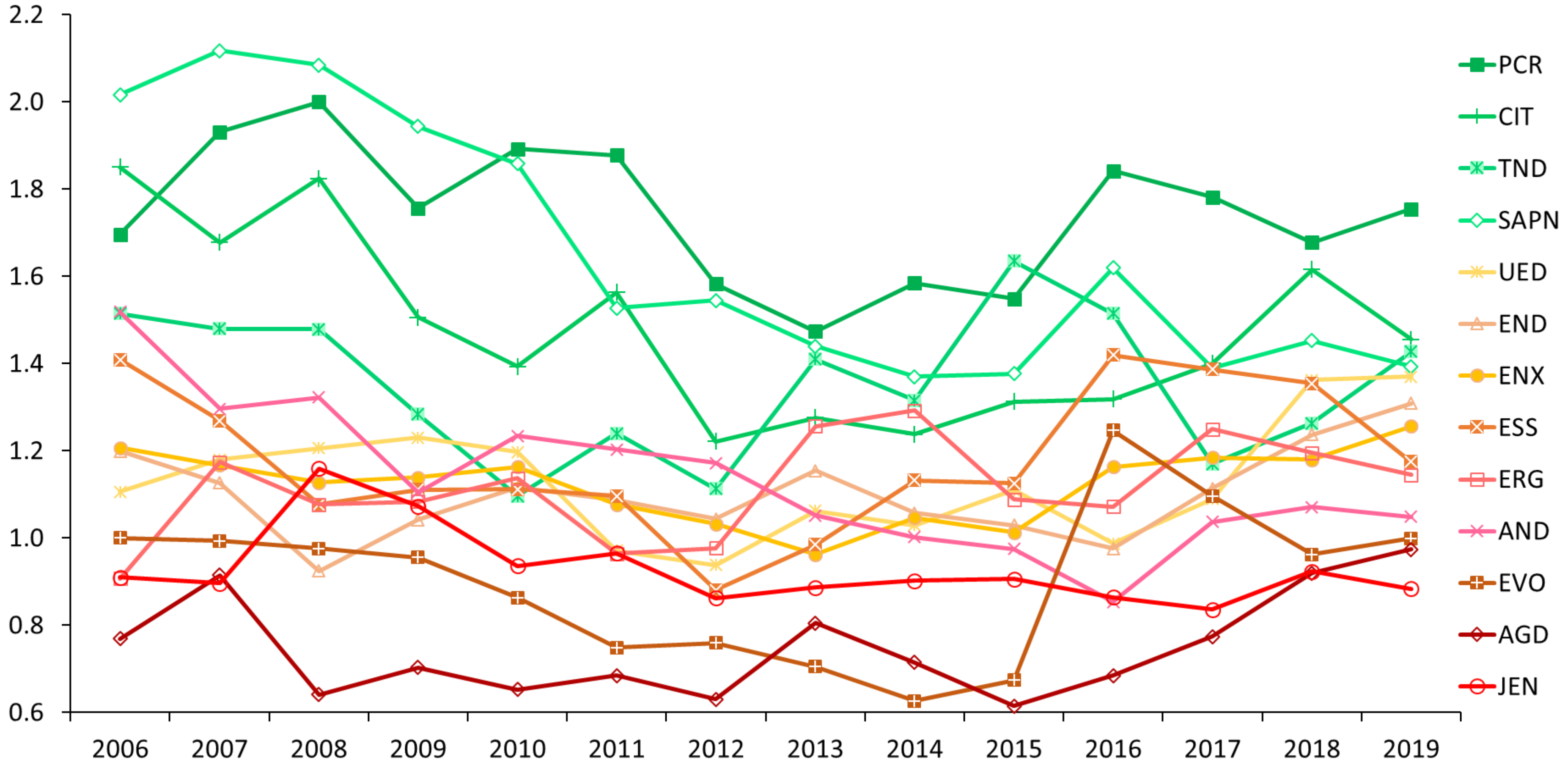
Our observations about these MTFP and MPFP results are discussed in section 4.2.

Figure 4.2 MTFP indexes by individual DNSP, 2006–19



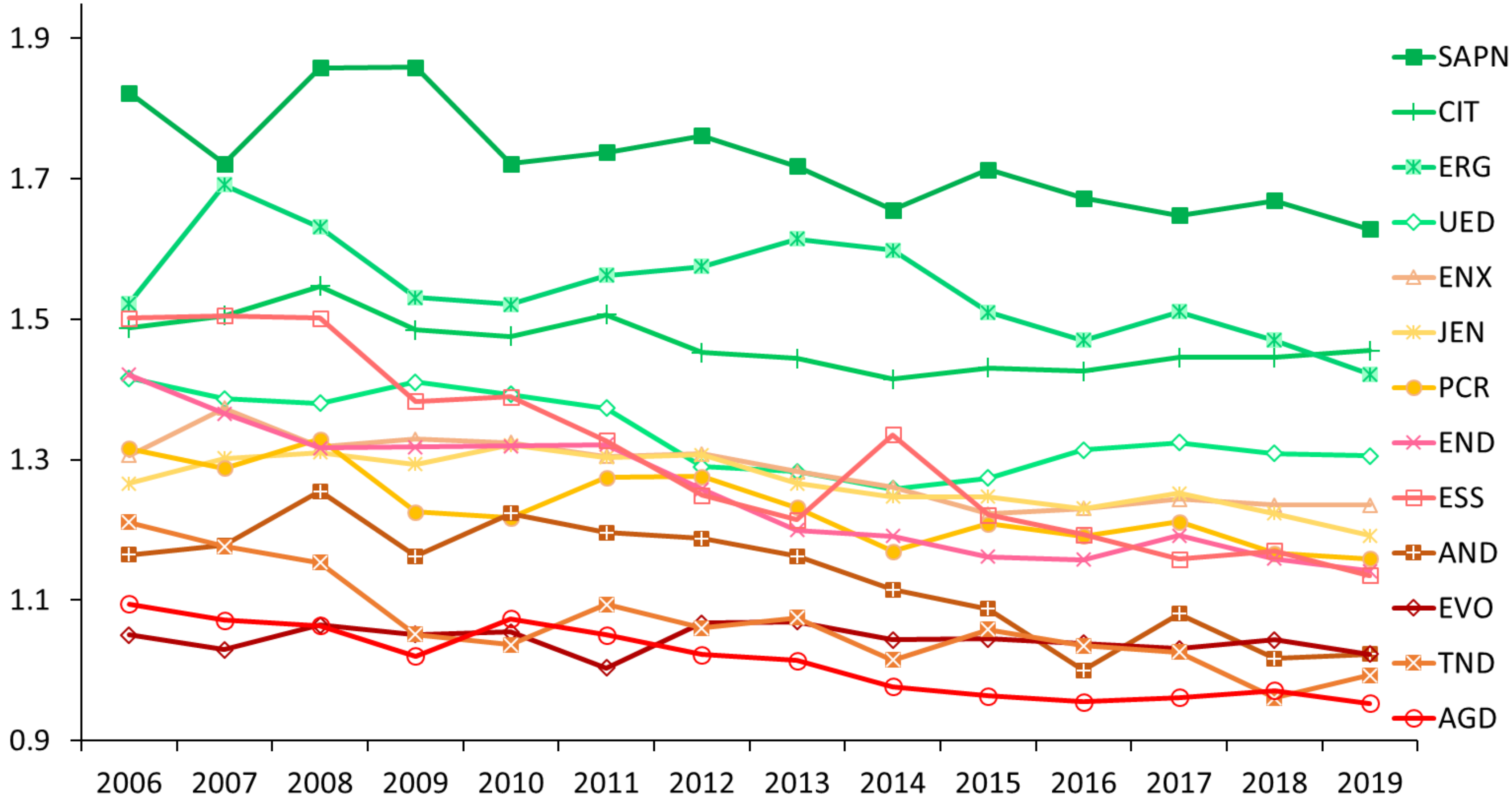
Source: Economic Insights; AER analysis.

Figure 4.3 DNSP opex multilateral partial factor productivity indexes, 2006–19



Source: Economic Insights; AER analysis.

Figure 4.4 DNSP capital multilateral partial factor productivity indexes, 2006–19



Source: Economic Insights; AER analysis.

4.2 Key observations about changes in productivity

This section describes some of our key observations about changes in the relative productivity of businesses both for 2019 and recent years, based on the MTFP and MPFP results presented above.

4.2.1 Significant changes in productivity in 2019

Six DNSPs became more productive in 2019

As can be seen in Figure 4.2, six DNSPs became more productive in 2019 as reflected by their MTFP results. TasNetworks increased its productivity by 4.4 per cent in 2019 which was the largest increase in the NEM. Energex also had a strong increase in productivity of 2.1 per cent. Increasing opex productivity reflecting lower opex was the main driver of these results for both distributors.[44] Endeavour Energy, Powercor, Ausgrid and United Energy also increased their productivity, but each by less than one per cent. Again, increasing opex productivity reflecting reductions in opex was generally a key driver for these results, other than for United Energy whose productivity improvements were driven by customer growth and increased reliability.[45]

TasNetworks' opex productivity measured in terms of opex MPFP increased by 12.2 per cent in 2019, the largest increase in the NEM. As can be seen in Figure 4.3 this caused TasNetworks to jump in opex MPFP rankings from sixth in 2018 to third in 2019. Energex's (ninth to seventh) and Endeavour Energy's (seventh to sixth) increases in opex productivity also led to improved opex MPFP rankings. Powercor's increase in opex productivity further solidified its position as the top-ranked distributor in terms of opex MPFP. Ausgrid's increase in opex productivity meant it is no longer ranked last in terms of opex MPFP in the NEM for the first time since 2014.

TasNetworks also had the largest increase in capital productivity as measured by capital MPFP in the NEM for 2019. Its increase of 3.5 per cent was comfortably larger than all other DNSPs and only three other DNSPs (CitiPower, AusNet and Energex) increased their capital productivity, each with increases of less than one per cent.

Seven DNSPs became less productive in 2019

Seven DNSPs became less productive in 2019 as reflected by their MTFP results. Figure 4.2 shows that Essential Energy had the largest decrease in productivity of 6.8 per cent, driven by increased opex and reduced reliability. [46] These two factors also

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[44] Economic Insights, *Economic Benchmarking Results for the Australian Energy Regulator's 2020 DNSP Annual Benchmarking Report*, 13 October 2020, pp. 64, 94, 95.

[45] Economic Insights, *Economic Benchmarking Results for the Australian Energy Regulator's 2020 DNSP Annual Benchmarking Report*, 13 October 2020, pp. 74, 90, 115, 120.

[46] Economic Insights, *Economic Benchmarking Results for the Australian Energy Regulator's 2020 DNSP Annual Benchmarking Report*, 13 October 2020, p. 105.

drove the decreased productivity of Jemena (3.4 per cent) and SA Power Networks (3.2 per cent).[47] Reliability was a key driver for Ergon Energy's decrease in productivity of 3.8 per cent, whereas opex increases drove CitiPower's decrease in productivity of 2.1 per cent.[48]

Essential Energy's opex productivity measured in terms of opex MPFP decreased by 14.2 per cent, which was the largest decrease in the NEM. This resulted in its opex MPFP ranking moving from fifth in 2018 to eighth in 2019 and we understand this reflects increased vegetation management and total overheads expenditure. While CitiPower had the second largest decrease in opex productivity of 10.4 per cent in 2019 it maintained its second-place ranking. Jemena's opex productivity decreased by 4.4 per cent, with its increased opex in 2019 partly due to costs for its transformation program, the benefits of which are expected to be realised from 2020.[49] This means in 2019 it now ranks last in terms of opex MPFP.

Ergon Energy's capital MPFP decreased by 3.5 per cent in 2019, which was the largest decrease in the NEM. Essential Energy also had a decrease in capital MPFP of more than three per cent and Jemena, SA Power Networks, Evoenergy and Ausgrid had decreases of at least two per cent. There were few changes in the capital productivity rankings in 2019. Even though it had declining capital productivity, SA Power Networks maintained its position as the most productive DNSP in terms of capital productivity in the NEM. With worsening capital MTFP in 2019, Ausgrid now ranks last in terms of capital MTFP.

Most DNSPs had declining reliability in 2019

Most DNSPs had lower levels of reliability in 2019.[50] CitiPower, Powercor and United Energy were the only DNSPs that improved their reliability in 2019. For most DNSPs reduced reliability was a key driver that negatively affected overall productivity. Although reliability worsened in 2019 for most DNSPs, it was generally similar to historical values. In 2019 only one DNSP had its worst reliability performance since 2006 (AusNet). As reliability tends to change year on year and in 2019 is in line with previous values, reliability does not appear to have a concerning trend.

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[47] Economic Insights, *Economic Benchmarking Results for the Australian Energy Regulator's 2020 DNSP Annual Benchmarking Report*, 13 October 2020, pp. 59, 110.

[48] Economic Insights, *Economic Benchmarking Results for the Australian Energy Regulator's 2020 DNSP Annual Benchmarking Report*, 13 October 2020, pp. 85, 100.

[49] Jemena, *2021–26 Electricity Distribution Price Review Regulatory Proposal – response to information request 052*, p. 2.

[50] Our reliability measure is customer minutes off-supply, which is the unplanned outage duration for all customers. Major outage events are not included in this measure.

The Public Interest Advocacy Centre agreed that declining reliability is not a concern. It considered this was a positive development, as network performance comes closer to consumers' preferences regarding the trade-off between price and reliability.[51]

Jemena noted its worsening reliability in 2019 was caused by a severe weather event (lightning and strong winds) beyond its control and states that, upon the exclusion of this event, its reliability is in line with performance over the last three years and results continue to outperform the AER's reliability target.[52]

Energy Queensland submitted that while the AER noted that reliability was a key driver in Ergon Energy's decrease in productivity, its reliability performance during 2019 was favourable relative to the AER's reliability performance measures.[53]

4.2.2 Productivity levels across the industry have converged over time

Since 2006 there has been some convergence in the productivity levels of DNSPs. The spread of productivity levels in 2019 is smaller than in 2012, which was also smaller than in 2006. This can be seen from the three equal-sized black columns placed in 2006, 2012 and 2019 in Figure 4.2.

The convergence is due to a number of factors, some of which are discussed below.

One important factor is that those DNSPs which have been the least productive over time have improved their performance, particularly since 2012. The least productive DNSPs in 2012 as measured by MTFP (Ausgrid and Evoenergy) have increased their productivity at higher rates than some DNSPs with middling productivity. Since 2012, Ausgrid and Evoenergy have increased their overall productivity (MTFP) by 1.4 per cent and 1.1 per cent respectively, compared with the industry average of 0.2 per cent. The growth in productivity of these DNSPs can be attributed to improvements in opex efficiency.

In addition to these DNSPs improving their MTFP performance, several middle-ranked DNSPs have also improved their relative MTFP and opex MPFP performance to be closer to the top-ranked DNSPs. In recent years this includes United Energy, Endeavour Energy and Energex, again reflecting improved opex efficiency. Since 2012, the NSW and ACT DNSPs have been among the most improved in the NEM in terms of MTFP and opex MPFP performance.

Further, while Powercor, SA Power Networks and CitiPower have consistently been the most productive DNSPs in the NEM as measured by MTFP and opex MPFP over the 2006 to 2019 period, they have also experienced a gradual decline in productivity.

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51 Public Interest Advisory Centre, *Submission on the AER's 2020 draft benchmarking report*, 19 November 2020, p. 1.

52 Jemena, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 5.

53 Energy Queensland, *Submission on the AER's 2020 draft benchmarking report*, pp. 2, 5–7.

As a result, their relative productivity is now much closer to the DNSPs that are middle-ranked. This is primarily due to increasing opex, as a result of new regulatory obligations among other factors. However, there has since been a turnaround in opex productivity for these three DNSPs from 2014.

Changes in opex productivity as measured by opex MPFP is the main driver of productivity convergence in the electricity distribution industry. It has increased since 2012 (as seen in Figure 4.3) with 11 out of the 13 DNSPs increasing their opex productivity as measured by opex MPFP. The DNSPs that have not improved their opex productivity since 2012 are SA Power Networks and AusNet. In contrast, capital productivity as measured by capital MPFP has consistently declined since 2006 throughout the NEM and there has been little convergence among DNSPs. All DNSPs have reduced capital MTFP in 2019 as compared to 2006. This is only marginally different when comparing 2019 to 2012, as CitiPower and United Energy are the only DNSPs that have increased their capital productivity since then.

The Public Interest Advocacy Centre noted its concern that DNSP productivity performance has converged, contrasting it to a market or industry with competitive outcomes.[54] It welcomed improvements by lower performing DNSPs, but was concerned by the diminished performance of some of the higher performing DNSPs and encouraged the AER to monitor this trend. The AER's Consumer Challenge Panel (CCP) also noted this trend and considered it highlighted three areas of concern with benchmarking: it is not driving improvements in capital productivity, the application of opex benchmarking appears to be leading to complacency by DNSPs that are efficient, and further work is required to quantify OEFs.[55]

[54] Public Interest Advocacy Centre, *Submission on the AER's 2020 draft benchmarking report*, 19 November 2020, p. 1.

[55] Consumer Challenge Panel (CCP), *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 3.

5 Other supporting benchmarking techniques

Key points

Econometric opex cost functions

- Powercor, CitiPower, SA Power Networks and TasNetworks are the most efficient DNSPs in terms of opex efficiency scores, for both the 2006 to 2019 and 2012 to 2019 periods.
- Due to improvements in opex efficiency in recent years, NSW and ACT DNSPs as well as Ergon Energy and TasNetworks are more efficient over the 2012 to 2019 period compared with the 2006 to 2019 period.
- Opex efficiency scores from the opex cost function models are broadly consistent with opex MPFP efficiency scores.

PPIs

- DNSPs with higher customer densities (such as CitiPower, United Energy and Jemena) tend to perform well on 'per customer' metrics.
  - Powercor performs strongly on 'per customer' metrics compared to other DNSPs with higher customer densities.
- DNSPs with lower customer densities (Essential Energy, Powercor, Ergon Energy and SA Power Networks) tend to perform well on ‘per km’ metrics.
  - United Energy and Jemena perform well on some 'per km' metrics compared to other DNSPs with lower customer densities.
  - Ausgrid is outperformed on some 'per km' metrics compared to other DNSPs with higher customer densities.

This section presents economic benchmarking results by DNSP level as measured by our opex econometric models and our PPI techniques.

5.1 Modelling of operating expenditure efficiency

This section presents the results of four econometric models that compare the relative opex efficiency of DNSPs in the NEM. These results reflect an average efficiency score for each DNSP over a specified period. The periods we look at are the 2006 to 2019 (long) period and the 2012 to 2019 (short) period.

The four econometric opex cost function models presented in this section are:[56]

- Cobb-Douglas stochastic frontier analysis (SFA)
- Cobb-Douglas least squares econometrics (LSE)
- Translog SFA

56 Further details about these econometric models can be found in the Economic Insights 2014 and 2018 reports.

- Translog LSE.

As noted in previous sections, we use a range of benchmarking results, including our PIN, opex econometric and PPI techniques, to inform the opex efficiency assessments in our revenue determinations. To date we have used the results of our econometric opex models in past determinations to inform the magnitude of any opex efficiency adjustments. Our approach to this is discussed further in the box in this section.

A key property required for these econometric opex models is that an increase in output can only be achieved with an increase in costs. However, this property may not be held across all the data points for the more flexible Translog models that allow for varying output elasticities. Before 2018 the results from Translog SFA model were not presented in our annual reports as this property was not met. In the 2018 Annual Benchmarking Report the Translog SFA model results were included for the short period as this property was largely satisfied for most DNSPs. Then in the 2019 Annual Benchmarking Report the results for this and the long period were included as again this property was largely met for most DNSPs.

With the current data update for the 2020 Annual Benchmarking Report the number of instances where this property is not met has become more prevalent for the models over the short period and in the current results it occurs in:

- The Translog SFA and LSE models over the short period for five DNSPs in each model. The Translog SFA results for Ausgrid, Ergon Energy, Jemena, AusNet and United Energy do not meet the property, whereas the Translog LSE results for Ausgrid, CitiPower, Energex, Jemena and United Energy do not meet the property.
- The Translog SFA models over the long period for two DNSPs: Jemena and United Energy.

We have presented the results from these models in the figures below. However, where this property is not satisfied in a model for specific DNSPs (indicated by a hatched pattern) we have not included the result in its average efficiency score across the models (we have shown this average by the horizontal black lines for each DNSP). We note when this is the case.

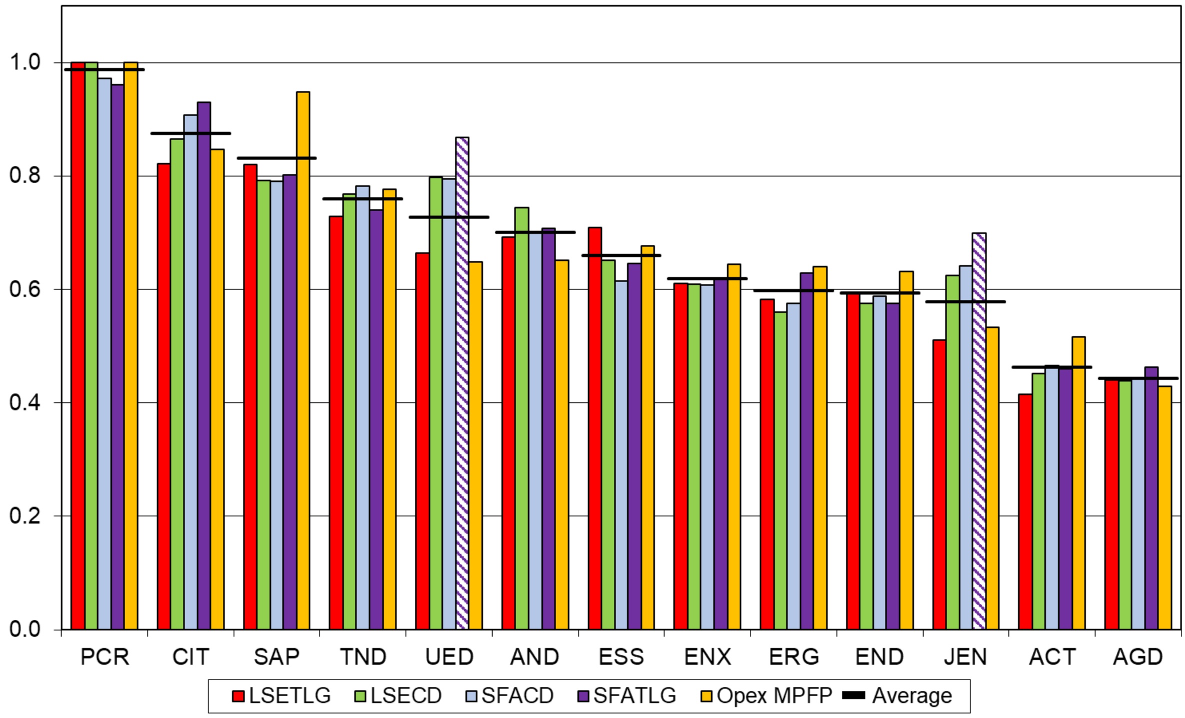
As discussed further in section 7.1, an area for future development is establishing if or how we can improve the performance of these models in relation to this property.

Figure 5.1 presents average efficiency scores for the above four models (plus opex MPFP) over the long period, ranked from highest to lowest on average.

CitiPower and Powercor have the highest average efficiency scores under the majority of models, followed by SA Power Networks, TasNetworks and United Energy. Evoenergy and Ausgrid have the lowest average opex efficiency scores over this period. As can be seen in Figure 5.1, the opex MPFP results (in the orange columns) are broadly consistent with the results from these econometric opex cost function models, although the results are most notably higher for SA Power Networks.

We received a submission from Ausgrid who believe there are now large differences between the opex MPFP efficiency scores and the econometric opex cost function efficiency scores.[57] As noted by Economic Insights, there are some fundamental differences between the methods used to estimate efficiency scores.[58] In particular, there are differences in outputs, cost functions and sample data between the opex MPFP and econometric opex model approaches.[59] Considering these differences the opex efficiency scores are not too dissimilar across these benchmarking approaches, and the opex MPFP scores are generally no more of an outlier than the other efficiency scores.

Figure 5.1 Opex efficiency scores and opex MPFP, (2006–19 average)



Source: Economic Insights; AER analysis.

Note: Columns with a hatched pattern represent results that violate the key property that an increase in output is achieved with an increase in cost and are not included in the average efficiency score for each DNSP (represented by the black horizontal line).

Figure 5.2 presents the average opex efficiency of each DNSP for these four models (plus opex MPFP) over the short period. Again, the average (including only those models where an increase in output is achieved with an increase in costs) is shown by the horizontal black lines for each DNSP. Examining this time period provides a more

57 Ausgrid, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 9.

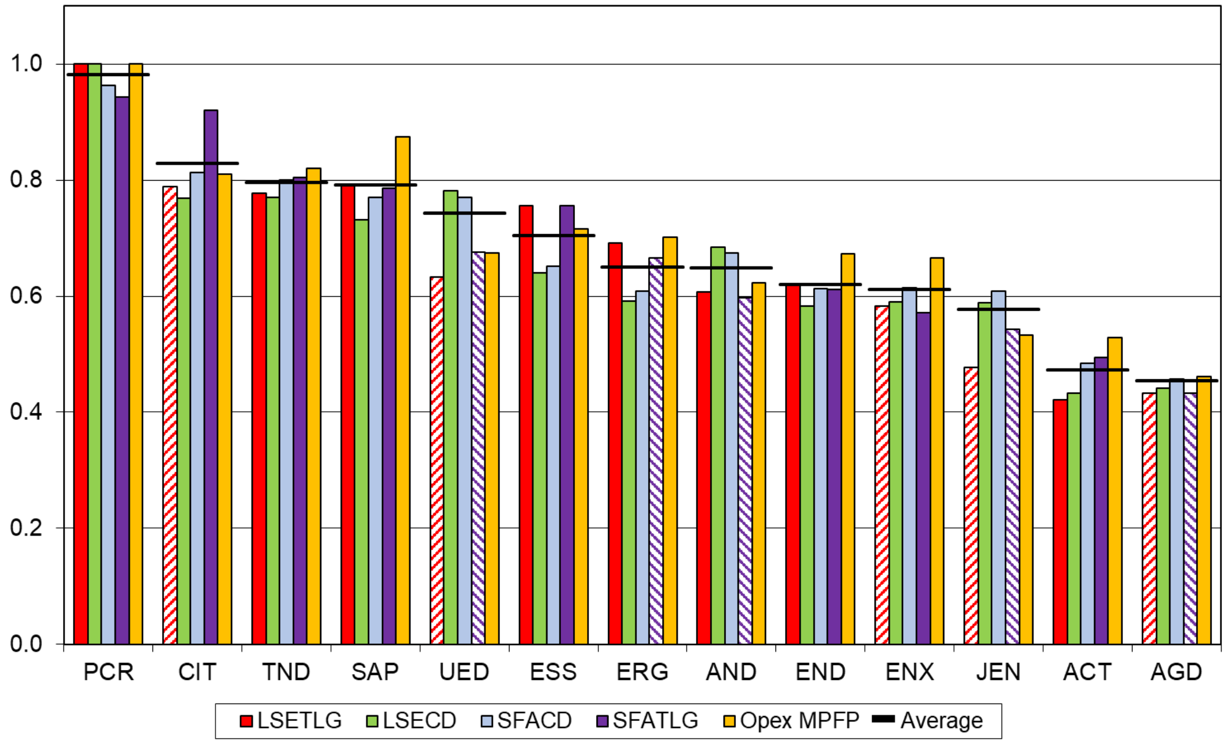
58 See Appendix B and Economic Insights, *Economic Benchmarking Results for the Australian Energy Regulator's 2020 DNSP Annual Benchmarking Report*, 13 October 2020, p. 15.

59 Economic Insights, *Advice on selected issues raised in DNSP ABR submissions*, 20 November, p. 4.

recent picture of relative efficiency of DNSPs in the NEM and takes into account that it can take some time for more recent improvements in efficiency by previously poorer performing DNSPs to be reflected in period-average efficiency scores. Figure 5.2 also shows that the corresponding opex MPFP results are broadly consistent with the results from the opex cost function models.

While the average opex efficiency results are similar between the long and short periods, particularly for those DNSPs that have the highest and lowest efficiency scores, there are some changes in average opex efficiency scores of the other DNSPs. Similar to trends observed in section 4, many middle and lower ranked DNSPs in terms of opex efficiency have improved their performance over recent years. This has a more pronounced effect on their opex efficiency scores for the shorter rather than the longer period. NSW and ACT DNSPs all improved their efficiency scores in the shorter period, and Endeavour Energy and Essential Energy also have higher rankings relative to their longer period rankings. Ergon Energy and TasNetworks were also able to achieve improved efficiency scores and rankings over the shorter period relative to the longer period. While Powercor, CitiPower and SA Power Networks have decreased efficiency scores in the shorter period, they are still among the most efficient DNSPs in this period. AusNet, Energex and Jemena generally have decreased efficiency scores in the shorter period relative to the longer period.

Figure 5.2 Opex efficiency scores and opex MPFP, (2012–19 average)



Source: Economic Insights; AER analysis.

Note: Columns with a hatched pattern represent results that violate the key property that an increase in output is achieved with an increase in cost and are not included in the average efficiency score for each DNSP (represented by the black horizontal line).

How we use average opex efficiency scores to assess relative efficiency in a specific year

The econometric models produce average opex efficiency scores for the period over which the models are estimated. The results we are using in this section reflect average opex efficiency over the 2006–19 period and the 2012–19 period. Where there are rapid increases or decreases in opex, it may take some time before the period average efficiency scores reflect these changes, in particular for the longer period. This means that in some circumstances the efficiency scores will not reflect a DNSP's relative efficiency in the most recent year.

To use the econometric results to assess the efficiency of opex in a specific year, we can estimate the efficient opex of a benchmark efficient service provider operating in the target DNSP's circumstances. We do this by first averaging the DNSP's actual opex (deflated by the opex price index) and calculating its efficiency score over the relevant period. We then compare the DNSP's opex efficiency score against a benchmark comparison score, adjusted for potential differences in operating environments. Where the DNSP's efficiency score is below the adjusted benchmark score, we adjust the DNSP's average opex by the difference between the two efficiency scores. This results in an estimate of average opex that is not materially inefficient. We then roll forward this period-average opex to a specific base year using a rate of change that reflects changes in outputs, OEFs and technology between the average year and the specific year. We then compare the DNSP's actual opex in the base year to the rolled forward efficient opex benchmark.

Examples of how we have applied this approach in practice are in the AER's opex draft decisions for Jemena and AusNet for the 2021–26 regulatory control period.[60]

Appendices 6 and B provide more information about our econometric models.

5.2 Partial performance indicators

PPI techniques are a simpler form of benchmarking that compare inputs to one output. This contrasts with the MTFP, MPFP and econometric techniques that relate inputs to multiple outputs.

The PPIs used here support the other benchmarking techniques because they provide a general indication of comparative performance of the DNSPs in delivering a specific output. While PPIs do not take into account the interrelationships between outputs (or the interrelationship between inputs), they are informative when used in conjunction with other benchmarking techniques.

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60 See AER, Draft Decision, *Jemena distribution determination 2021–26 - Attachment 6 - Operating Expenditure*, September 2020, and AER, *Draft Decision, AusNet Services distribution determination 2021–26 - Attachment 6 - Operating Expenditure*, September 2020.

On a 'per customer' metric, large rural DNSPs will generally perform poorly relative to DNSPs in suburban and metropolitan areas. Typically, the longer and sparser a DNSP's network, the more assets it must operate and maintain per customer. The 'per MW' metric exhibits a similar pattern. Conversely, on 'per km' metrics, large rural DNSPs will perform better because their costs are spread over a longer network. Where possible, we have plotted PPIs against customer density,[61] to enable readers to visualise and account for these effects when interpreting the results.

We have updated the PPIs to include 2019 and present them as an average for the five year period 2015–19. The results are broadly consistent with those presented in the 2019 Annual Benchmarking Report with no major changes.

5.2.1 Total cost PPIs

This section presents total cost PPIs. These compare each DNSPs' total costs (opex and asset cost) against a number of outputs.[62] Total cost has the advantage of reflecting the opex and assets for which customers are billed on an annual basis. The three total cost PPIs shown here are:

- Total cost per customer
- Total cost per circuit length kilometre
- Total cost per mega-watt of maximum demand.

Total cost per customer

Figure 5.3 shows each DNSP's total cost per customer. Customer numbers are one of the main outputs DNSPs provide. The number of customers connected to the network is one of the factors that influences demand and the infrastructure required to meet that demand.[63]

Broadly, this metric should favour DNSPs with higher customer density because they are able to spread their costs over a larger customer base. However, it is worth noting that there is a large spread of results across the lower customer density networks. Both Ergon Energy and Essential Energy have a relatively higher total cost per customer compared to DNSPs with similar customer densities, including SA Power Networks,

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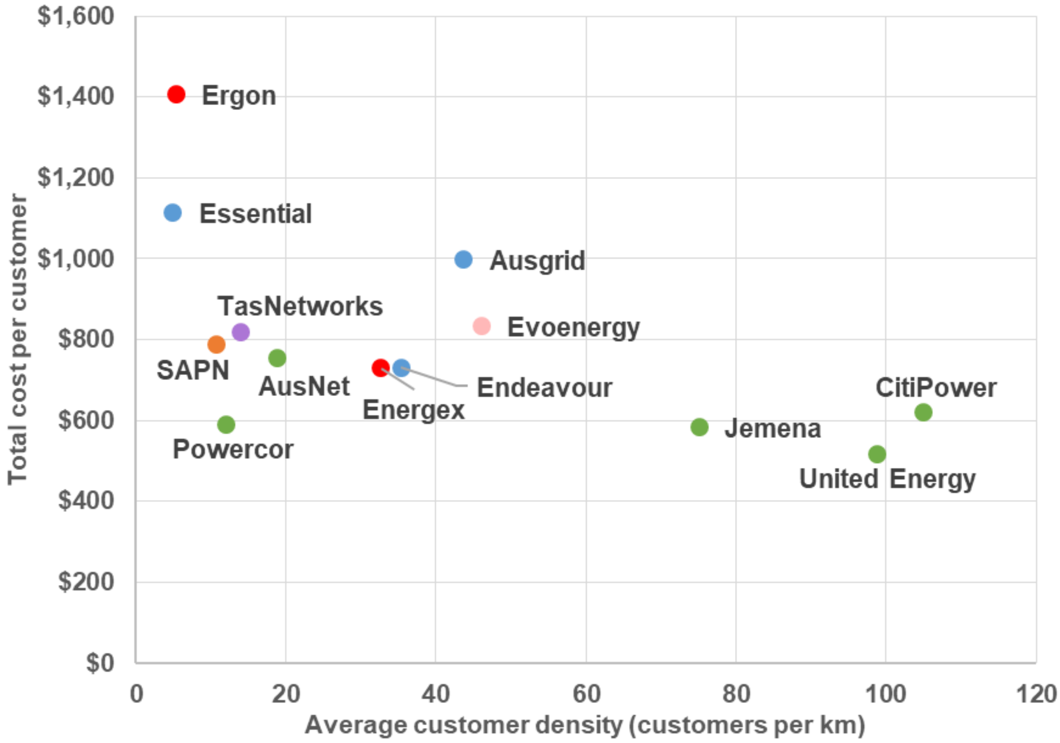
61 Customer density is calculated as the total number of customers divided by the route line length of a DNSP.

62 Asset cost is the sum of annual depreciation and return on investment associated with the historical and current capex of a DNSP (as included in its regulatory asset base), using the average return on capital over the period. In economic benchmarking studies, it is generally referred to as the annual user cost of capital.

63 With the corrected output weights, the customer numbers output carries the third largest weight (in terms of per cent share of total revenue) in the MTFP and MPFP indices. It generally carries the largest weight (in terms of the magnitude of coefficient estimates) in the opex cost function models. See Economic Insights, *Review of reports submitted by CitiPower, Powercor and United Energy on opex input price and output weights*, 18 May 2020, pp. 16, 21.

Powercor, AusNet and TasNetworks. Ausgrid also has relatively higher costs per customer compared to most networks with lower customer densities.

Figure 5.3 Total cost per customer ($2019) (average 2015–19)

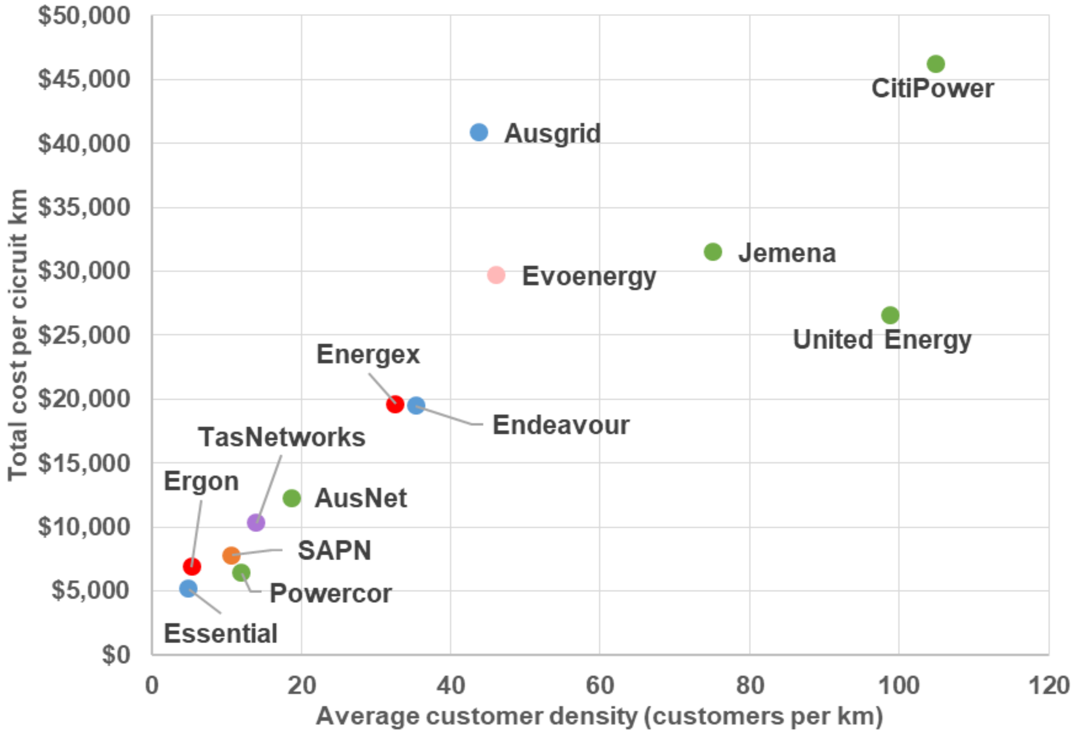


Source: AER analysis; Economic Benchmarking RINs.

Total cost per kilometre of circuit line

Figure 5.4 presents each DNSP's total cost per km of circuit line length. Circuit line length reflects the distance over which DNSPs must deliver electricity to their customers. CitiPower has the highest total cost per kilometre of circuit line length. As the most customer dense network in the NEM, this finding must be considered with caution, as 'per km' metrics tend to favour DNSPs with lower customer densities. However, compared to United Energy, which has a similar average customer density, CitiPower performs relatively poorly. Ausgrid reports the second highest total cost per kilometre of circuit line length in the NEM, and performs worse than some networks with relatively higher customer densities (Evoenergy, Jemena and United Energy).

Figure 5.4 Total cost per kilometre of circuit line length ($2019) (average 2015–2019)

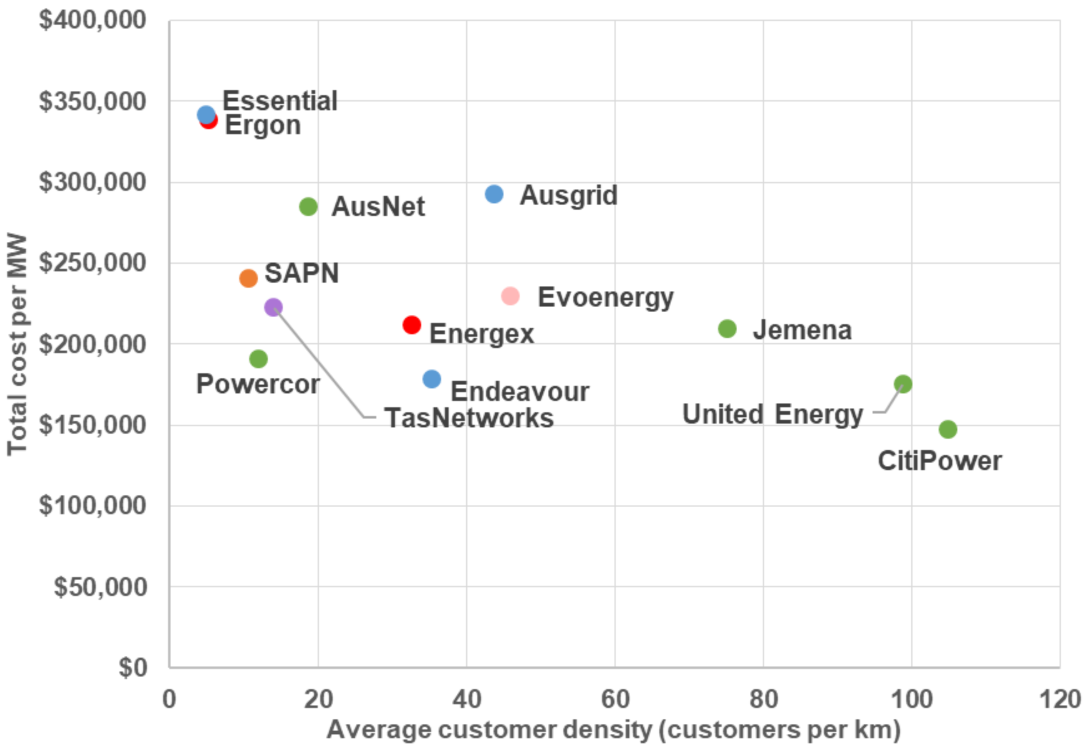


Source: AER analysis; Economic Benchmarking RINs.

Total cost per MW of maximum demand

Figure 5.5 shows each DNSP's total cost per MW of maximum demand. DNSPs install assets to meet maximum demand. Maximum demand also indirectly influences opex, as installed assets require maintenance (opex). Similar to total cost per customer, the measure of total cost per MW of maximum demand favours DNSPs with higher customer density. However, the spread of results tends to be narrower than that of the other metrics.

Figure 5.5 Total cost per MW of maximum demand ($2019) (average 2015–19)



Source: AER analysis; Economic Benchmarking RINs.

5.2.2 Cost category PPIs

This section presents the opex category level cost PPIs over the 2015–19 period. These compare a DNSP's category level opex (vegetation management, maintenance, emergency response, and total overheads) against a relevant output.[64] The data for these PPIs are from the category analysis RIN and economic benchmarking RIN reported to the AER.[65]

When used in isolation, these category level PPI results should be interpreted with caution. This is because reporting differences between DNSPs may limit like-for-like category level comparisons. For example, DNSPs may allocate and report opex across categories differently due to different ownership structures, and the cost allocation

[64] We have considered a number of possible output measures such as the length of lines, the energy delivered, the maximum demand and the number of customers served by the service provider. Each of these output measures have advantages and disadvantages. We explain our choice of selected output measure for each of the PPIs below.

[65] We have used the category analysis RIN for category level expenditure data, and the economic benchmarking RIN for non-expenditure data (i.e. route line length, number of interruptions etc.). The expenditure data reported in the category analysis RIN reflects the cost allocation methodology, service classification and reporting requirements in place at the time the RIN was submitted.

policies it has in place at the time of reporting. There may also be differences in the interpretation and approaches taken by DNSPs in preparing their RIN data.

In its submission to a draft of this report Energy Queensland considered there is a need to review the benchmarking data to ensure there is more consistent interpretation among DNSPs and that the data quality continues to improve.[66] It notes consistent interpretation is an issue for vegetation management (see section 7 where this is discussed) and queried the emergency response cost definition (see the discussion below).

We use category level PPIs as supporting benchmarking techniques in our distribution determinations to identify potential areas of DNSP inefficiency. As noted in section 2, to date we have not used these opex cost category PPIs to determine the magnitude of any opex efficiency adjustments but rather as qualitative cross checks of our top-down benchmarking results.

Vegetation management

Vegetation management expenditure includes tree trimming, hazard tree clearance, ground clearance, vegetation corridor clearance, inspection, audit, vegetation contractor liaison, and tree replacement costs. We measure vegetation management per kilometre of overhead route line length because overhead line length is the most relevant proxy of vegetation management costs.[67]

Figure 5.6 shows that Endeavour Energy, Ausgrid and United Energy have the highest vegetation management expenditure per kilometre of overhead circuit line length relative to other DNSPs in the NEM and relative to DNSPs with similar customer density. In terms of other DNSPs with similar customer density, Evoenergy benchmarks relatively better, although its cost per kilometre of overhead circuit line length has increased since the 2019 Annual Benchmarking Report. This likely reflects that since July 2018 Evoenergy has been required to undertake vegetation management in the public spaces in urban areas of the ACT (whereas this activity was previously undertaken by the ACT government).

In contrast, Ergon Energy, Essential Energy, SA Power Networks and Powercor have the lowest vegetation management expenditure per kilometre of overhead circuit line length in the NEM. As ‘per km’ measures tend to favour networks with smaller customer densities, the relative performance of these DNSPs is somewhat expected.

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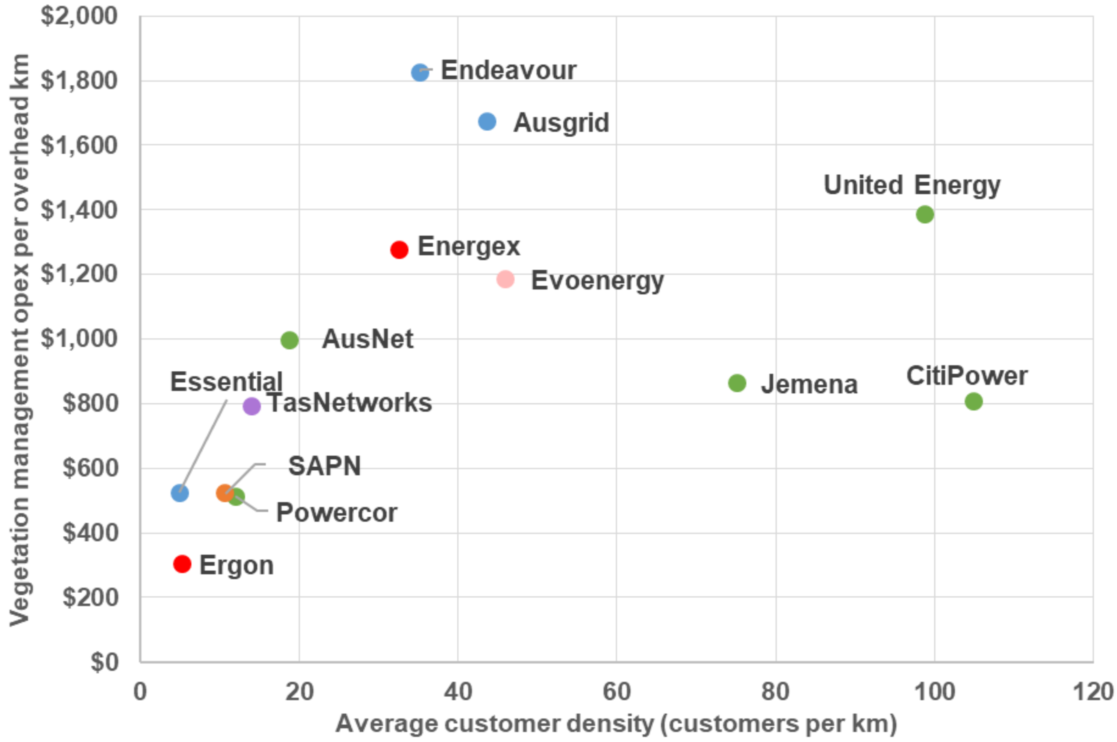
66 Energy Queensland, *Submission on the AER’s 2020 draft benchmarking report*, 10 November 2020, pp. 2–5.

67 We note that route line length contains lengths of lines that are not vegetated. Vegetation maintenance spans is a better indicator of the length of vegetated spans. However, we have used overhead route line length instead of vegetation maintenance span length due to DNSPs' estimation assumptions affecting maintenance span length data.

Figure 5.6 Vegetation management opex per km of overhead circuit length ($2019) (average 2015–19)



Source: AER analysis; Category Analysis RINs; Economic Benchmarking RINs.

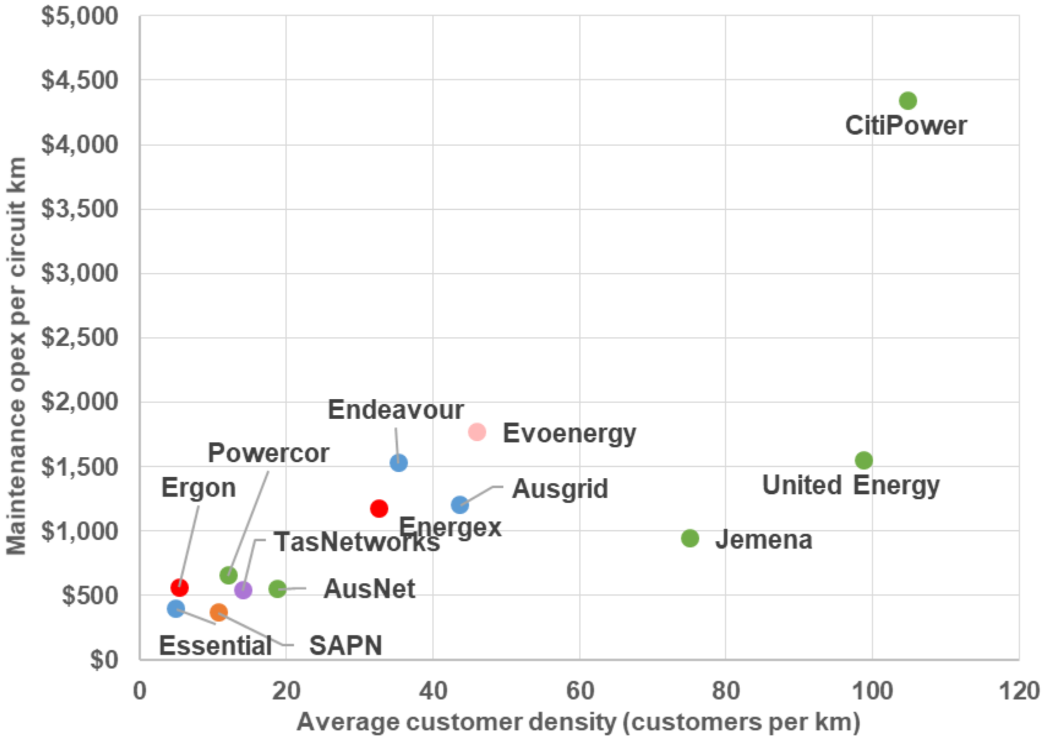
Maintenance

Maintenance expenditure relates to the direct opex incurred in maintaining poles, cables, substations, and protection systems. It excludes vegetation management costs and costs incurred in responding to emergencies. We measure maintenance per circuit kilometre because assets and asset exposure are important drivers of maintenance costs.[68] We used circuit length because it is easily understandable and a more intuitive measure of assets than transformer capacity or circuit capacity.

While CitiPower is one of the best performers in our opex MPFP analysis and econometric benchmarking, Figure 5.7 shows that it has highest maintenance opex spend per km of circuit length in the NEM. As a high customer density network, CitiPower is likely to be somewhat disadvantaged through the use of 'per km' metrics. However, even compared to other customer dense networks in the NEM, CitiPower still performs relatively poorly.

68 Circuit line length includes both overhead and underground cables.

Figure 5.7 Average maintenance opex spend per circuit km ($2019) (average 2015–19)



Source: AER analysis; Category Analysis RINs; Economic Benchmarking RINs.

Emergency response

Emergency response expenditure is the direct opex incurred in responding to network emergencies.[69] We measure emergency response costs per circuit km because network emergencies primarily affect powerlines and poles in the field (e.g. due to storms, fires and road accidents leading to network interruptions and loss of power). Using circuit length also allows for comparisons with maintenance opex per km and vegetation management opex per overhead km. The amount of opex spent on maintenance and vegetation management can influence the instances and severity of emergency responses, and in turn there may be trade-offs between maintenance, vegetation management and emergency response.

Figure 5.8 shows that CitiPower, United Energy, Ausgrid and Energex have higher emergency response cost per km relative to other DNSPs of similar customer density,

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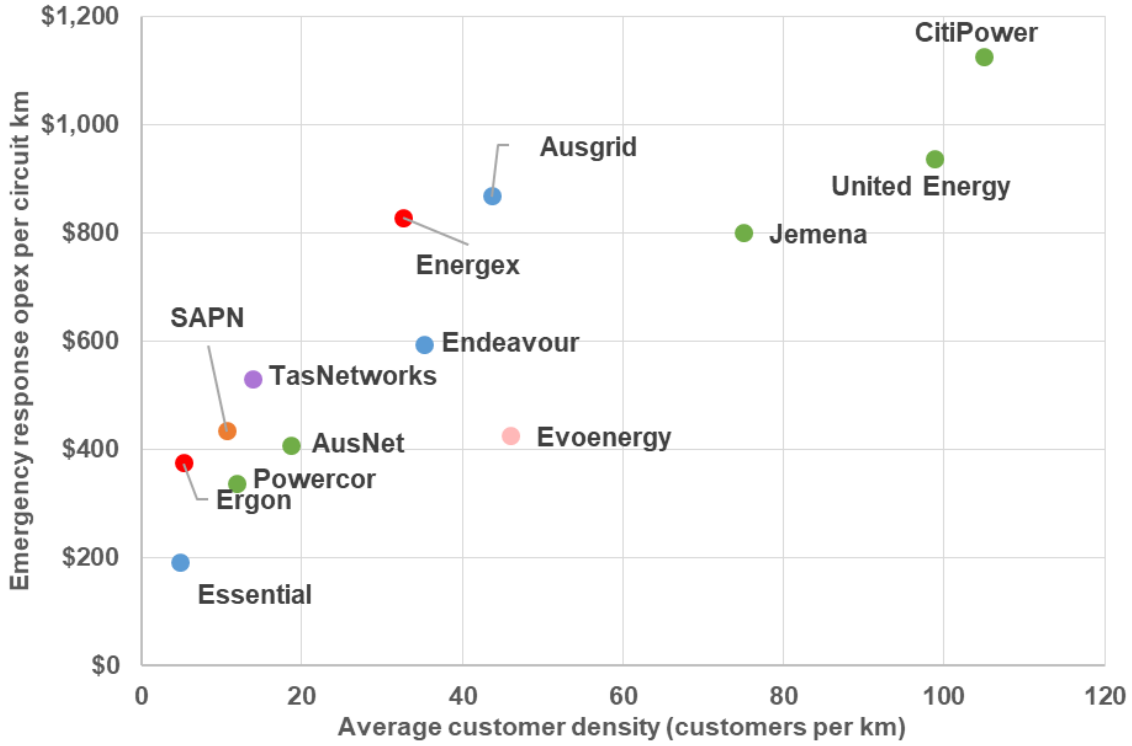
[69] We have not excluded opex associated with major events, including major event days, consistent with our approach for total opex where we do not exclude specific cost categories. We also have concerns with how consistently costs associated with major events are reported. Note this issue was raised by Energy Queensland in its submission to the draft benchmarking report. Energy Queensland, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 5.

and in the NEM. In comparison, Essential Energy, Ergon Energy and Powercor have the lowest emergency response costs per km. There may be higher costs associated with responding to emergencies in more customer dense networks due to the costs of managing congestion (e.g. closing roads and managing traffic).

Figure 5.8 Average emergency response spend per circuit km ($2018) (average 2014–18)



Source: AER analysis; Category Analysis RINs; Economic Benchmarking RINs.

Note: Jemena's data excludes emergency response opex in 2015 and 2016. Jemena claimed confidentiality on its emergency response data for these years in its Category Analysis RIN.

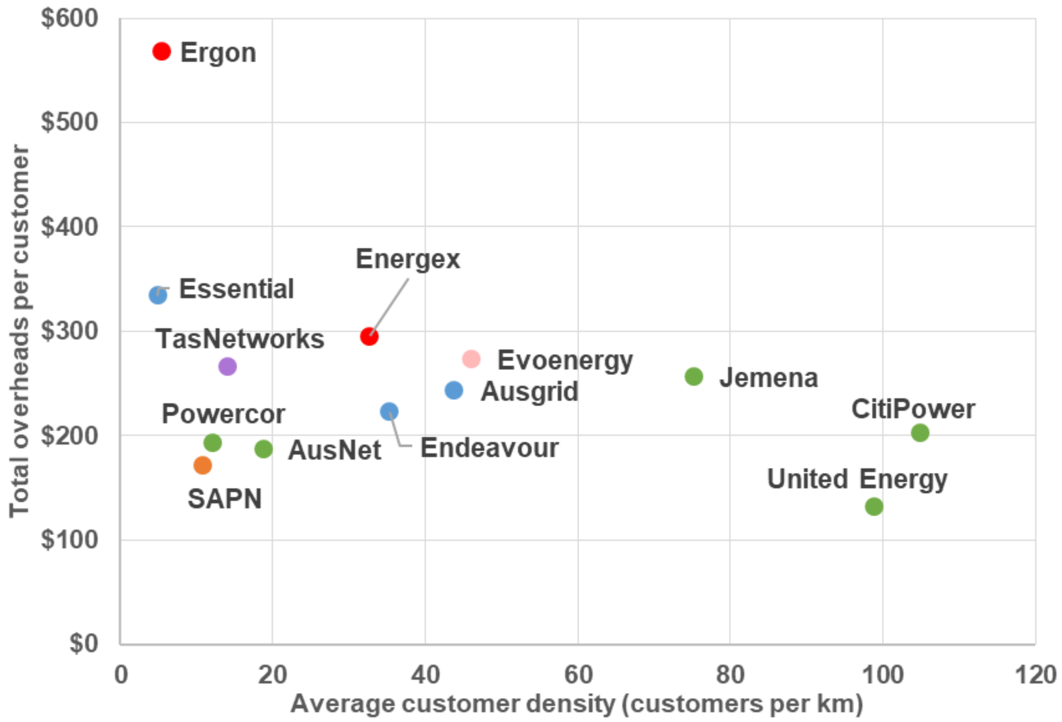
Total overheads

Total overheads are the sum of corporate and network overheads allocated to standard control services. We measure total overheads allocated to both capex and opex to ensure that differences in a DNSP's capitalisation policy does not affect the analysis.[70] It also mitigates the impact of a DNSP's choice in allocating their overheads to corporate or network services.

70 By doing this, any differences in capitalisation approaches between DNSPs, i.e. whether a cost is classified as opex or capex, does not impact the comparison. This is important because, as set out in Appendix D, there are differences in capitalisation approaches between DNSPs, and some DNSPs have changed approaches over time.

We have examined total overheads by customer numbers because it is likely to influence overhead costs. Figure 5.9 shows that Ergon Energy has higher overhead costs compared to all other DNSPs in the NEM, including those DNSPs with similar customer densities. While the ‘per customer’ measure may favour DNSPs with higher customer density, we do not consider this explains Ergon’s relative performance. This is because it has higher costs relative to DNSPs of similar customer densities such as Essential Energy.

Figure 5.9 Total Overheads per customer ($2019) (average 2015–19)



Source: AER analysis; Category Analysis RINs; Economic Benchmarking RINs.

6 The impact of different operating environments

This section outlines the impact of differences in operating environments not directly included in our benchmarking models. This gives stakeholders more information to interpret the benchmarking results and assess the efficiency of DNSPs. We have also quantified many of the operating environment factors (OEFs) set out below to include in network determinations as a part of our opex efficiency analysis, particularly when using the results from the four econometric opex cost function models.

DNSPs do not all operate under exactly the same operating environments. When undertaking a benchmarking exercise, it is desirable to take into account how OEFs can affect the relative expenditures of each service provider when acting efficiently. This ensures we are comparing like-with-like to the greatest extent possible. By considering these operating conditions, it also helps us determine the extent to which differences in measured performance are affected by exogenous factors outside the control of each business.

Our economic benchmarking techniques account for differences in operating environments to a significant degree. In particular:

- The benchmarking models (excluding partial performance indicators) account for differences in customer, energy and demand densities through the combined effect of the customer numbers, network length, energy throughput and ratcheted peak demand output variables. These are material sources of differences in operating costs between networks.
- The opex cost function econometric models also include a variable for the proportion of power lines that are underground. DNSPs with more underground cables will, all else equal, face less maintenance and vegetation management costs and fewer outages.
- The opex included in the benchmarking is limited to the network service activities of DNSPs. This excludes costs related to metering, connections, street lighting and other negotiated services, which can differ across jurisdictions or are outside the scope of regulation and helps us compare networks on a similar basis.
- The capital inputs for MTFP and capital MPFP exclude sub-transmission transformer assets that are involved in the first stage of two-stage transformation from high voltage to distribution voltage, for those DNSPs that have two stages of transformation. These are mostly present in NSW, QLD and SA, and removing them better enables like-for-like comparisons.

However, our benchmarking models do not directly account for differences in legislative or regulatory obligations, climate and geography. These may materially affect the operating costs in different jurisdictions and hence may have an impact on our measures of the relative efficiency of each DNSP in the NEM. As a result, we, and the consultants we engaged to provide us advice on OEFs in 2017, Sapere-Merz, used the following criteria to identify relevant OEFs.[71]

Criteria for identifying relevant OEFs

1. **Is it outside of the service provider's control?** Where the effect of an OEF is within the control of the service provider's management, adjusting for that factor may mask inefficient investment or expenditure.
2. **Is it material**? Where the effect of an OEF is not material, we would generally not provide an adjustment for the factor. Many factors may influence a service provider’s ability to convert inputs into outputs.
3. **Is it accounted for elsewhere?** Where the effect of an OEF is accounted for elsewhere (e.g. within the benchmarking output measures), it should not be separately included as an OEF. To do so would be to double count the effect of the OEF.[72]

Sapere-Merz identified a limited number of OEFs that materially affect the relative opex of each DNSP in the NEM, reflecting its (and our) analysis and consultation with the electricity distribution industry.[73] These are:

- the higher operating costs of maintaining sub-transmission assets
- differences in vegetation management requirements
- jurisdictional taxes and levies
- the costs of planning for, and responding to, cyclones
- backyard reticulation (in the ACT only)
- termite exposure.

Sapere-Merz’s analysis and report also provided:

- preliminary quantification of the incremental opex of each OEF on each DNSP in the NEM, or a method for quantifying these costs

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71 In 2017, we engaged Sapere Research Group and Merz Consulting (‘Sapere-Merz’) to provide us with advice on material OEFs driving differences in estimated productivity and operating efficiency between DNSPs in the NEM. See its final report Sapere Research Group and Merz Consulting, *Independent review of Operating Environment actors used to adjust efficient operating expenditure for economic benchmarking*, August 2018.

72 For example, our models capture the effect of line length on opex by using circuit length as an output variable. In this context, an operating environment adjustment for circuit length would double count the effect of route line length on opex. Another example is that we exclude metering services from our economic benchmarking data. In this case, an operating environment adjustment would remove the metering services from services providers' benchmarked opex twice.

73 The Sapere-Merz report includes more detail about the information and data it used, our consultation with the distribution industry, and the method for identifying and quantifying these OEFs.

- illustration of the effect of each OEF on our measure of the relative efficiency of each DNSP, in percentage terms, using a single year of opex.[74]

A brief overview of each of the material factors follows.

Sub-transmission operating costs (including licence conditions)

Sub-transmission assets relate to the varying amounts of higher voltage assets (such as transformers and cables) DNSPs are responsible for maintaining. The distinction between distribution and sub-transmission assets is primarily due to the differing historical boundaries drawn by state governments when establishing distribution and transmission businesses. In addition, DNSPs in NSW and QLD have historically faced licence conditions that mandated particular levels of redundancy and service standards for network reliability on their sub-transmission assets. DNSPs have little control over these decisions.

Sub-transmission assets cost more to maintain than distribution assets as they are more complex to maintain and higher voltage lines generally require specialised equipment and crews.[75] Our benchmarking techniques do not directly account for these differences in costs. This is because our circuit line length and ratcheted demand output metrics do not capture the incremental costs to service sub-transmission assets compared to distribution assets. It is necessary to consider these relative costs when evaluating the relative efficiency of DNSPs using our benchmarking results.

Sapere-Merz's analysis of sub-transmission costs suggests that most of the NSW and QLD DNSPs require between four and six per cent more opex to maintain their sub-transmission assets, compared to a reference group of efficient DNSPs. Conversely, TasNetworks requires four per cent less opex because it has far fewer sub-transmission assets.[76]

Vegetation management

DNSPs are required to ensure the integrity and safety of overhead lines by maintaining adequate clearances from vegetation, which involves various activities (see section 5.2.2). Vegetation management expenditure accounts for between 10–20 per cent of total opex for most DNSPs and can differ due to factors outside of their control. Some of these factors include:

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74 See Sapere Research Group and Merz Consulting, *Independent review of Operating Environment Factors used to adjust efficient operating expenditure for economic benchmarking*, August 2018, p. 35.

75 Sapere Research Group and Merz Consulting, *Independent review of Operating Environment Factors used to adjust efficient operating expenditure for economic benchmarking*, August 2018, p.48.

76 Sapere Research Group and Merz Consulting, *Independent review of Operating Environment Factors used to adjust efficient operating expenditure for economic benchmarking*, August 2018, p.55.

- different climates and geography affect vegetation density and growth rates, which may affect vegetation management costs per overhead line kilometre and the duration of time until subsequent vegetation management is again required
- state governments, through enacting statutes, decide whether to impose bushfire safety regulations on DNSPs
- state governments also make laws on how to divide responsibility for vegetation management between DNSPs and other parties.

Sapere-Merz found that variations in vegetation density and growth rates, along with variations in regulation around vegetation management, are likely to be a material and exogenous driver of variations in efficient vegetation management opex. However, under its suggested methods, it could not quantify this OEF based on available data.[77] Sapere-Merz observed that while total vegetation management opex is collected, data about the spans impacted and the density of vegetation needs refinement and consultation with DNSPs to ensure consistency. Sapere-Merz noted that if reliable and consistent data was available, then an OEF could be estimated. It also proposed refinements in relation to regulatory (bushfire regulation and division of responsibility) data.[78]

Recognising this as an area for improvement, we have undertaken some analysis into the quantity and quality of data related to vegetation management. Our main focus was assessment of network characteristic data in the RINs relating to spans, including the total number of vegetation management spans, with a view to calculating an OEF.[79] However, we were not able to develop any clear conclusions from this analysis due to concerns regarding the comparability and consistency of some of the data. For example:

- there may be some inconsistency in DNSPs' definitions of active vegetation management span
- differences in contractual arrangements and vegetation management cycles also raised comparability concerns.

As discussed in section 7.1, we intend to consult further with DNSPs in refining the data and methodology for calculating this OEF.

While not able to use Sapere-Merz's suggested methodology, or our further work, to quantify the impacts of any differences arising due to vegetation management, in our

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77 Sapere Research Group and Merz Consulting, *Independent review of Operating Environment Factors used to adjust efficient operating expenditure for economic benchmarking*, August 2018, pp. 65–66.

78 Sapere Research Group and Merz Consulting, *Independent review of Operating Environment Factors used to adjust efficient operating expenditure for economic benchmarking*, August 2018, pp. 67–68.

79 A span refers to the distance between two poles. If a DNSP records poles rather than spans, the number of spans can be calculated as the number of poles less one. Total vegetation management spans refer to the number of spans in a DNSP's network that are subject to active vegetation management practices (i.e. not merely inspection) in the relevant year.

recent reset decisions for Queensland and Victorian DNSPs, we included a vegetation management OEF in our benchmarking analysis.[80] This used the same method as in the previous (2015) Queensland determination and involved the summation of two exogenous factors:

- differences in vegetation management obligations relating to managing bushfire risk
- differences in the division of responsibility for vegetation clearance with local councils, road authorities and land owners.

As done in 2015 we quantified the differences in the costs related to bushfire obligations by examining the increase in costs faced by Victorian DNSPs following the 2009 Black Saturday bushfires. These reflect an incremental difference in bushfire risk and responsibilities between the Victorian and non-Victorian DNSPs. This quantification was based on forecast costs of step changes and opex pass throughs for the Victorian DNSPs that we approved for the 2011–15 period. The increased opex incurred as a result of these new regulations is used as a proxy for the differences in costs of managing bushfire risks in Victoria compared to other states. We updated the cost estimates for the relevant benchmark periods and new comparator benchmark DNSPs.

We calculated a division of responsibility OEF for Ergon Energy and Energex[81] to reflect the cost disadvantage these DNSPs face in the scale of vegetation management responsibility compared to the benchmark comparator firms in Victoria and South Australia. This is because in Queensland DNSPs are responsible for vegetation clearance from all network assets, whereas other parties such as councils, landowners and roads authorities are responsible for some vegetation clearance in Victoria and South Australia. We derived the OEF adjustment by calculating:

- how much of the vegetated lines in Victoria and South Australia were managed by parties other than the DNSPs (e.g. local councils) in those states, and
- then multiplying the proportion of opex that relates to vegetation management by the proportionate increase in responsibility the Queensland DNSPs faced relative to the Victorian and South Australian distribution businesses.

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80 AER, *Final decision Ergon Energy distribution determination 2020−25 Attachment 6 - Operating expenditure*, June 2020, p. 25; AER, *Draft decision Energex distribution determination 2020−25 Attachment 6 - Operating expenditure*, June 2020, p. 57–79; AER, *Draft decision Jemena distribution determination 2021−26 Attachment 6 - Operating expenditure*, September 2020, pp. 40–41; AER, *Draft decision AusNet Services distribution determination 2021−26 Attachment 6 - Operating expenditure*, September 2020, pp. 34–35.

81 This OEF adjustment is by definition zero for any Victorian or South Australian DNSP since the cost disadvantage is calculated by comparison to the division of responsibility applying in Victoria or South Australia.

Cyclones

Cyclones require a significant operational response including planning, mobilisation, fault rectification and demobilisation. DNSPs in tropical cyclonic regions may also have higher insurance premiums and/or higher non-claimable limits. Ergon Energy is the only DNSP in the NEM that regularly faces cyclones. Sapere-Merz estimated that Ergon Energy requires up to five per cent more opex than other DNSPs in the NEM to account for the costs of cyclones.[82]

Taxes and levies

A number of jurisdictions require the payment by DNSPs of state taxes and levies such as licence fees and electrical safety levies. As they are state-based, any such taxes or levies could vary between jurisdictions and hence DNSPs. These are outside the control of DNSPs.

Sapere-Merz provided a preliminary quantification of the impact of taxes and levies on each DNSP. This was based on information provided by each DNSP in its RINs and in response to information requests. The impact of differences in taxes and levies generally do not have a significant impact on the relative costs of DNSPs (i.e. beyond one per cent). However, Sapere-Merz estimated that TasNetworks requires five per cent more opex than other DNSPs due to significant costs imposed by the Tasmanian Electrical Safety Inspection Levy.[83]

Backyard reticulation in the ACT

Historical planning practices in the ACT mean that in some areas overhead distribution lines run along a corridor through backyards rather than the street frontage as is the practice for other DNSPs. Although landowners are theoretically responsible for vegetation management along the majority of these corridors, Evoenergy has a responsibility to ensure public safety, which includes inspecting backyard lines and issuing notices when vegetation trimming is required. Sapere-Merz estimated that Evoenergy requires 1.6 per cent more opex than other DNSPs in the NEM to manage backyard power lines in the ACT.[84]

Termite exposure

DNSPs incur opex when carrying out termite prevention, monitoring, detecting and responding to termite damage to assets. These costs depend on the number of a DNSP's assets that are susceptible to termite damage and the prevalence of termites

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[82] Sapere Research Group and Merz Consulting, *Independent review of Operating Environment Factors used to adjust efficient operating expenditure for economic benchmarking*, August 2018, p. 77.

[83] Sapere Research Group and Merz Consulting, *Independent review of Operating Environment Factors used to adjust efficient operating expenditure for economic benchmarking*, August 2018, p. 72.

[84] Sapere Research Group and Merz Consulting, *Independent review of Operating Environment Factors used to adjust efficient operating expenditure for economic benchmarking*, August 2018, p. 80.

within the regions where the DNSP’s assets are located. Termite exposure is the smallest of the material OEFs identified by Sapere-Merz. Its preliminary analysis suggested that termite exposure primarily affects Ergon Energy and Essential Energy, where they require 1 per cent more opex to manage termites.[85]

Network accessibility

Some DNSPs may incur higher cost of network access to undertake route maintenance (e.g. due to adverse climate and heavy rainfall). In its final report, Sapere-Merz noted that a network accessibility OEF (for Power and Water in the Northern Territory) would require further data and analysis to determine if it met the OEF criteria.[86]

In our recent determination for Ergon Energy, we included a network accessibility OEF in our benchmarking analysis.[87] We had included this OEF in our previous (2015) Ergon Energy decision, and considered that the network accessibility circumstances faced by Ergon Energy have likely not changed since our 2015 assessment.[88] We relied on our 2015 assessment approach, with updated data on network without standard vehicle access up to 2018. Where this OEF is relevant and data is satisfactory, we intend to apply this approach.

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85 Sapere Research Group and Merz Consulting, *Independent review of Operating Environment Factors used to adjust efficient operating expenditure for economic benchmarking*, August 2018, p. 74.

86 Sapere Research Group and Merz Consulting, *Independent review of Operating Environment Factors used to adjust efficient operating expenditure for economic benchmarking*, August 2018, p. 31.

87 AER, *Final decision Ergon Energy distribution determination 2020−25 Attachment 6 - Operating expenditure*, June 2020, pp. 23–24.

88 AER, *Preliminary decision Ergon Energy distribution determination 2015−20 Attachment 7 - Operating expenditure*, April 2015, p. 248. We upheld this number in the final decision. See AER, *Final decision Ergon Energy distribution determination 2015−20 Attachment 7 - Operating expenditure*, October 2015, p. 53.

7 Benchmarking development

We operate an ongoing program to review and incrementally refine elements of the benchmarking methodology and data. The aim of this work is to maintain and continually improve the reliability and applicability of the benchmarking results we publish and use in our network revenue determinations.

We categorise our benchmarking development work as:

- ongoing incremental improvement in data and methods that support our annual benchmarking reporting
- specific issues that have the potential to materially affect the benchmarking results and should involve consultation with affected stakeholders
- changes and improvements in the way that we and other stakeholders use economic benchmarking in decision making.

Our 2019 Annual Benchmarking Report outlined our recent benchmarking improvements and our priorities for future development work.[89] We have made limited progress advancing this development work in 2020 due to competing priorities. As a result the issues identified in our 2019 Annual Benchmarking Report remain our priority areas for development over the course of the next 12 months.

Our future development program has been informed by submissions we received from DNSPs and other stakeholders. This included submission to our previous annual benchmarking reports (including the preparation of this report), issues raised throughout revenue determinations processes, and specific reviews such as our operating environment factor review. In consulting on a draft of this report there was broad support from stakeholders for progressing the development areas identified below.[90] Stakeholders made specific comments in relation to both ongoing incremental improvements to our dataset and methods and the specific issues requiring further investigation, with many noting their readiness to work with the AER and other DNSPs in progressing these issues.

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89 AER, *2019 Annual Benchmarking Report, Electricity distribution network service providers*, November 2019, pp. 41–42.

90 Endeavour Energy, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 4; SA Power Networks, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, pp. 1–2; Essential Energy, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 2; Energy Networks Australia, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 2; Consumer Challenge Panel (CCP), *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 2.

7.1 Ongoing incremental improvement

Further to the areas of incremental improvement identified in the 2019 Annual Benchmarking Report we have also included two additional issues reflecting advice from our consultant Economic Insights.

The key areas for ongoing incremental improvement to our dataset and methods include:

- Continual data refinements in response to our annual review of benchmarking RIN data and data issues identified by stakeholders.
- Examining the weight allocated to the reliability output in the PIN models and whether it should be capped in some way.
- Improving the performance of the opex cost function models and in particular the performance of the two Translog models, particularly in relation to satisfying the key property that an increase in output can only be achieved with an increase in costs.
- Continuing to improve and update the quantification of material OEFs working with DNSPs. This includes updating the datasets used to quantify individual OEFs and quantifying the impact of OEFs that have not yet been considered. Improving the data and quantification of the vegetation management OEF will be a particular focus, as discussed in section 6, e.g. consistency in DNSPs' definitions of active vegetation management span, and understanding differences in DNSP contractual arrangements and vegetation management cycles.

On reliability, Essential Energy supported further investigation into the capping of the reliability output, given that high weights for the reliability output may distort the efficiency results.[91]

Several stakeholders also supported our continuing to improve the quantification of material OEFs.[92] Many submissions also stated that more investigation is required in relation to existing OEFs to build on the initial work undertaken by Sapere-Merz, particularly in relation to vegetation management and sub-transmission. Some stakeholders submitted that improving comparability and consistency of data on vegetation management was a priority.[93] In addition, Essential Energy considered that

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91 Essential Energy, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 3.

92 Endeavour Energy *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 4; Energy Queensland, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 7; AusNet, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 3; Essential Energy, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 2; Consumer Challenge Panel (CCP), *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 5.

93 Endeavour Energy, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 4; Energy Queensland, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 2; Essential Energy, *Submission on the AER's 2020 draft benchmarking report,* 10 November 2020, p. 3.

the set of material OEFs should potentially be expanded to include Network Accessibility, weather events (in addition to cyclones) and Fauna.[94]

AusNet also suggested that in light of forthcoming changes to the Victorian GSL scheme we should revisit whether GSL payments should be a part of the benchmarking, particularly as the payments do not represent the underlying reliability of the network.[95]

7.2 Specific issues for investigation

In addition to the above incremental development work, consistent with last year, we consider there are three key issues that have the potential to materially impact the benchmarking results and/or are changes and improvements in the way that we and other stakeholders use economic benchmarking in decision making, and which should involve consultation with stakeholders. These are:

- The implications of cost allocation and capitalisation differences on the benchmarking results
- The future review of benchmarking output specifications to account for distributed energy resources
- The choice of benchmarking comparison point when making our opex efficiency assessments.

These issues are discussed briefly below.

Differences in cost allocation and capitalisation approaches

We continue to receive submissions and feedback in relation to the implications of cost allocation and capitalisation differences, and ongoing changes, on the benchmarking results. Some submissions suggest that these differences are leading to differences in benchmarking results that are unrelated to the efficiency of DNSPs and that some DNSPs are disadvantaged due to their cost allocation/capitalisation decisions. This includes submissions to a draft of this report, where many stakeholders noted their support of further work and consultation to investigate the impact of different cost allocation/capitalisation approaches on benchmarking. Appendix D summarises these submissions.

We are also observing a number of changes in cost allocation methods by DNSPs since we began benchmarking.

We have made some progress in examining these issues and the implications. We have focused our analysis on capitalisation practices rather than cost allocation more generally, as this has been the consistent focus of stakeholder feedback. Capitalisation

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94 Essential Energy, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 3.

95 AusNet, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 3.

practices include both capitalisation policy (which can be changed via a DNSP's Cost Allocation Method (CAM)) and opex/capital trade-offs.

Our past considerations and recent analysis are set out in Appendix D. While our analysis is ongoing, we have examined the ways in which we can measure the differences in capitalisation practices to understand whether the benchmarking results are being impacted. As set out in Appendix D, we continue to see merit in using opex/capital ratios as a high level gauge of the net effect of capitalisation practices on benchmarking. We have updated the opex/totex ratios first used in our NSW 2015 decisions and have included two further measures that capture the opex/capital mix, namely opex cost-to-total cost and opex input-to-total inputs. While we have examined a variety of measures that we consider useful as high level gauges of capitalisation practices, we also recognise that each of these measures has limitations.

Broadly, however, our preliminary conclusion remains that capitalisation practices are not likely to be having a sizeable impact on efficiency results for most DNSPs. For most of the measures analysed, the differences between the comparator DNSP and other DNSPs is within 5–7 percentage points. As noted below, further work is needed on how to specify a more precise materiality threshold. However, we acknowledge that there may be some DNSPs with outlier opex/capital ratios and in those instances we may consider it appropriate to adopt a case-by-case approach, where we will perform sensitivity analysis, including potentially making OEF adjustments.

Over the next 12 months, we intend to further extend and consult on this issue. We consider this a priority area for benchmarking development. Based on stakeholder feedback and our recent analysis, we will examine and consult on a range of issues, including:

- the most appropriate methods to measure differences in capitalisation practices across DNSPs, including various ratios of opex-to-capital, and the capacity of these measures to account for material capitalisation policy differences and opex/capex trade-offs
- where these measures indicate that a DNSP's capitalisation practices are materially different to the comparators', the best way to address this, including:
    - use of an OEF adjustment to its efficiency scores (as previously used in resets)
    - whether alternative benchmarking approaches could supplement or substitute our current approach, such as including a fixed proportion of total overheads in the opex series for benchmarking purposes
    - benchmarking on the basis of DNSPs' current CAMs (incorporating their most recent capitalisation policy), in addition to or instead of our current approach of backcasting opex for benchmarking based on DNSPs' CAMs that existed at the start of our benchmarking in 2014.

Review of benchmarking modelling to account for distributed energy resources

We have also continued to receive submissions from some stakeholders about the impact that distributed energy resources is having, or is likely to have, on DNSPs' comparative benchmark performance.

Distributed energy resources includes such things as rooftop photovoltaics (e.g. solar panels), batteries and electric vehicles. This is an emerging issue and reflects the evolution of the electricity distribution industry and the expected increase in distributed energy across the NEM. The rollout and penetration of distributed energy resources varies significantly across the NEM and currently affects some DNSPs more than others. This is likely to change as more distributed energy is rolled out across the NEM.

In recent years, several DNSPs have made submissions on the inclusion of distributed energy resources in the outputs of the benchmarking models. In particular, submissions have noted that the rise of distributed energy resources has:

- potentially reduced the importance and/or relevance of currently included outputs, namely RMD and energy throughput, which may have contributed to a decline in measured productivity
- raised questions about whether energy throughput and RMD remain appropriate outputs to include
- raised questions about whether an additional output is required to recognise distributed energy
- led to additional costs being incurred, which also needs to be considered in the benchmarking analysis.

Many submissions commenting on a draft of this report supported further work to investigate the impact of distributed energy resources on benchmarking (particularly the output specification) given it is likely to become a more material issue and is subject to AEMC considerations of the proposed 'DER access and pricing rule changes' and SA Power Network's proposed rule changes.[96] It was noted this could be combined with a review of the output weights.[97]

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96 Endeavour Energy, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 5; SA Power Networks, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, pp. 1–2; Energy Queensland, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 3; Consumer Challenge Panel (CCP), *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 6; Public Interest Advocacy Centre, *Submission on the AER's 2020 draft benchmarking report*, 19 November 2020, pp. 1–2.

97 Endeavour Energy, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 5.

Currently, the energy throughput output variable captures changes in the amount of energy delivered to customers over the distribution network as measured at the customer meter. It does not measure energy delivered into the distribution network via distributed energy resources, such as from residential rooftop solar panels. In the extreme, an increase in rooftop solar panels could potentially involve a substitution of different energy sources amongst the same customers without changing the total energy consumed or materially changing the existing network in terms of circuit length or maximum demand. However, a distributor may be required to incur higher opex and/or capital to manage the safety and reliability of its network. In this situation there could be a material increase in inputs without a corresponding increase in any or all of the output measures.

Economic Insights noted in its 2020 benchmarking report that distributed generation is becoming increasingly common in Australia and poses a number of challenges, and there is an imperative on DNSPs to respond to the associated increase in the proportion of two–way electricity flows. It considers it will be important to investigate the scope to include this as an additional output in the index number models. It also notes that whether this can be extended to the opex cost function models will depend on the availability of similar data for the overseas jurisdictions.[98]

We acknowledge that more work will need to be done to properly assess impacts of this nature. To the extent they are material, it would be appropriate to review the specifications of the outputs to appropriately account for the relationship between changes in inputs and growth in distributed energy. Such a review will not be confined to just removing certain outputs—it will need to consider whether it is appropriate to add new outputs[99] as well as removing any obsolete outputs. Such a review would also need to consider the data requirements for any new output specification.

We consider that it will be appropriate in the next 12 months to scope the issues to be considered to ensure the benchmarking models appropriately account for the impact of distributed energy resources on the electricity distribution industry. As noted in section 1.1, as a part of any development work in the context of considering the impacts of distributed energy, it may also be appropriate to consider a review of the output specification and weights, including the suggestions from NERA.

Some DNSPs submitted that the corrected PIN model output weights (which we have included in this report, as discussed in section 1 and Appendix C) should have been part of a broader consultation on output specification, including on the incorporation of

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98 Economic Insights, *Economic Benchmarking Results for the Australian Energy Regulator's 2020 DNSP Annual Benchmarking Report*, 13 October 2020, p. 12.

99 For example, we note Energy Queensland's submission that the development of a new variable to account for differences in single-wire earth return (SWER) networks between DNSPs should be considered. See Energy Queensland, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, pp. 3–4.

DER.[100] We consider it is appropriate to incorporate the corrected output weights in this report, rather than as part of a broader review of the output specification. Our view, and that of Economic Insights, is that errors, once identified, should be corrected as soon as possible.

Benchmarking comparison point

In recent years, the AER's Consumer Challenge Panel has advocated for a review of the selection of the benchmark comparison points that we use in our regulatory decisions.[101] In our opex decisions as a part of the revenue determinations, we draw on the efficiency scores from our econometric opex cost function models (as contained in section 5.1 of this report) to assess the efficiency of individual DNSPs' historical opex and base year opex and determine any efficiency adjustments. We do this by comparing the efficiency scores of individual DNSPs against a benchmark comparison score of 0.75 (adjusted further for OEFs), which reflects the upper quartile of possible efficiency scores by DNSPs. The Consumer Challenge Panel has advocated for a raising of our benchmark comparison point and a tightening of the analysis of whether a DNSP is "not materially inefficient".

Some submissions to a draft of this report considered that review of the 0.75 benchmark comparison point we currently use could not occur prior to the other development issues being addressed.[102] In contrast, the CCP maintained its view that this is a priority issue and that the benchmark comparison point should be raised above 0.75, stating that the current approach is inadequate to ensure that the AER determines the efficient benchmark operating costs for a distribution network.[103]

As we have previously noted, our benchmarking comparison point is conservative and provides a margin for general limitations of the models with respect to the specification of outputs and inputs, data imperfections and other uncertainties when forecasting efficient opex. We consider that it is appropriate to be conservative while our benchmarking models are maturing and the underlying data and method are being refined as set out above. It is also important to provide certainty to industry and other stakeholders because benchmarking is an input into decision making.

We recognise the differing views from stakeholders on prioritisation of this issue relative to other benchmarking development issues and noting this feedback will review the relative priority of addressing this issue. Any assessment of the appropriateness of the current benchmark comparison point will take account of the refinements and

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100 Jemena, *Submission on Economic Insights' 2020 draft benchmarking report,* 9 September 2020, pp. 3–4; Endeavour Energy, *Submission on the AER's 2020 draft benchmarking report,* 10 November 2020, pp. 2, 4.

101 See Consumer Challenge Panel (CCP), *Submission to the AER Opex Productivity Growth Forecast Review Draft Decision Paper*, 20 December 2018, p. 13.

102 Essential Energy, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 2.

103 Consumer Challenge Panel (CCP), *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, pp. 6–7.

improvements we make to our benchmarking approaches and metrics over time. It will also involve examining the practices of other regulators to inform our considerations.

Power and Water Corporation benchmarking

Further to the development work noted above, under section 6.27A of the NER (Northern Territory), Power and Water Corporation (‘Power and Water’) is now a relevant DNSP for our annual benchmarking report. Power and Water transitioned to the NER in 2018 but has not been included in our previous annual benchmarking reports.

This is because we do not consider that the economic benchmarking of Power and Water is currently at a stage where we can use it to assess its efficiency relative to other DNSPs in the NEM. Its benchmarking and regulatory data is relatively immature compared to other DNSPs in the NEM and needs to be thoroughly examined to ensure it is fit for purpose for benchmarking. We are also mindful of the challenges of Power and Water’s potentially unique operating environment in assessing its efficiency relative to the rest of the NEM. While some preliminary qualitative OEF analysis was undertaken by Sapere-Merz in 2018, this requires further work and development.[104]

We intend to review Power and Water’s benchmarking data, and assess the impact of its operating environment, with the aim of including it in our future benchmarking reports. This would occur in advance of the start of its next regulatory control period, most likely in our 2022 Annual Benchmarking Report.

104 See the 2019 Annual Benchmarking Report where some of these factors were set out in further detail.

Shortened Forms

Shortened form	Description
AEMC	Australian Energy Market Commission
AER	Australian Energy Regulator
AGD	Ausgrid
AND	AusNet Services (distribution)
Capex	Capital expenditure
CIT	CitiPower
DNSP	Distribution network service provider
END	Endeavour Energy
ENX	Energex
ERG	Ergon Energy
ESS	Essential Energy
EVO	Evoenergy (previously ActewAGL)
JEN	Jemena Electricity Networks
MW	Megawatt
NEL	National Electricity Law
NEM	National Electricity Market
NER	National Electricity Rules
Opex	Operating expenditure
PCR	Powercor
RAB	Regulatory asset base
SAPN	SA Power Networks
TND	TasNetworks (Distribution)
UED	United Energy Distribution

Glossary

Term	Description
Efficiency	A Distribution Network Service Provider’s (DNSP) benchmarking results relative to other DNSPs reflect that network's relative efficiency, specifically their cost efficiency. DNSPs are cost efficient when they produce services at least possible cost given their operating environments and prevailing input prices.
Inputs	Inputs are the resources DNSPs use to provide services. The inputs our benchmarking models include are operating expenditure and physical measures of capital assets.
LSE	Least squares econometrics. LSE is an econometric modelling technique that uses 'line of best fit' statistical regression methods to estimate the relationship between inputs and outputs. Because they are statistical models, LSE operating cost function models with firm dummies allow for economies and diseconomies of scale and can distinguish between random variations in the data and systematic differences between DNSPs.
MPFP	Multilateral partial factor productivity. MPFP is a PIN technique that measures the relationship between total output and one input. It allows partial productivity levels as well as growth rates to be compared.
MTFP	Multilateral total factor productivity. MTFP is a PIN technique that measures the relationship between total output and total input. It allows total productivity levels as well as growth rates to be compared between businesses. In this year’s annual benchmarking report, we also apply the method to time-series TFP analysis at the industry level and for individual TNSP to better capture large ENS changes.
Network services opex	Operating expenditure (opex) for network services. It excludes expenditure associated with metering, customer connections, street lighting, ancillary services and solar feed-in tariff payments.
OEFs	Operating environment factors. OEFs are factors beyond a DNSP’s control that can affect its costs and benchmarking performance.
Outputs	Outputs are quantitative or qualitative measures that represent the services DNSPs provide.
PIN	Productivity index number. PIN techniques determine the relationship between inputs and outputs using a mathematical index.
PPI	Partial performance indicator. PPIs are simple techniques that measure the relationship between one input and one output.
Ratcheted maximum demand	Ratcheted maximum demand is the highest value of maximum demand for each DNSP, observed in the time period up to the year in question. It recognises capacity that has been used to satisfy demand and gives the DNSP credit for this capacity in subsequent years, even though annual maximum demand may be lower in subsequent years.

Term	Description
SFA	Stochastic frontier analysis. SFA is an econometric modelling technique that uses advanced statistical methods to estimate the frontier relationship between inputs and outputs. SFA models allow for economies and diseconomies of scale and directly estimate efficiency for each DNSP relative to the estimated best practice frontier.
TFP	Total factor productivity is a PIN technique that measures the relationship between total output and total input over time. It allows total productivity changes over time or growth rates to be compared across networks. This method was used in previous annual benchmarking reports, and is relevant to our sensitivity analysis that examines the impact of changing the index method.
VCR	Value of Customer Reliability. VCR represents a customer's willingness to pay for the reliable supply of electricity.

A References and further reading

Several sources inform this benchmarking report. These include ACCC/AER research and expert advice provided by Economic Insights.

Economic Insights publications

The following publications explain in detail how Economic Insights developed and applied the economic benchmarking techniques used by the AER.

- Economic Insights, Memorandum – Advice on selected issues raised in DNSP ABR submissions, 20 November 2020
- Economic Insights, *Economic Benchmarking Results for the Australian Energy Regulator's 2019 DNSP Benchmarking Report*, 13 October 2020
- Economic Insights, *AER Memo Revised files for 2019 DNSP Economic Benchmarking Report*, 24 August 2020
- Economic Insights, *Economic Benchmarking Results for the Australian Energy Regulator's 2019 DNSP Benchmarking Report*, 5 September 2019
- Economic Insights, *Economic Benchmarking Results for the Australian Energy Regulator's 2018 DNSP Benchmarking Report*, 9 November 2018
- Economic Insights, *Economic Benchmarking Results for the Australian Energy Regulator's 2017 DNSP Benchmarking Report*, 31 October 2017
- Economic Insights, *Memorandum – DNSP Economic Benchmarking Results Report*, 4 November 2016
- Economic Insights, *Memorandum – DNSP MTFP and Opex Cost Function Results*, 13 November 2015
- Economic Insights, *Response to Consultants' Reports on Economic Benchmarking of Electricity DNSPs*, 22 April 2015 (link)
- Economic Insights, *Economic Benchmarking Assessment of Operating Expenditure for NSW and ACT Electricity DNSPs*, 17 November 2014 (link)
- Economic Insights, *Economic Benchmarking of Electricity Network Service Providers*, 25 June 2013.

ACCC/AER publications

These publications provide a comprehensive overview of the benchmarking approaches used by overseas regulators.

- ACCC/AER, *Benchmarking Opex and Capex in Energy Networks – Working Paper no. 6*, May 2012 (link)
- ACCC/AER, *Regulatory Practices in Other Countries – Benchmarking opex and capex in energy networks*, May 2012 (link)

- WIK Consult, *Cost Benchmarking in Energy Regulation in European Countries*, 14 December 2011 (link).

AER distribution determinations

The AER applies economic benchmarking to assess the efficiency of total forecast opex as proposed by distribution network service providers. These decisions provide examples of how the AER has applied benchmarking in its decision making:

- AER, Draft Decision, *Jemena distribution determination 2021–26 - Attachment 6 - Operating Expenditure*, September 2020 (link)
- AER, Draft Decision, *AusNet Services distribution determination 2021–26 - Attachment 6 - Operating Expenditure*, September 2020 (link)
- AER, Draft Decision, *Ergon Energy distribution determination 2020–21 to 2024–25 - Attachment 6 - Operating Expenditure,* October 2019 (link)
- AER, Draft Decision, *SA Power Networks distribution determination 2020–21 to 2024–25 - Attachment 6 - Operating Expenditure*, October 2019 (link)
- AER, Draft Decision, *Ausgrid distribution determination 2019–20 to 2023–24 - Attachment 6 - Operating Expenditure*, November 2018 (link)
- AER, *Ausgrid distribution determination 2014–15 to 2018–19,* January 2019 (link)
- AER, *Jemena distribution determination 2016 to 2020 - Attachment 7 - Operating Expenditure*, May 2016, p. 7–22 (link)
- AER, *Endeavour Energy distribution determination 2015–16 to 2018–19 - Attachment 7 - Operating Expenditure*, April 2015 (link)
- AER, Preliminary decision, *Energex determination 2015–16 to 2019–20 - Attachment 7 - Operating Expenditure*, April 2015 (link)
- AER, Preliminary decision, *Ergon Energy determination 2015–16 to 2019–20 - Attachment 7 - Operating Expenditure*, April 2015 (link).

B Benchmarking models and data

This appendix contains further information on our economic benchmarking models and techniques, as well as the output and input data used in the benchmarking techniques.

B.1 Benchmarking techniques

This report presents results from three types of 'top-down' benchmarking techniques.

1. **PIN**. These techniques use a mathematical index to determine the relationship between outputs and inputs, enabling comparison of productivity levels and trends over time.
    - TFP relates total inputs to total outputs and provides a measure of overall productivity growth for a single entity (a network or the whole industry). It allows total productivity growth rates to be compared across networks but does not allow productivity levels to be compared across networks. It is used to decompose productivity change into its constituent input and output parts.
    - MTFP relates total inputs (opex and capital) to total outputs and can provide a measure of overall network efficiency. It allows total productivity levels to be compared between networks.[105] It is applied to combined time-series, cross-section (or 'panel') data.
    - MPFP is a partial efficiency measure, which uses the same output specification as MTFP but separately examines the productivity of opex and capital inputs against total output.
2. **Econometric opex models.** These model the relationship between opex (as the input) and outputs, and so measure opex efficiency. The report presents two types of econometric opex models — LSE and SFA – and uses two types of functional form for each model – Cobb Douglas and translog.
3. **PPIs.** These techniques, also partial efficiency measures, relate one input to one output (contrasting with the above techniques that relate one or all inputs to total outputs). PPIs measure the average amount of an input (such as total cost or opex category costs) used to produce one unit of a given output (such as total customer numbers, megawatts of maximum electricity demand or kilometres of circuit length).

There are a number of important differences across the various models. In particular:

- Operating environment factors**.** The productivity index and econometric models include allowance for the key network density differences (e.g. customer density, maximum demand density). The econometric models also account for the degree of network undergrounding.
- Output variables. The econometric models include three outputs whereas the productivity index models include five outputs (the three outputs in the econometric

[105] There may be minor differences in MTFP and TFP growth rates for a particular firm due to differences in the sample means used in the calculations.

models plus energy delivered and reliability). The PPIs only include one output variable per indicator.

- Estimation technique:
  - The econometric opex models estimate two types of cost functions. The LSE opex cost function models use least squares estimation, whereas the SFA models use frontier estimation methods. The econometric models also estimates two different types of functional form—Cobb-Douglas and translog.
  - The opex MPFP model uses a non-parametric method.
- Data. The productivity index models and the PPIs use Australian data only, whereas the econometric opex models use Australian data and overseas data.

Notwithstanding the differences in the features and data requirements of each model, the opex efficiency results of each model are broadly consistent with each other (although there is some variation in individual DNSP results and the relative rankings of DNSPs). The broad similarity between the results from the opex MPFP model and the opex econometric models is particularly noteworthy, given the very different approaches. This reinforces the confidence in the results from each model.[106]

Economic Insights' 2020 report provides more detail on the econometric methodology and modelling results. The Economic Insights November 2014 report referenced in Appendix A also provides more information about each model, and the rationale supporting the choice of input and output specifications used in this report.

B.2 Benchmarking data

This appendix contains further information about the benchmarking data used in the benchmarking techniques (specifically the outputs and inputs data).

Inputs include a mix of the infrastructure assets needed to distribute electricity to end users and the network opex to run and maintain the network. DNSPs primarily exist to provide customers with access to a safe and reliable supply of electricity and a range of outputs have been selected to reflect this goal.[107]

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106 Economic Insights, *Economic benchmarking assessment of operating expenditure for NSW and ACT electricity DNSPs*, 17 November 2014, pp. 46–47.

107 The 17 November 2014 Economic Insights referenced in Appendix A details the input and output weights applied to constructing the productivity index numbers. The 9 November 2018 Economic Insights report contains further information on the updated output weights, while the 13 October 2020 Economic Insights report contains detail on a correction to these weights due to a coding error.

Categories of inputs and outputs used in benchmarking

Inputs:

- Capital stock (assets) is the physical assets DNSPs invest in to replace, upgrade or expand their networks. Electricity distribution assets provide useful service over a number of years or even several decades. We split capital into:
  - overhead distribution (below 33kV) lines
  - overhead sub-transmission (33kV and above) lines
  - underground distribution cables (below 33kV)
  - underground sub-transmission (33kV and above) cables
  - transformers and other capital
- Operating expenditure (opex) is expenditure needed to operate and maintain a network. Opex is an immediate input into providing services and is fully consumed within the reporting year.

Outputs:

- Customer numbers. The number of customers is a measure of the scale of the DNSP and the services a DNSP must provide. We measure the number of customers as the number of active connections on a network, represented by each energised national metering identifier.
- Circuit length. This reflects the distances over which DNSPs deliver electricity to their customers.
- Ratcheted maximum demand (RMD). DNSPs endeavour to meet the demand for energy from their customers when that demand is greatest. This means that they must build and operate their networks with sufficient capacity to meet the expected peak demand for electricity.[108]
- Energy delivered (MWh). Energy throughput is a measure of the amount of electricity that DNSPs deliver to their customers.
- Reliability (Minutes off-supply). Reliability measures the extent to which networks are able to maintain a continuous supply of electricity. Minutes off-supply enters as a negative output and is weighted by the value of consumer reliability.

The November 2014 Economic Insights referenced in Appendix B details the rationale for the choice of these inputs and outputs.

The econometric modelling differs from the other benchmarking techniques in that it uses Australian and overseas data. The lack of variability in the Australian DNSP data means that sufficiently robust results cannot be produced with Australian DNSP data

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108 The economic benchmarking techniques use 'ratcheted' maximum demand as an output rather than observed maximum demand. Ratcheted maximum demand is the highest value of peak demand observed in the time period up to the year in question for each DNSP. It recognises capacity that has been used to satisfy demand and gives the DNSP credit for this capacity in subsequent years, even though annual maximum demand may be lower in subsequent years.

alone using econometric methods. Economic Insights incorporated comparable data from electricity DNSPs in Ontario and New Zealand to increase the size of the dataset and enable more robust estimation of the opex cost function models. Sensitivity analysis of the econometric opex benchmarking results (using cost functions generated with and without the overseas data) indicates that the addition of the overseas data improves the robustness of the econometric opex models (by allowing better estimation of the opex cost function parameters) without distorting the estimation of individual DNSP's efficiency results. Appendix A contains references to further reading on how Economic Insights incorporated overseas data into the econometric models and the sensitivity analyses.

To prepare this year's report, each DNSP provided the AER with input and output data from their businesses as defined in standardised economic benchmarking regulatory information notices (EB RINs). The EB RINs require all DNSPs to provide a consistent set of data, which is verified by each DNSP's chief executive officer and independently audited. We separately tested and validated the data provided by the networks. Economic Insights prepared the benchmarking results using the set of agreed benchmarking techniques.[109] We provided the DNSPs with a draft version of the benchmarking report to allow each network to provide feedback on the results before we publically release the final benchmarking report.[110]

The complete data sets for all inputs and outputs from 2006 to 2019, along with the Basis of Preparation provided by each DNSP, are published on our website.[111]

B.2.1 Outputs

The techniques in this report measure output using some or all of customer numbers, circuit line length, maximum demand, energy throughput and reliability.

Customer numbers

The primary function of a distribution network is providing its customers with access to electricity. Regardless of how much electricity a customer consumes, infrastructure is required to connect every customer to the network. The number of customers, therefore, is a measure of the services a DNSP provides.[112]

Figure B.1 shows the average customer numbers of each DNSP over the five-year period from 2015 to 2019.

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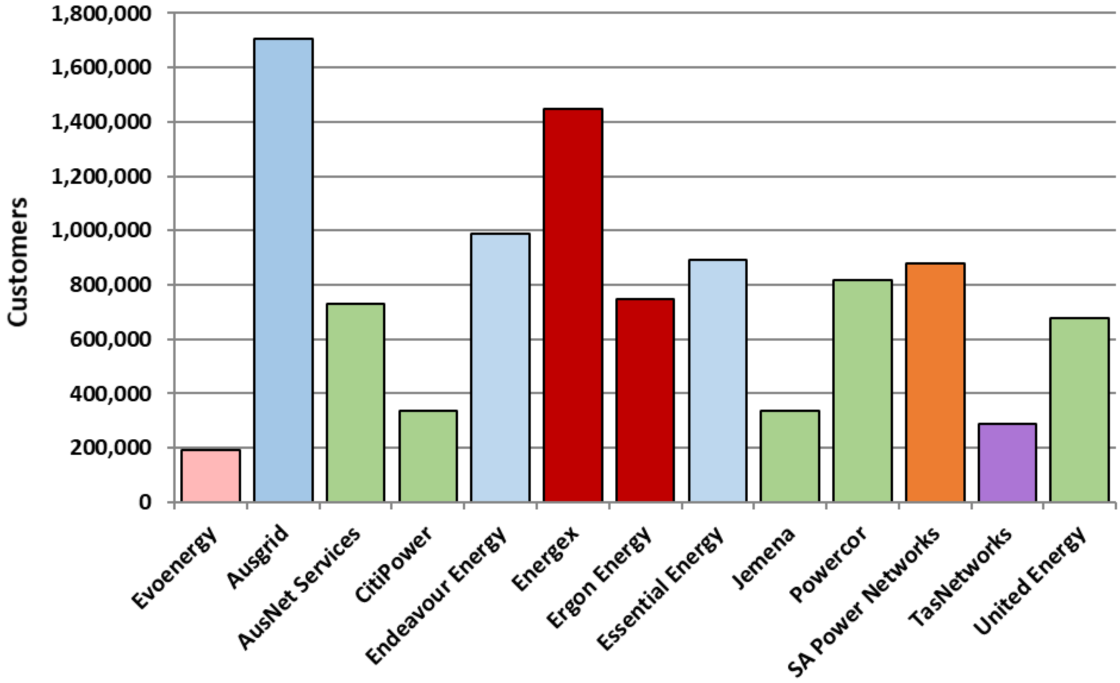
109 The Economic Insights report outlining the results for this year's report and the data and benchmarking techniques used can be found on the AER's benchmarking website.

110 NER, cll. 8.7.4(c)(1) and 8.7.4(c)(2).

111 This dataset is available at www.aer.gov.au/networks-pipelines/performance-reporting.

112 We measure the number of customers as the number of active connections on a network, represented by each energised national metering identifier.

Figure B.1 Five year average customer numbers by DNSP (2015–19)



Source: Economic Benchmarking RIN.

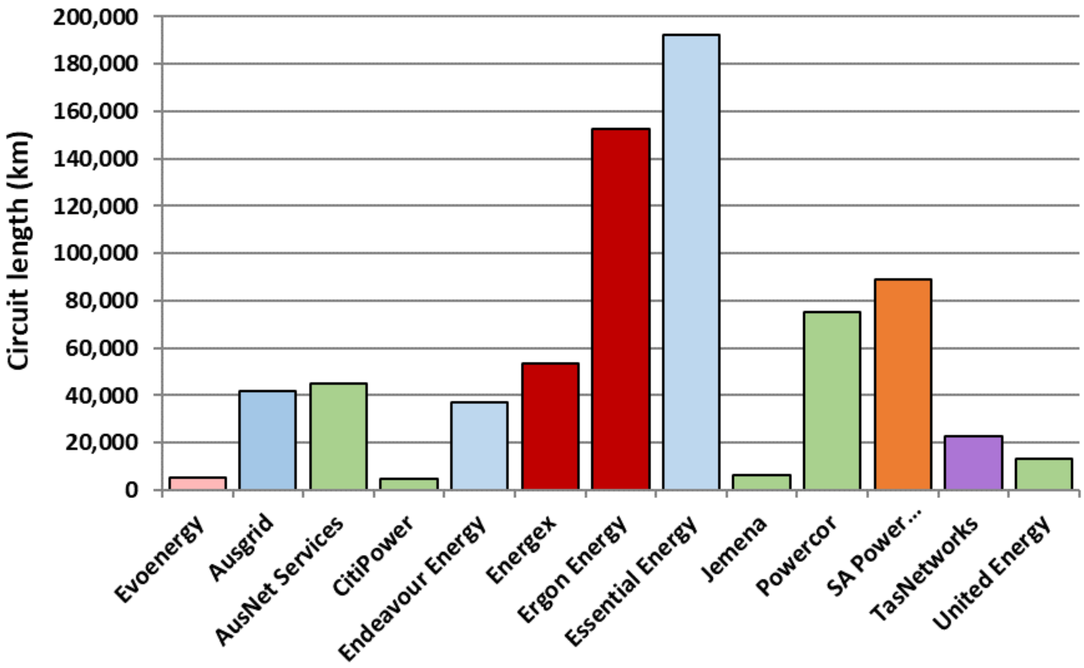
Circuit line length

Line length reflects the distances over which DNSPs deliver electricity to their customers. To provide their customers with access to electricity, DNSPs must transport electricity from the transmission network to their customers' premises. DNSPs will typically operate networks that transport electricity over thousands of kilometres.

In addition to measuring network size, circuit length also approximates the line length dimension of system capacity. System capacity represents the amount of network assets a DNSP must install and maintain to supply consumers with the quantity of electricity demanded at the places where they are located.

Figure B.2 shows each DNSP’s circuit length, on average, over the five years from 2015 to 2019.

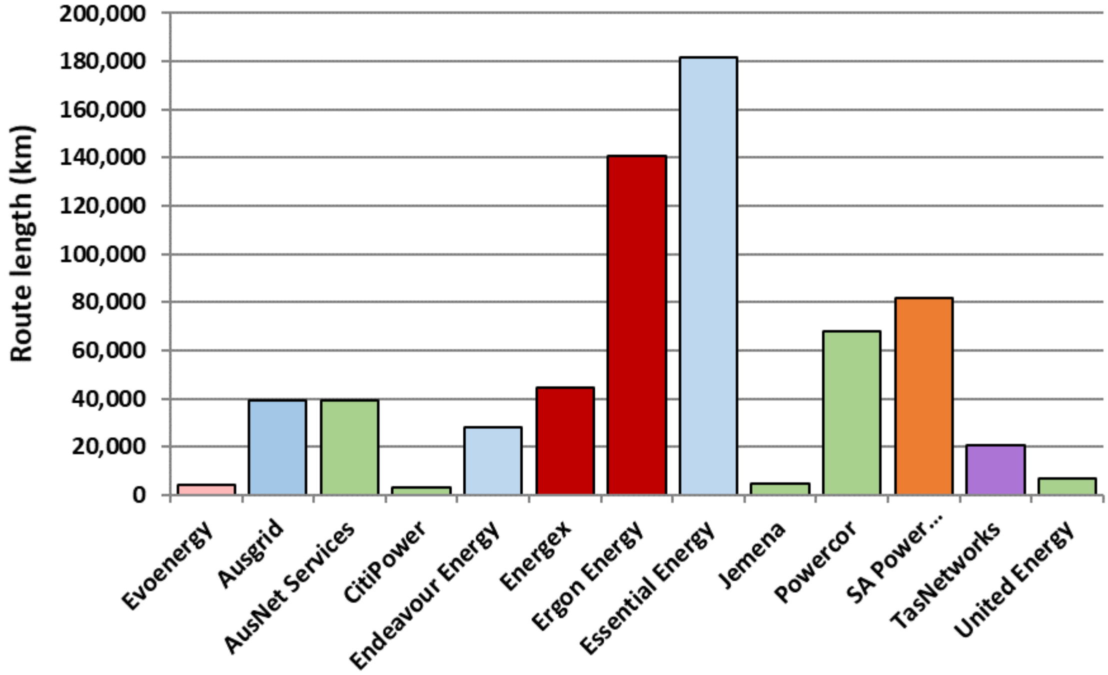
Figure B.2 Five year average circuit line length by DNSP (2015–19)



Source: Economic Benchmarking RIN.

For PPI metrics, we use route length to calculate customer density because it is a measure of a DNSP's physical network footprint (because it does not count multiple circuits on the same route). Figure B.3 demonstrates that, for all DNSPs, route length is shorter than circuit length but there is little to no change in DNSP rankings. The only difference is with Ausgrid having a smaller circuit length than AusNet but a marginally larger route line length than AusNet on average over the past five years.

Figure B.3 Five year average route line length by DNSP (2015–19)



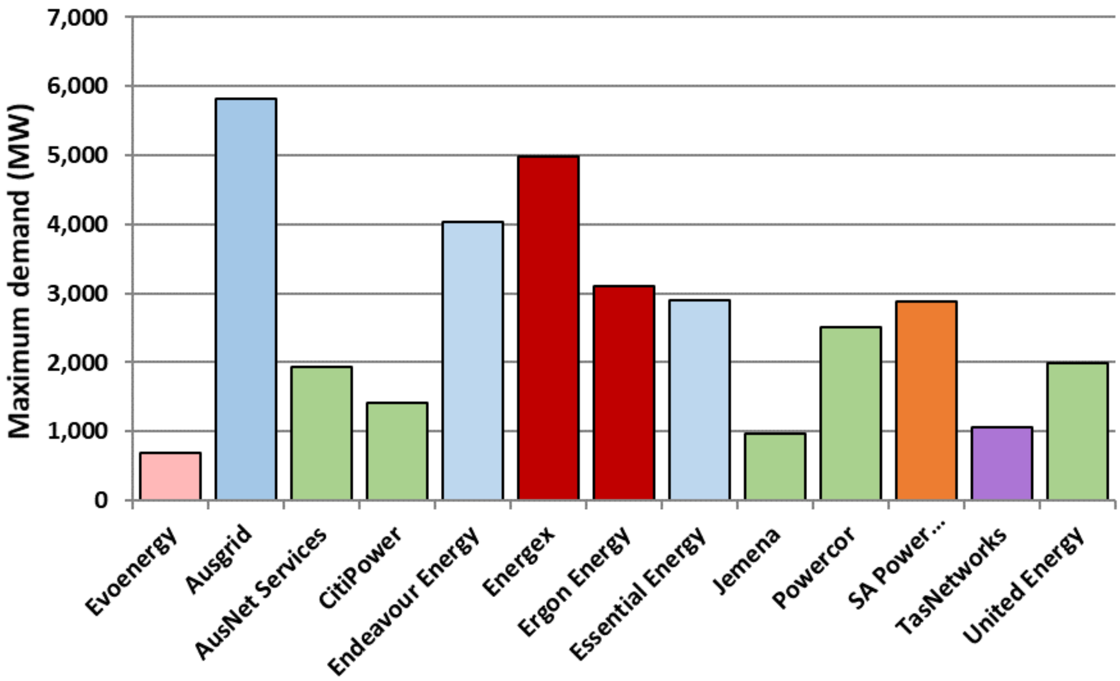
Source: Economic Benchmarking RIN.

Maximum demand

DNSPs are required to meet and manage the demand of their customers. This means that they must build and operate their networks with sufficient capacity to meet the expected peak demand for electricity. Maximum demand is a measure of the overall peak in demand experienced by the network. The maximum demand measure we use is non-coincident summated raw system annual maximum demand, at the transmission connection point, measured in megawatts (MW).

Figure B.4 shows each DNSP's maximum demand, on average, over the five years from 2015 to 2019.

Figure B.4 Five year average maximum demand by DNSP (2015–19)

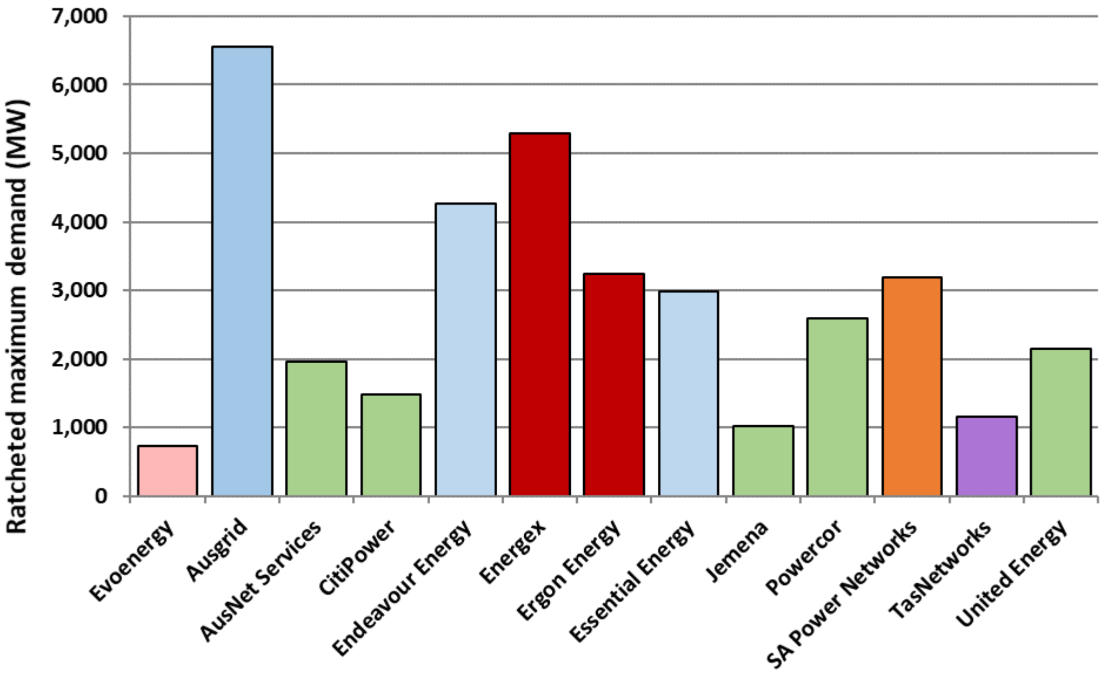


Source: Economic Benchmarking RIN.

The economic benchmarking techniques use 'ratcheted' maximum demand as an output rather than observed maximum demand. RMD is the highest value of peak demand observed in the time period up to the year in question for each DNSP. It thus recognises capacity that has actually been used to satisfy demand and gives the DNSP credit for this capacity in subsequent years, even though annual peak demand may be lower in subsequent years.

Figure B.5 shows each DNSP’s ratcheted maximum demand, on average, over the five years from 2015 to 2019.

Figure B.5 Five year average ratcheted maximum demand by DNSP (2015–19)



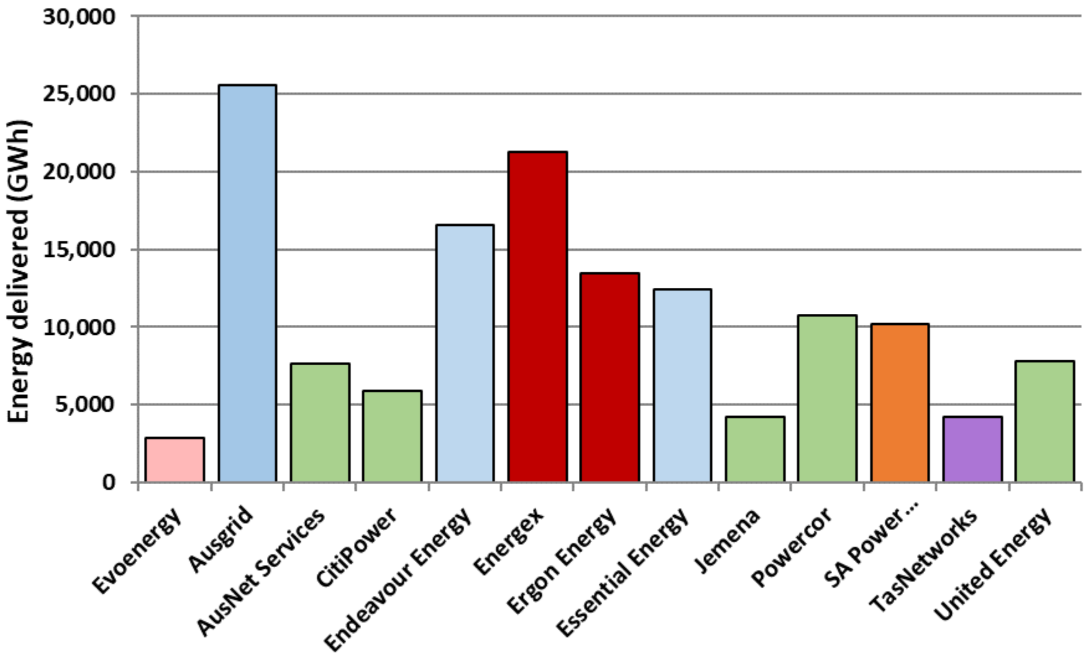
Source: Economic Benchmarking RIN.

Energy delivered

Energy delivered is a measure of the amount of electricity that DNSPs deliver to their customers. While energy throughput is not considered a significant driver of costs (distribution networks are typically engineered to manage maximum demand rather than throughput) energy throughput reflects a service provided directly to customers and is a key part of what they pay for in their bills. Energy delivered is measured in Gigawatt hours (GWh).

Figure B.6 shows each DNSP's energy delivered, on average, over the five years from 2015 to 2019.

Figure B.6 Five year average energy delivered by DNSP (2015–19)

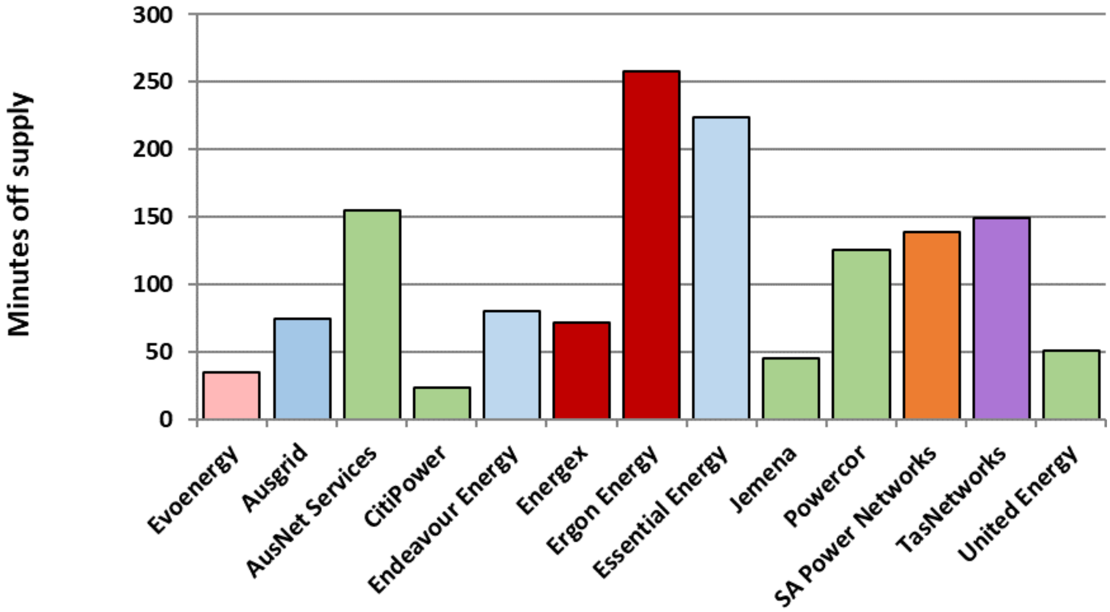


Source: Economic Benchmarking RIN.

Reliability

Another dimension of the outputs of DNSPs is the reliability of their electricity supply. This is commonly measured as the average number of minutes off-supply per customer (per annum) or the average number of interruptions per customer. Figure B.7 presents for each DNSP the average annual number of minutes off-supply per customer, excluding the effects of major events, planned outages and transmission outages.

Figure B.7 Average annual minutes off-supply per customer (2015–2019)

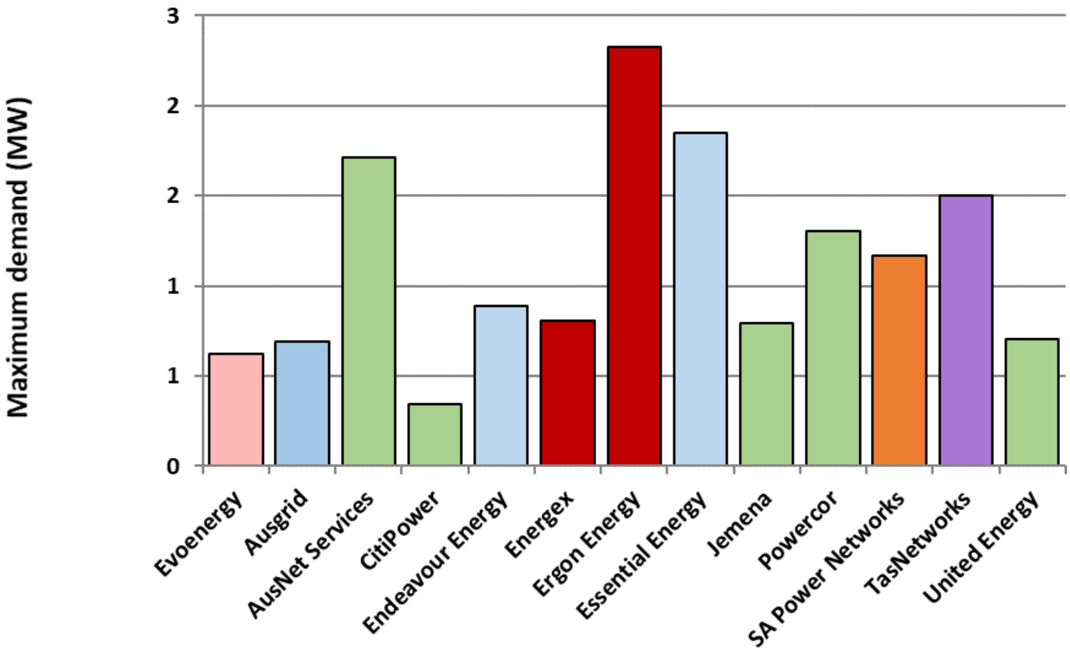


Source: Economic Benchmarking RIN.

Figure B.8 presents the average annual number of interruptions to supply per customer, excluding the effects of major events, planned outages and transmission outages. There are other measurements of reliability but the frequency and duration of interruptions to supply per customer are the Institute of Electrical and Electronics Engineers (IEEE) standard measures for DNSPs.

For productivity measurement purposes we use the number of customer minutes off-supply aggregated across all customers as the reliability output.

Figure B.8 Average annual number of interruptions per customer (2015–2019)



Source: Economic Benchmarking RIN.

B.2.2 Inputs

The inputs used in this report are assets and opex. DNSPs use a mix of assets and opex to deliver services. Electricity assets can provide useful service over several decades. However, benchmarking studies typically focus on a shorter period of time.

For our MTFP and TFP analyses we use physical measures of capital inputs. Using physical values for capital inputs has the advantage of best reflecting the physical depreciation profile of DNSP assets. Our MTFP and TFP analyses use five physical measures of capital inputs: the capacity of transformers, overhead lines of 33kV and above, overhead lines below 33kV, underground cables of 33kV and above, and underground cables below 33kV. The MTFP and TFP analyses also use constant dollar opex as an input. The November 2014 Economic Insights report referred to in Appendix A provides further detail on the capital inputs for MTFP and TFP.

For the purpose of PPI analysis we use the real value of the regulatory asset base as the proxy for assets as the starting point in deriving the real cost of using those assets. To be consistent with Economic Insights' MTFP and TFP analyses, and in response to a submission by Ausgrid,[113] we have adjusted the PPI analysis to remove assets associated with the first-stage of the two-step transformation at the zone substation

[113] Ausgrid, *Submission on the AER's 2016 draft benchmarking report*, 14 October 2016, p. 3.

level for those DNSPs with more complex system structures. This allows better like-with-like comparisons to be made across DNSPs.

Asset cost is the sum of annual depreciation and return on investment.[114] This measure has the advantage of reflecting the total cost of assets for which customers are billed on an annual basis, using the average return on capital over the period. This accounts for variations in the return on capital across DNSPs and over time.

Table B.1 presents measures of the cost of network inputs relevant to opex and assets for all DNSPs. We have presented the average annual network costs over five years in this table to moderate the effect of any one-off fluctuations in cost.

Table B.1 Average annual input costs for 2015–19 ($m, 2019)

	Opex	Asset cost
Evoenergy (ACT)	57.1	101.8
Ausgrid (AGD)	562.5	1,140.2
AusNet (AND)	215.1	336.8
CitiPower (CIT)	55.5	154.1
Endeavour Energy (END)	283.1	439.2
Energex (ENX)	375.8	679.5
Ergon Energy (ERG)	377.9	674.9
Essential Energy (ESS)	371.7	622.2
Jemena (JEN)	82.7	119.8
Powercor (PCR)	185.7	294.7
SA Power Networks (SAP)	255.4	437.3
TasNetworks (TND)	82.1	152.8
United Energy (UED)	126.2	223.4

Source: Economic Benchmarking RIN; AER analysis.

114 To calculate asset costs relevant to PPIs, MTFP, TFP, Capital MPFP and Capital PFP, where possible we have applied annual weighted average cost of capital values calculated in accordance with the AER's approach to setting rate of return in the most recent determination. These include a market risk premium of 6.5 per cent, and a risk free rate based on the yield of ten year CGS (noting we use a 365 day averaging period for each year in the benchmarking report). For this benchmarking report, we choose to continue to use the approach in previous benchmarking reports that use the Bloomberg BBB fair value curve (365 day averaging period) to calculate the debt risk premium. The AER's present approach averages ten year maturity BBB yields from the RBA and Bloomberg (appropriately extrapolated out to ten years where necessary). However, historical data going back to 2006 is not available for the RBA curve. Given this, we have continued to rely solely on estimates based on the Bloomberg fair value curve data. Where relevant, the tax component uses gamma of 0.4.

C Corrected output weights for the PIN techniques

C.1 Description of the output weight error and correction

As part of their initial proposals in the Victorian 2021–26 Electricity Distribution Pricing Review, CitiPower, Powercor and United Energy submitted a Frontier Economics report that raised concerns about statistical problems with the estimation of the cost function model used to determine the non-reliability output weights used in the opex MPFP model. In particular, it identified a coding error in the estimation of these weights.[115]

Economic Insights reviewed Frontier Economics' report and agreed there was a coding error in the estimation. Economic Insights found correcting this error significantly improves the performance of the cost function model and consequently mitigates the other concerns raised by Frontier Economics.[116]

The error affects the non-reliability output weights used in the PIN techniques, including the opex MPFP models. These techniques aggregate a range of outputs into an aggregate output index by allocating weights to each output. In our distribution benchmarking, these non-reliability output weights are taken from the estimated total cost function. In estimating the total cost function, the time trend (which is included to represent technological change) was incorporated incorrectly, which in turn generated incorrectly estimated output weights.[117]

Specifically, the time trend variable should start from a common integer value in the first year of each time period (2006) and then increment by one for each following year. For example, if the time trend is one in 2006, then it should be two in 2007, three in 2008, and so on, up until the final year of the sample (the time trend was 12 for 2017, which was the final year of data for the report this error was identified in). This should be the same for all occurrences of this variable in the dataset and should not vary among DNSPs.

However, in the coding the time trend variable was mistakenly formed over the entire sample. The data was structured by first ordering observations by DNSP and then chronologically by years. This meant the first 12 observations in the dataset were the 2006–17 observations of the first business in the database, then the 13th–24th

115 Frontier Economics, *Review of econometric models used by the AER to estimate output growth*, 5 December 2019, pp. 7–15.

116 Economic Insights, *Memorandum prepared for the AER on review of reports submitted by CitiPower, Powercor and United Energy on opex input price and output weights*, 18 May 2020.

117 Economic Insights, *Economic Benchmarking Results for the Australian Energy Regulator's 2020 DNSP Annual Benchmarking Report*, 13 October 2020, pp. 3–6.

observations were the 2006–17 observations from the second business, and so on. The time trend for the first business was correct; however, the time trend did not reset to start from one for the second business. This meant observation 13 in the database (the 2006 value for the second business) had a time trend value of 13 instead of one. This continued throughout the dataset which meant the time trend was incorrectly set to equal the observation's position in the dataset. Because the models are non-linear, this had a distorting effect on the results obtained.

The output weights used in the MTFP and MPFP benchmarking were updated by Economic Insights in 2018 based on estimation over the period 2006 to 2017.[118] The intention had been to use these weights for approximately five years. Given we now have an extra year of data, Economic Insights included the extra data when it re-estimated the models after correcting the coding error that impacts the non-reliability output weights. The corrected output weights are set out in Table 1.1.

C.2 Impact of the corrected output weights

We present here the DNSP MTFP and opex and capital MPFP rankings for 2019 using corrected output weights (from this year's report) and the previous output weights (from the 2019 Annual Benchmarking Report). This comparison is done using the data used in this year's benchmarking report. While there are some other less significant methodology changes (updated VCR estimates and revised index number method) this year, the effect of the change in weights has been isolated in the following results.

Tables C.1 to C.3 show the impact on the MTFP and MPFP results and rankings for the DNSPs in 2019. As can be seen in Tables C.1 to C.3, rural businesses like SA Power Networks, Essential Energy and Ergon Energy, which are more intensive with regard to circuit length, have relatively higher MTFP and MPFP results with the corrected weights. Urban businesses such as Ausgrid, Evoenergy and Jemena, which are more intensive with regard to customer numbers, have relatively lower MTFP and MPFP results. Energex and Endeavour Energy have higher MTFP and MPFP results with the corrected weights, although their rankings have decreased as the results of some rural DNSPs were more positively affected, leading to them ranking higher than Energex and Endeavour Energy.

Table C.1 2019 MTFP rankings and scores under corrected and previous weights

DNSP	Ranking - corrected weights	Ranking - previous weights	Score – corrected weights	Score – previous weights
SA Power Networks	1 ↑	3	1.506	1.301

118 Economic Insights, *Economic Benchmarking Results for the Australian Energy Regulator's 2018 DNSP Benchmarking Report*, 9 November 2018.

DNSP	Ranking - corrected weights	Ranking - previous weights	Score – corrected weights	Score – previous weights
CitiPower	2 ↓	1	1.381	1.501
Powercor	3 ↑	5	1.32	1.17
United Energy	4 ↓	2	1.292	1.354
Ergon Energy	5 ↑	8	1.29	1.031
Energex	6 ↓	4	1.206	1.179
Endeavour Energy	7 ↓	6	1.164	1.131
Essential Energy	8 ↑	13	1.129	0.9
TasNetworks	9 ↑	10	1.078	0.959
Jemena	10 ↓	7	1.03	1.093
AusNet	11 ↑	12	0.999	0.926
Evoenergy	12 ↓	9	0.978	0.986
Ausgrid	13 ↓	11	0.911	0.932

Table C.2 2019 Opex MPFP rankings and scores under corrected and previous weights

DNSP	Ranking - corrected weights	Ranking - previous weights	Score – corrected weights	Score – previous weights
Powercor	1 ↑	2	1.754	1.555
CitiPower	2 ↓	1	1.454	1.58
TasNetworks	3 ↑	5	1.418	1.261
SA Power Networks	4 ↑	7	1.393	1.203
United Energy	5 ↓	3	1.369	1.435
Endeavour Energy	6 ↓	4	1.306	1.269
Energex	7 ↓	6	1.255	1.228
Essential Energy	8 ↑	11	1.178	0.939
Ergon Energy	9 ↑	13	1.15	0.919
AusNet	10	10	1.045	0.969
Evoenergy	11 ↓	8	0.998	1.006

DNSP	Ranking - corrected weights	Ranking - previous weights	Score – corrected weights	Score – previous weights
Ausgrid	12 ↓	9	0.973	0.995
Jemena	13 ↓	12	0.883	0.937

Table C.3 2019 Capital MPFP rankings and scores under corrected and previous weights

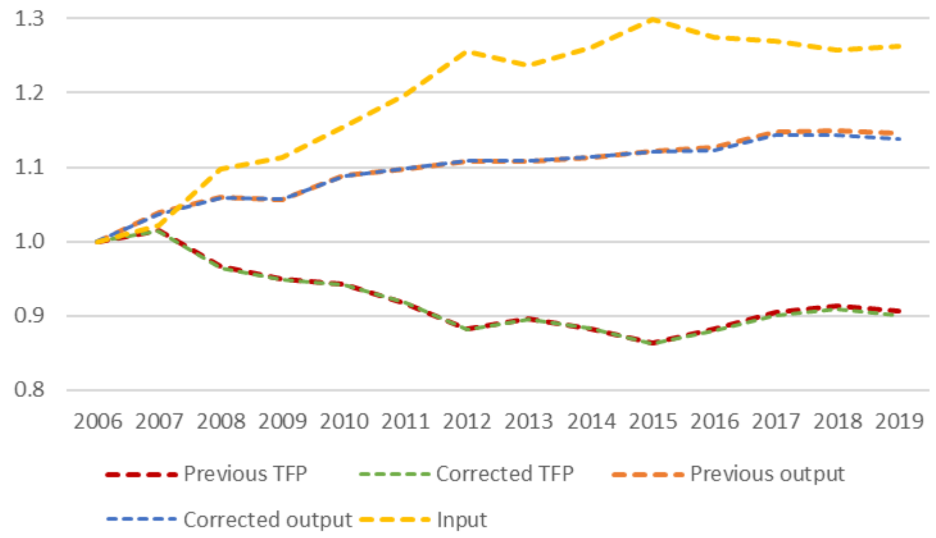
DNSP	Ranking - corrected weights	Ranking - previous weights	Score – corrected weights	Score – previous weights
SA Power Networks	1 ↑	2	1.578	1.363
CitiPower	2 ↓	1	1.404	1.526
Ergon Energy	3 ↑	6	1.377	1.1
United Energy	4 ↓	3	1.254	1.315
Energex	5	5	1.184	1.158
Jemena	6 ↓	4	1.141	1.21
Powercor	7 ↑	8	1.108	0.983
Endeavour	8 ↓	7	1.09	1.059
Essential Energy	9 ↑	12	1.087	0.867
Evoenergy	10 ↓	9	0.972	0.98
AusNet	11	11	0.97	0.9
TasNetworks	12 ↑	13	0.936	0.833
Ausgrid	13 ↓	10	0.902	0.923

Industry-wide impact of the corrected output weights

The correction made to output weights also affects total factor productivity (TFP) at the aggregate electricity distribution industry level. We present here a comparison of electricity distribution TFP and input and output indexes before and after the correction. As above, the impact of the output weight change is isolated here and other smaller methodology changes made this year are not factored into the analysis below.

Figure C.1 illustrates the impact of the output weight correction on TFP in the electricity distribution industry. From 2006–2015, this impact was negligible but a small divergence between the two series is apparent following 2015. The uncorrected output weights overstated the value of output and hence TFP somewhat from 2016 onwards.

Figure C.1 Electricity distribution industry TFP under corrected and previous weights (2006–19)



D Differences in cost allocation and capitalisation approaches that may impact on benchmarking results

As discussed in section 7, cost allocation and capitalisation differences between DNSPs may impact on the comparability of benchmarking results. This appendix outlines our recent analysis and findings as well as the issues that we consider require further analysis, investigation and consultation with stakeholders. We have focused the analysis below on capitalisation practices rather than cost allocation more generally, as this has been the consistent focus of stakeholder feedback.

Why might capitalisation differences pose a problem for our benchmarking and how we currently seek to address this

Differences in capitalisation practices can and do exist among the DNSPs. These can arise through differing capitalisation policies (which can be changed via a DNSP's Cost Allocation Method (CAM)) and/or different opex/capital mixes adopted by DNSPs in delivering required outputs and outcomes.[119] There have been changes in CAMs by a number of DNSPs since our first benchmarking report.

Changes for CitiPower[120] and Powercor[121] in 2016 and Ergon Energy[122] in 2015, have led to material changes in the costs allocated to network services opex, in particular through greater expensing of overheads. The AER also recently approved changes to Ergon Energy and Energex's[123] (combined) and Jemena's[124] CAMs that will apply from 2020 and 2021 onwards respectively. Among other things, Ergon Energy and Energex's new CAM applies Energex's current method of shared cost allocation to Ergon Energy. Under its new CAM Jemena will expense all of its corporate overheads. We expect that DNSP cost allocation methodologies will continue to change over time.

The aim of our benchmarking is that differences in benchmarking results should reflect differences in DNSPs' efficiency, with all other sources of differences accounted for

119 The scope for differences in DNSPs' cost allocation and capitalisation practices is not unlimited. Expenditure is prepared in accordance with applicable accounting standards, the DNSP's AER-approved CAMs (assessed against our Cost Allocation Guidelines), and the AER's instructions on the various RINs.

120 https://www.aer.gov.au/networks-pipelines/determinations-access-arrangements/cost-allocation-method/citipower-cost-allocation-method-2016

121 https://www.aer.gov.au/networks-pipelines/determinations-access-arrangements/cost-allocation-method/powercor-cost-allocation-method-2016

122 https://www.aer.gov.au/networks-pipelines/determinations-access-arrangements/cost-allocation-method/ergon-energy-cost-allocation-method-2018

123 https://www.aer.gov.au/networks-pipelines/determinations-access-arrangements/cost-allocation-method/ergon-energy-cost-allocation-method-2018

124 https://www.aer.gov.au/networks-pipelines/determinations-access-arrangements/cost-allocation-method/jemena-cost-allocation-method-2019

either directly in the econometric opex modelling (e.g. in the explanatory variables), or by adjustments to efficiency results for OEFs. In the context of resets, our opex assessments make substantial use of the opex benchmarking results. This means the manner in which a DNSP classifies its expenditure as opex or capex potentially impacts its opex (and capital) benchmarking scores. All else equal, greater expensing (capitalising) of expenditure will tend to worsen (improve) a DNSP's opex benchmarking score that we rely on in our opex assessments.

As a result, and to minimise the impact of changing CAMs and capitalisation approaches, our economic benchmarking is based on costs under the DNSPs' CAMs that applied from the start of 2014. Economic Insights' explains this as follows:[125]

> In line with previous practice, all Australian DNSPs' data for all years are based on the cost allocation methodologies (CAMs) that applied in 2014 rather than on more recently revised CAMs. The CAMs applying in 2014 (including ACT's revised CAM) led to opex/capex ratios being broadly consistent across DNSPs. 'Freezing' the CAMs at this point has minimised the scope for DNSPs to game the benchmarking results by reallocating costs between opex and capex and currently provides the best basis for like–with–like comparisons of overall network services opex in most cases.

Issues raised about the impact of differences in capitalisation practices

We have received various submissions in relation to the potential impact of differences in capitalisation practices on the benchmarking results. This includes submissions to a draft of this report. These are outlined below.

In its recent submissions, AusNet has observed that different DNSPs adopt different capitalisation approaches to allocate corporate overheads to opex and capex.[126] AusNet submitted that the different capitalisation approaches can materially impact the AER's opex benchmarking results and that these approaches are unrelated to the productivity of different networks. It put forward that establishing a standardised approach to the allocation of overheads is required to make meaningful comparisons between DNSPs.[127]

Jemena also presented benchmarking results that reflect CitiPower and Powercor's reported opex under its current CAM to demonstrate the impact that capitalisation changes are having on the benchmarking results.[128]

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125 Economic Insights, *Economic Benchmarking Results for the Australian Energy Regulator's 2020 DNSP Annual Benchmarking Report*, 13 October 2020, p. 14.

126 AusNet, *Submission on the AER's 2018 draft benchmarking report*, 17 October 2018, pp. 1–2; AusNet, *Submission on the AER's 2019 draft benchmarking report*, 9 October 2019, pp. 3–5, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, pp. 1–2.

127 AusNet, *Submission on Economic Insights' 2020 draft benchmarking report*, 7 September 2020, p. 1; AusNet, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, pp. 1–2.

128 Jemena, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 2–4.

In relation to measuring the materiality of the issue, some submissions thought our focus should be on capitalisation of overheads, rather than capex / opex trade-offs, and others questioned whether the ratios we have presented to measure these impacts can be relied upon.[129] Jemena expressed the concern that the opex/totex ratio could inadvertently capture capex differences unrelated to opex, e.g. different asset replacement cycle, asset age profiles, and capital contribution levels.[130]

In relation to how we might address the impact of capitalisation where material, AusNet, Endeavour Energy and SA Power Networks submitted that the AER should apply a consistent approach to capitalisation policies between DNSPs.[131] AusNet and Endeavour Energy stated that the AER could apply a fixed capitalisation ratio for every DNSP's overheads and this would equalise the impact of differences in corporate overheads capitalisation. The uniform application of a fixed capitalisation ratio would require a proportion of reported capex to be 'expensed' or a proportion of reported opex to be 'capitalised' for some or even all DNSPs.[132]

Ausgrid thought that while a fixed capitalisation rate would provide a consistent capitalisation rate for benchmarking purposes, it would not account for differences in capital spend requirements across each electricity distributor.[133] The CCP considered the AER should require more consistency in capitalisation approaches, albeit recognising that some flexibility in capitalisation practices will always be required.[134]

Further, several submissions to a draft of this report and the preliminary results from Economic Insights raised the possibility of benchmarking using current CAMs, rather than our current approach of using the frozen 2014 CAMs. This was on the basis that benchmarking should be reflective of the actual performance and opex levels that customers are paying for. It was noted that for some DNSPs there is a growing disconnect between actual opex and opex used for benchmarking purposes. Specific perspectives raised include:

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129 Endeavour Energy, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 4; Jemena, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 1–4; Consumer Challenge Panel (CCP), *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 5.

130 Jemena, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 2–4.

131 AusNet, *Submission on the AER's 2018 draft benchmarking report*, 17 October 2018, pp. 1–2; Endeavour Energy, *Submission on the AER's 2019 draft benchmarking report*, 9 October 2019, p. 1–2; SA Power Networks, *Submission on the AER's 2019 draft benchmarking report*, 9 October 2019, p. 2–3.

132 Endeavour Energy also stated that "irrespective of how the data is normalised, we consider the adjustment mechanism should not limit a DNSPs discretion to adopt a capitalisation approach that best aligns with their circumstances and accounting practices. It would also be important for the AER to be clear that differences between the standard rate and a DNSP's actual rate is a consequence of its normalisation approach rather than an assessment of the efficiency of a particular DNSP's capitalisation policy." See Endeavour Energy, *Draft 2019 Benchmarking Report for Distribution Service Providers*, 9 October 2019, p. 2.

133 Ausgrid, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 14.

134 Consumer Challenge Panel (CCP), *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 5.

- Endeavour noted that accounting standards constrain ability of networks to 'game' the benchmarking, and that the AER has opportunity to scrutinise new CAMs.[135]
- AusNet submitted that the AER's conclusion in the draft report that capitalisation practices are not materially different between businesses indeed supports the use of actual reported opex for benchmarking for all businesses.[136]
- Jemena argued that it is not reasonable to continue relying on 2014 capitalisation policy to make decisions going to 2025 and 2030. It considers the AER should utilise the latest information in front of it to make an assessment of base year efficiency.[137] It submitted that the incentive to reallocate opex/capex to improve benchmarking outcomes has been removed by Economic Insights' approach of freezing the CAMs as at 2014. As a result, it considered benchmarking based on recent CAMs is unlikely to be impacted by any gaming and can provide a more up-to-date view of DNSPs' opex efficiency, and actual costs borne by consumers.[138]
- Ausgrid considered that using current CAMs may be a short-term solution if businesses subsequently update their CAMs, resulting in a new 'freezing' of CAMs in the future.[139]
- In the short term, Jemena and Ausgrid stated a preference for using an OEF adjustment, subject to industry consultation.[140] Jemena considered that the OEF should be calculated by reference to benchmarking results generated with the use of the current CAMs, and noted that the accounting requirements of a DNSP drive changes of a capitalisation policy changes rather than regulatory changes (gaming).[141] Where the AER relies on opex/totex ratios to inform an OEF, Jemena argued that the AER undertake a detailed bottom-up investigation on the drivers of capex differences and adjust the ratios to exclude factors unrelated to the assessment of opex efficiencies.[142]
- SA Power Networks argued that freezing the 2014 CAMs maintains cost allocation inconsistencies that applied at the time, whereas actual overhead capitalisation percentages have continued to change. SA Power Networks also noted that changes in capitalisation are generally made without requiring changes to DNSP's underlying CAM.[143]

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135 Endeavour Energy, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 5

136 AusNet, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 2.

137 Jemena, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 3.

138 Jemena, *Submission on Economic Insights' 2020 draft benchmarking report,* 9 September 2020, p. 5.

139 Ausgrid, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 14.

140 Ausgrid, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 14; Jemena, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 3.

141 Jemena, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, p. 3.

142 Jemena, *Submission on the AER's 2020 draft benchmarking report*, 10 November 2020, pp. 3–4.

143 SA Power Networks, *Submission on Economic Insights' 2020 draft benchmarking report*, 9 September 2020, p. 2.

Our previous consideration of differences in capitalisation policies

We previously considered the influence of capitalisation approaches on the comparability of DNSP expenditures. Most notably, for the NSW, Queensland and ACT distribution determinations in 2015, we assessed whether differences in capitalisation policies at the time were leading to material differences in total opex between the NSW, Queensland and ACT DNSPs and the benchmark comparison firms.[144] These decisions addressed submissions from a number of stakeholders at the time about the effect of differences in capitalisation practices, in particular, on benchmarking.[145]

In these regulatory decisions, we considered the specific question of adjusting the benchmarking opex to normalise for differences in overhead allocation[146]:

> We are not satisfied that it is necessary to make adjustments to all of the service providers in the sample to adjust for differences in the reported allocation of overheads to opex and capex. The method in which service providers allocate direct costs between capex and opex is also likely to affect capitalisation rates. As a result rather than focusing on indirect costs it is better to compare the ratio of total opex to total capex. This measure will take into account the allocation of overheads between opex and capex, but also other factors such as opex capex trade-offs.

Our analysis of total opex to total capex ratios at the time (shown in Figure D.1 below) found that the NSW and Queensland DNSPs had similar opex to capex ratios as the customer weighted average of the benchmark comparison firms in Victoria and South Australia. This led us to conclude that differences in capitalisation practices between these DNSPs are not likely to lead to material differences in opex.[147]

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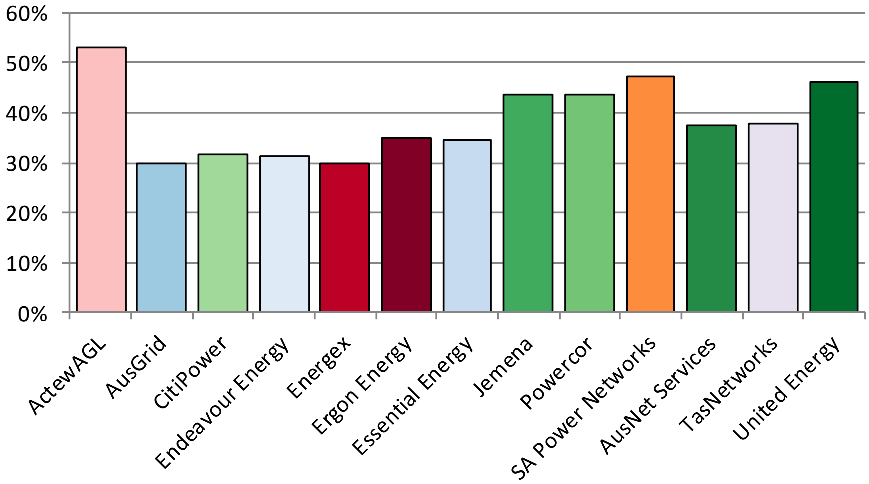
[144] These benchmark comparison firms were CitiPower, Powercor, SA Power Networks, United Energy and AusNet. See AER (2015), Final Decision Ausgrid distribution determination 2015–16 to 2018–19, Attachment 7 – Operating expenditure, April; AER (2015), Final Decision ActewAGL distribution determination 2015–16 to 2018–19, Attachment 7 – Operating expenditure, April 2015.

[145] These decision considered submissions and reports from ActewAGL (now Evoenergy), Advisian, CEPA, the Consumer Challenge Panel, Frontier Economics, Ergon Energy, Energex, SAPN, and the NSW DNSPs. For more information on these submissions see AER, *Final Decision Ausgrid distribution determination 2015–16 to 2018–19, Attachment 7 - Operating expenditure*, April 2015, p. 192; AER, *Preliminary Decision Ergon Energy distribution determination 2015–16 to 2019–20, Attachment 7 - Operating expenditure*, April 2015, p. 182.

[146] AER, *Final Decision Ausgrid distribution determination 2015–16 to 2018–19, Attachment 7 - Operating expenditure*, April 2015, p. 193.

[147] AER, *Final Decision Ausgrid distribution determination 2015–16 to 2018–19, Attachment 7 - Operating expenditure*, April 2015, pp. 193–194.

Figure D.1 Opex to total expenditure ratios for DNSPs, 2006–13



Source: Economic Benchmarking RINs, all DNSPs; AER analysis.

We found that ActewAGL (now Evoenergy) was an outlier and expensed more of its total expenditure (totex) than any other DNSP. Evoenergy subsequently amended its CAM, effective on 1 July 2014, which brought it more in line with other DNSPs' capitalisation policy. As such our regulatory decision for opex provided an 8.5 per cent adjustment to Evoenergy's benchmarking results (as an OEF adjustment) for its remaining differences in IT and vehicle leasing.[148] To provide a consistent time series for benchmarking purposes, Evoenergy backcast its historical data from 2006 to 2014 to be consistent with its new CAM, which we have used since the 2016 benchmarking report.[149]

We have also recently considered the impact of capitalisation practices on our opex benchmarking in the context of the Victorian 2021–26 reset decisions. In particular, our draft decisions set out our responses to issues raised by the Victorian DNSPs.[150] We draw on this analysis below.

Our recent analysis and findings

Further to our analysis and approach set out above, we have given these issues further consideration. To do this we have approached our recent analysis by breaking it down into the following key topics and questions:

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148 We calculated this by the increase ($3 million, as a percentage) that its unique operating leases approach to IT and fleet added to its efficient opex forecast. AER, *Final Decision ActewAGL distribution determination 2015–16 to 2018–19, Attachment 7 - Operating expenditure*, April 2015, p. 191.

149 AER, *Annual Benchmarking Report Electricity Distribution Service Providers*, November 2016, p. 16.

150 AER, *Draft Decision Jemena distribution determination 2021 to 2026, Attachment 6 - Operating expenditure*, September 2020, pp. 45–46, 88–96; AER, *Draft Decision AusNet Services distribution determination 2021 to 2026, Attachment 6 - Operating expenditure*, September 2020, pp. 36–40.

- Is there a problem posed by capitalisation differences for the like-with-like comparability of expenditures between DNSPs, and if so, how material is the problem?
    - How should differences in capitalisation practices be measured?
    - Using these measures, how material is the impact of capitalisation differences between DNSPs on the benchmarking scores?
    - How should materiality be defined in this context?
- To the extent these differences are material, how might this be addressed?

Measures and materiality of the problem

We consider there are several possible ways to measure whether there is a problem and its materiality. The options we have considered are set out below, including details of the results from their application and our initial views on the use of them as a measure. However, we intend to consult further on the appropriateness of these ratios to measure the impact of capitalisation differences, along with whether there are any other measures that we have not considered. Further, whether there are any other cross-checks which should be undertaken.

We continue to see merit in using the opex/totex ratio as a high level gauge of the net effect of capitalisation practices, covering both capitalisation policy and opex/capital trade-offs. We consider this ratio useful as a high level measure of the extent to which DNSPs report and/or use opex relative to capex at the total level, rather than focusing of one particular type of expenditure (e.g. corporate overheads). We consider that high level measures at the total level are superior to partial measures; e.g. even if all DNSPs adopted the same capitalisation policy regarding allocation of overheads to opex or capex, some degree of divergence in opex/capex would still be observed due to differing opex/capex trade-offs.

Economic Insights explained why the opex/totex ratio is a useful measure, particularly compared with a more partial measure:[151]

> However, providing adjustments for differences in capitalisation practices in only certain categories is likely to bias opex forecasts. This is because a DNSP is likely to only identify differences in practice that provide it with a cost disadvantage, therefore increasing its operating environment factor adjustment. A better method, in our view, is to examine the opex to totex ratio at the overall level. This accounts for differences in opex/capex trade–offs and differences in accounting policies.

The potential implication of this is that if a DNSP's opex to totex ratio materially diverges from the benchmark comparators' ratio, this would be prima facie evidence of

[151] Economic Insights, *Response to Consultants' Reports on Economic Benchmarking of Electricity DNSPs,* 22 April 2015, p. 52.

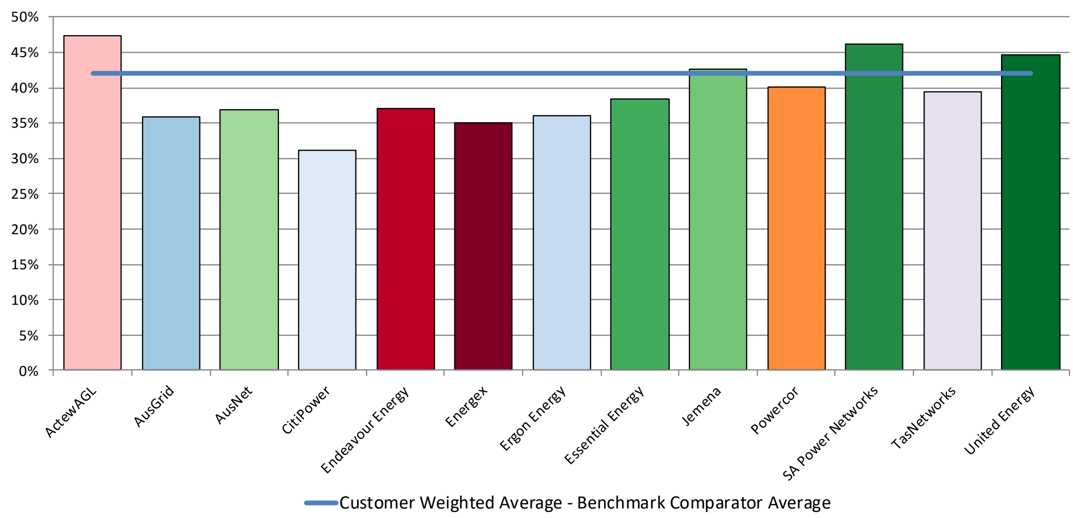
its capitalisation practices having a material effect on its opex benchmarking score relative to the comparator DNSPs.

We note the concern Jemena has raised in its submission to a draft of this report that the opex/totex ratio could capture capex differences unrelated to opex. However, the ratios we presented cover significant periods of time so as to smooth out year-to-year fluctuations in capex. In addition, consistent with our finding in 2015[152], our recent review of asset age profiles across the DNSPs indicates that asset age is not likely to be a source of material differences in opex.

We have updated the opex/totex ratio analysis that we first presented in the NSW 2015 decisions. These are shown (under the frozen 2014 CAMs (i.e. the CAMs for all DNSPs other than Evoenergy frozen as at 2013 plus Evoenergy's revised 2014 CAM)) for all DNSPs in Figures D.2 and D.3 for the full (2006–19) and short (2012–19) benchmarking periods respectively.

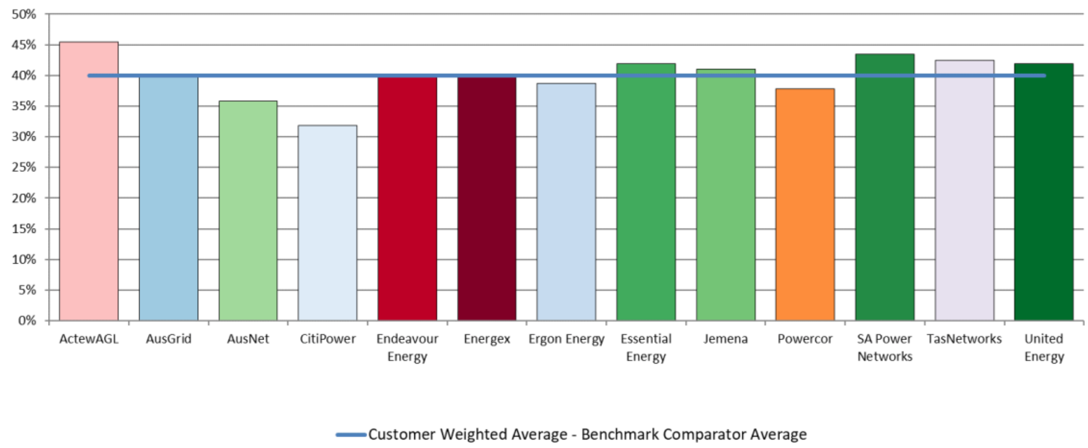
[152] AER, *Final Decision Ausgrid distribution determination 2015–16 to 2018–19, Attachment 7 - Operating expenditure*, April 2015, pp. 251–255.

Figure D.2 Opex to totex ratios for DNSPs, 2006–19[153]



Source: Economic Benchmarking RINs, all DNSPs; AER analysis.

Figure D.3 Opex to totex ratios for DNSPs, 2012–19



Source: Economic Benchmarking RINs, all DNSPs; AER analysis.

Using this approach, we find that, broadly, most DNSPs' opex/totex ratios are not substantially different from the customer-weighted average of the benchmark

153 Consistent with the opex series used for economic benchmarking, these charts use 2013 CAM recast opex for those distribution businesses which have changed their CAM.

comparators (Powercor, SA Power Networks, United Energy, CitiPower). All DNSPs' ratios except for CitiPower are a maximum of 5–7 percentage points different to the comparator-average for both time periods. While there is no definitive measure of materiality, we also observe some degree of convergence since the 2014 analysis presented above where only eight DNSPs' ratios were within seven percentage points.

While the range has narrowed slightly, we have not settled on an exact threshold of materiality and consider this is an issue for further analysis, investigation and consultation. In the interim, we consider that it is appropriate to assess this on a case-by-case basis. For example, in our recent draft decision for CitiPower, we took account of its relatively low opex/totex ratio (particularly compared to most other businesses) in conducting some sensitivity analysis in our use of its benchmarking results.[154]

While a useful measure, we also consider the opex/totex ratio is not a perfect indicator of comparative opex/capital mix among the DNSPs and the extent to which this may be impacting the benchmarking results. As capital assets are long-lived, the use of capex in the opex/totex ratio, even over a long period, may not fully take account of different age asset age profiles and investment cycles among DNSPs. As a result, in addition to the opex/totex ratio, we have considered two further ratios:

- opex cost-to-total cost (opex plus capital annual user cost)[155]
- opex inputs-to-total inputs (opex plus capital input quantity), using the opex quantity and capital input quantity indexes from the MTFP models.

The average opex/total cost ratio for the DNSPs is shown in Figure D.4 and D.5 for the 2006–19 and 2012–19 periods respectively.

As can be seen, again we find that, broadly, most DNSPs opex/total cost ratios are not substantially different from the benchmark comparator average ratio, with all DNSPs except CitiPower again a maximum of 5–7 percentage points different to the comparator-average ratio. CitiPower is again the relative outlier with an opex/total cost ratio 9–10 percentage points below that of the comparator DNSPs across both periods.

There is a degree of consistency across the opex/totex and opex/total cost measures. However, in some cases (e.g. for AusNet, Powercor, Jemena, SA Power Networks), the performance against the comparator average ratio goes in the opposite direction i.e. it is below for the comparator average for the opex/totex ratio and above the comparator average for the opex/ total cost ratio, or vice versa. Among other things, this reflects a degree of divergence between capex and annual user cost for some DNSPs. We are further investigating what might be the possible reasons for this.

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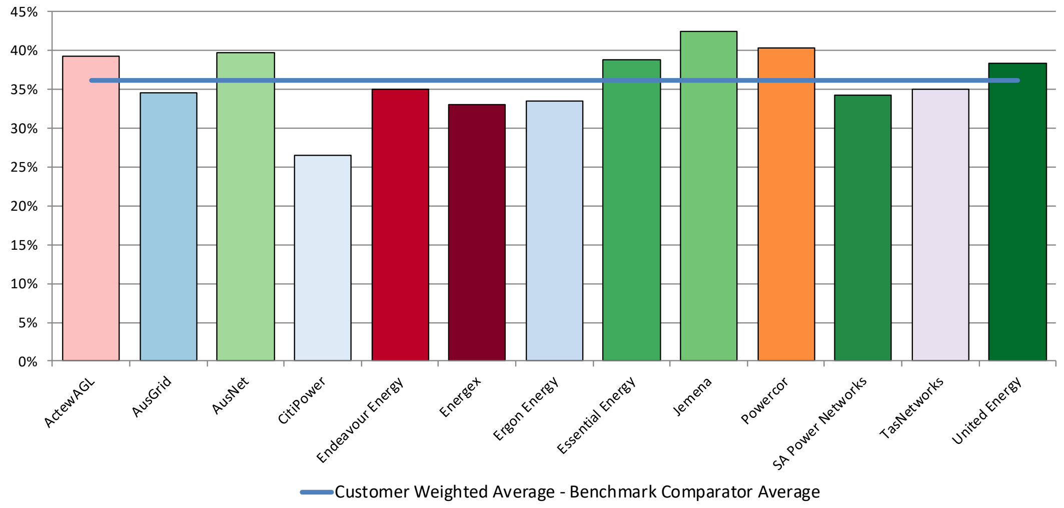
[154] AER, *Draft decision CitiPower distribution determination 2021–26 Attachment 6 - Operating expenditure*, September 2020, pp. 24–25.

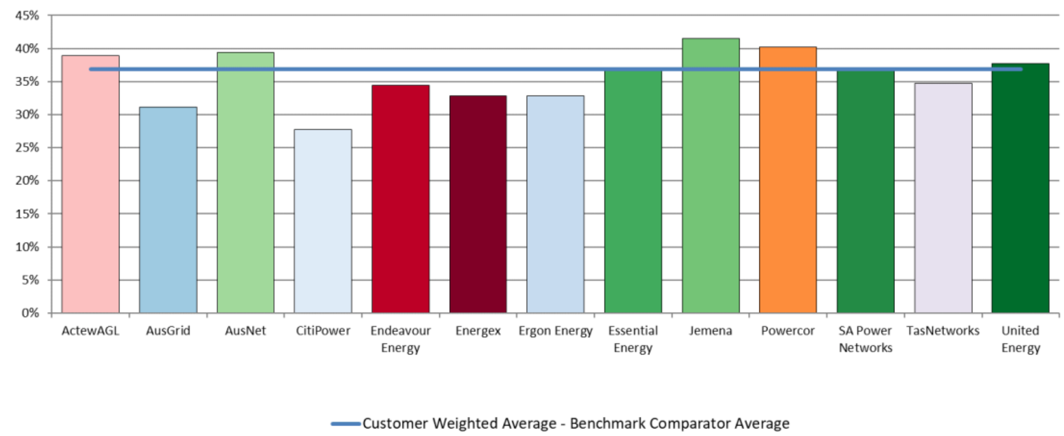
[155] Asset cost is the sum of annual depreciation and return on investment associated with the historical and current capex of a DNSP (as included in its regulatory asset base), using the average return on capital over the period. In economic benchmarking studies, it is generally referred to as the annual user cost of capital.

Figure D.4 Opex to total cost ratios for DNSPs, 2006–19[156]



Source: Economic Benchmarking RINs, all DNSPs; AER analysis.

Figure D.5 Opex to total costs ratio for DNSPs, 2012–19



Source: Economic Benchmarking RINs, all DNSPs; AER analysis.

However, we consider this ratio also has weaknesses as a measure of the extent to which opex/capital mix may be affecting the benchmarking results. Primarily, this is because opex/capital input trade-offs are to a reasonable extent captured in the opex

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156 Consistent with the opex series used for economic benchmarking, these charts use 2013 CAM recast opex for those distribution businesses which have changed their CAM.

benchmarking models. Economic theory would suggest that capital inputs would be an explanatory variable in the opex benchmarking models and this was explored in our original model specification. As explained by Economic Insights, a capital input variable was not included in these opex benchmarking models due to data unavailability.[157] However, due to its high correlation with the output variables in the opex models, it is likely that the relationship between capital inputs and opex is captured de facto in the opex models, and thus the omission of a capital input variable is unlikely to significantly affect the efficiency results. At the time Economic Insights explained:

> 'With regard to capital variables, due to the lack of comparable capital data available for Ontario, we were unable to include a capital measure in this instance. … However, we do note that in the Australian data the aggregate capital quantity variable formed by aggregating physical measures of lines, cables and transformers and using annual user costs as weights has a very high correlation of 0.95 with the energy delivered (Energy) output and of 0.94 with the ratcheted maximum demand (RMDemand) output. Similarly the constant price capital stock variable had a correlation of 0.88 with both the customer number (CustNum) and RMDemand output variables. This suggests that the omission of a capital input variable is unlikely to have a significant bearing on the results as it is likely to be highly correlated with the included output variables.'[158]

Another weakness in this measure is that we consider that annual user cost is an imperfect measure of capital inputs, notably due to inconsistencies among the distribution businesses in approaches to asset valuation, asset age and depreciation profile. As a specific example, the Victorian Government adjusted the asset values of the five Victorian distribution businesses for the purpose of equalisation of consumer prices at the time of privatisation in 1995.

The other measure of the extent to which opex/capital mix may be affecting the benchmarking results is the ratio of opex to total inputs. This uses the opex and capital input quantity indexes from the MTFP models to construct an index that reflects the ratio of opex to total inputs.[159] This is shown in Figure D.6 for the 2006–19 period.[160]

In this case it can be seen that there is significantly higher variability, both above and below the comparator-average, when compared to the previous two ratios. In particular, only four of the 13 DNSPs are within 10 percentage points of the comparator-average ratio, with a range (highest to lowest) of 44 percentage points. Such variability can be expected of a quantity-based ratio as compared to one based on dollar values.

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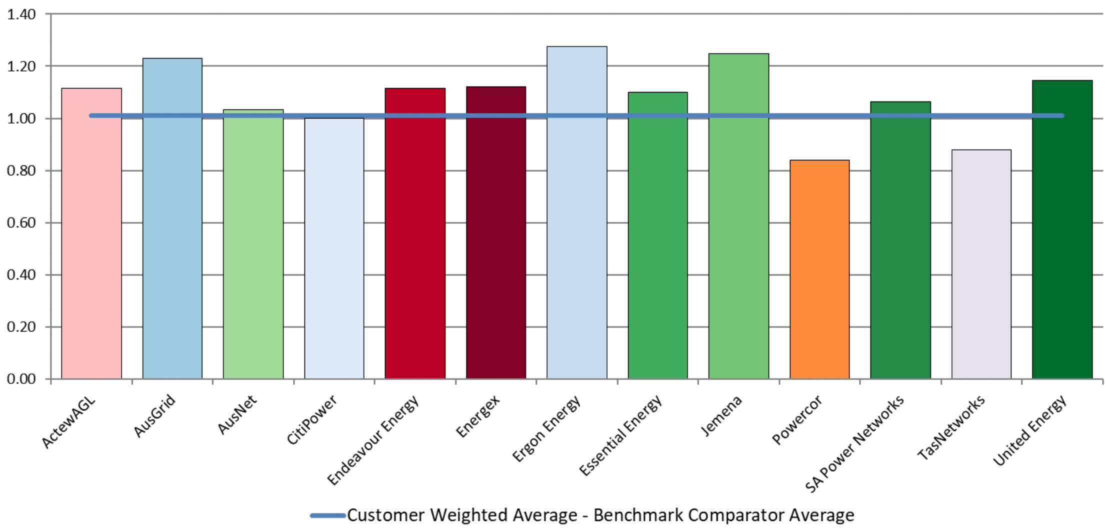
157 Economic Insights, *Economic Benchmarking Assessment of Operating Expenditure for NSW and ACT Electricity DNSPs*, 17 November 2014, p. 32.

158 Economic Insights, *Economic Benchmarking Assessment of Operating Expenditure for NSW and ACT Electricity DNSPs*, 17 November 2014, p. 32.

159 For each DNSP, the average MTFP over the 2006–2019 period is divided by the average opex MPFP over that period. This gives the ratio of Opex/total inputs, since MTFP = Outputs/Total inputs, and Opex MPFP = Outputs/Opex. Simplifying yields Opex/Total inputs.

160 We consider the 2012–18 period to be too short for this particular ratio.

Figure D.6 Opex to total inputs ratios for DNSPs, 2006–19[161]



Source: Economic Benchmarking RINs, all DNSPs; Economic Insights, *Revised files for 2019 DNSP Economic Benchmarking Report,* 24 August 2020; AER analysis

While we have considered the opex to total inputs ratio, we also consider that there are quite significant issues with using it as a primary measure of the extent to which opex/capital mix may be affecting the benchmarking results. In addition to its volatility, the capital input quantity may also not adequately take into account important sources of capex as noted by the submissions, such as capitalisation of overheads.

To the extent these differences are material, how might this be addressed?

As discussed above, across most of the measures, most DNSPs' ratios are not substantially different to the relevant comparator-average ratio. However, we have not settled on a specific threshold for materiality and consider this is an issue for further analysis, investigation and consultation with stakeholders.

Where we do find material departures from the average ratio, we intend to explore whether a more systematic response could be feasible. Drawing on our analysis, previous approaches and stakeholder feedback, we consider there may be several possible options, including:

- applying an OEF adjustment to the efficiency results under our current benchmarking approach to reflect material departures from benchmark comparators' capitalisation practices

161 Consistent with the opex series used for economic benchmarking, these charts use 2013-CAM recast opex for those distribution businesses which have changed their CAM.

- modifying our approach by benchmarking on the basis of opex plus a fixed proportion of (corporate and/or network) overheads for all DNSPs
- modifying our approach by benchmarking on the basis of DNSPs' current CAMs (incorporating their most recent capitalisation policy)
- developing and introducing a common CAM for benchmarking purposes
- moving to totex benchmarking as a complement or substitute to our current benchmarking approach.

Along with examining how to measure capitalisation differences and their materiality, we intend to investigate these options for addressing material differences over the next 12 months. We note some initial views in relation to these options below.

Applying an OEF adjustment is consistent with our general approach of adjusting benchmarking scores for material and exogenous[162] factors not otherwise accounted for in our benchmarking approach. We also note it is consistent with our previous approach (for Evoenergy in 2015) to addressing circumstances where there are material differences in capitalisation impacting the benchmarking results. We consider it is potentially feasible to implement, at little regulatory cost, and we are likely to have the data to implement such an OEF. However, given the limitations of the various opex/capital ratios, we have not settled on a specific calculation method.

In relation to the second option, we note AusNet and Endeavour Energy's specific proposal that we benchmark on the basis of a fixed capitalisation of corporate overheads to each network. Our early view is that while this approach would potentially make corporate overhead data more consistent between DNSPs, we consider it would not account for differences in the allocation/classification of other costs between DNSPs, such as direct costs and network overheads. It would also not account for opex/capex trade-offs.

Modifying our approach by benchmarking on the basis of DNSPs' current CAMs (incorporating their most recent capitalisation policy) would potentially mean benchmarking better reflects DNSPs' current operations and corporate structures. We recognise the view of some stakeholders that conducting benchmarking using current CAMs leads to different results and will further consider this option. Our preliminary analysis indicates that capitalisation practices for most DNSPs are relatively comparable, with outliers to be assessed on a case-by-case basis.[163] This should be

[162] Choices on capital inputs and accounting policies are management decisions, and therefore would not ordinarily be seen as an exogenous OEF. However, because these differences may lead to differences in operating costs or capital costs unrelated to efficiency, we consider that this factor can be treated as if it is exogenous when assessing them separately.

[163] We note the point Ausgrid raises in its submission to a draft of this report that the AER's comparison point for calculating a DNSP's ratio's divergence should be relative to the frontier DNSP (Powercor), not to the (customer-weighted average ratio of the DNSPs scoring above 0.75. The reason we have presented these divergences in this form is to be consistent with the general approach for calculating OEF adjustments.

seen in the broader context of our conservative benchmarking approach, which recognises that it is not feasible to precisely control for every difference in operating conditions among DNSPs. Further, we consider that this option could open up the risk of future CAMs being conditioned by gaming incentives (whereby DNSPs may anticipate a further re-freeze of CAMs in future). The resultant time series discontinuity in the efficiency scores, and the greater difficulties to accurately back casting the data as opposed to recasting more recent data, would also be relevant issues to address. We also note that the issue of capitalisation differences is unlikely to be eliminated under this approach.

In relation to introducing a common CAM for benchmarking, this may have some benefits in terms of driving further convergence of capitalisation (and cost allocation) approaches. However, we would need to weigh that up in the context of the materiality of current capitalisation differences, and the likely complexity and resource intensiveness of the exercise for all stakeholders. We also note that differing opex/capex trade-offs among the DNSPs would remain under a common CAM approach.

At this stage we have undertaken limited consideration of totex benchmarking. We recognise that the impact of opex/capital mix differences would essentially be eliminated on totex benchmarking scores. Economic Insights notes that totex analysis is used by some overseas energy regulators and that it may be worth considering including totex benchmarks as an additional technique in future benchmarking reports.[164]

As set out in section 7.2, over the next 12 months we intend to further extend and consult on the issues set out above.

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164 Economic Insights, *Economic Benchmarking Results for the Australian Energy Regulator's 2020 DNSP Annual Benchmarking Report*, 13 October 2020, p. 9.