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Assessment of Transgrid's benchmarking performance

A report for Transgrid

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Contents

Figures

Tables

1. Introduction and key findings

Transgrid is developing its revenue proposal for its forthcoming 2023/24 to 2027/28 regulatory period. The revenue proposal is due in January 2022.

Transgrid has asked HoustonKemp to:

- provide advice on the Australian Energy Regulator's (AER's) approach in considering its benchmarking analysis in its assessment of opex and capex forecasts;
- assess Transgrid's benchmarking performance for both opex and capex; and
- estimate an appropriate opex productivity factor.

This report is structured as follows:

- section 2 describes the regulatory framework for transmission network service providers (TNSPs) and how the AER has developed and used its benchmarking model within this framework:
  - to inform the assessment of the efficiency of base year opex;
  - to derive the appropriate productivity growth factor to apply across the regulatory period; and
  - to inform the assessment of capital productivity;
- section 3 presents our review of the efficiency of Transgrid's revealed opex and our conclusions, drawing on both:
  - the AER's benchmarking analysis, and
  - our assessment of Transgrid's historical opex (both over time and compared to its peers), on a total basis and by major opex category; and
- section 4 presents our analysis of the appropriate productivity factor to apply to Transgrid's opex for the 2023/24 to 2027/28 regulatory period; and
- section 5 presents our assessment of the sensitivity of Transgrid's capital benchmarking performance to model specification changes.

1.1 Key findings

Our assessment of Transgrid's benchmarking results finds:

- Transgrid's productivity benchmarking results, both in absolute and trend terms, suggest that it is operating relatively efficiently when compared to other TNSPs in the NEM;
- Transgrid has been improving its opex performance over time, which is consistent with it responding to the incentives in the regulatory framework;
- consistent with the AER's application of the benchmarking framework for TNSPs and its recognition of its limitations, there is nothing to indicate that Transgrid's revealed opex is 'materially inefficient' or that the incentive framework is not working as intended. That is, the latest benchmarking results suggest that as a 'first pass' there is nothing to raise concerns that Transgrid's opex expenditure in its proposed base year is inefficient;
- Transgrid's benchmarking results have improved relative to its 2016/17 performance, when its base year opex was deemed efficient by the AER;
- our conclusion based on the consideration of the AER's benchmarking results is that there is nothing to indicate that Transgrid's opex is materially inefficient, and that as a consequence the presumption should remain that revealed actual opex reflects efficient levels, consistent with the ex-ante design of the regulatory framework and the incentive schemes;

- Transgrid's opex has fluctuated over time, but it has reduced its opex since 2013/14, and its 2019/20 expenditure was lower than in 2016/17 (which was determined by the AER to be efficient);
- the category analysis shows that there is nothing to indicate that Transgrid's revealed opex is materially inefficient, which would warrant overturning a presumption that revealed costs are efficient;
- our conclusion based on the consideration of the AER's benchmarking results and our category analysis is therefore that there is nothing to indicate that Transgrid's opex is 'materially inefficient', and that as a consequence the presumption should remain that its revealed actual opex reflects efficient levels;
- the benchmarking data provide little evidence to apply a positive opex productivity factor for Transgrid for the forthcoming regulatory period.
  - The productivity factor of 0.5% derived by Economic Insights is only weakly significant (ie, only weak evidence that it is different to zero) and our analysis of earlier calculations shows they are highly sensitive to changes in specification or input data (which have been subject to change).
  - Further, if TasNetworks is excluded from the sample, on the basis of its performance arising as a result of the merger of its transmission and distribution networks, then the resulting productivity factor falls substantially, and is not statistically different from zero;
- the incentives provided by the design of the ex-ante regulatory framework applying to TNSPs, including the Efficiency Benefit Sharing Scheme (EBSS), provide a continuous incentive for Transgrid to make efficiency gains over time and can be expected to drive further efficiencies in the next regulatory period, even where if no positive productivity factor is applied; and
- our capital multilateral partial factor productivity (MPFP) analysis lends credence to the current balance of weight given by the AER in considering the results of its benchmarking analysis for capex, in focusing on changes in a TNSP's own performance over time, rather than its relative rankings compared to other TNSPs.

2. The AER's benchmarking model

Productivity benchmarking involves comparing how effectively businesses produce outputs from inputs, both relative to prior performance (across time) and relative to other businesses. The benchmarking model adopted by the AER for TNSPs calculates the following types of TNSP benchmarks:[1]

- partial performance indicators (PPIs);
- multilateral partial factor productivity (MPFP) of capital and opex; and
- multilateral total factor productivity (MTFP).

The PPI analysis involves the development of a range of performance metrics or partial performance indicators. Each PPI connects the quantity of a single input with each unit of output produced by a TNSP.

In addition to the PPIs, the AER also calculates the following two MPFPs:

- capital MPFP, which examines the productivity of a TNSP's use of its major capital assets (ie, overhead lines, underground cables and transformers); and
- opex MPFP, which examines the productivity of a TNSP's use of opex.

The AER's MTFP analysis compares the relative performance of different TNSPs in totality. A MTFP index is a measure of productivity over time, formed as a ratio of the outputs of a business to the inputs of the business. Once estimated, these indices may be used as a basis for comparing the performance of TNSPs relative to one another.

2.1 Development of MPFP models and MTFP

The AER's MPFP and MTFP benchmarking involves comparing how effectively a TNSP produces outputs from inputs, both relative to prior performance (across time) and relative to other businesses. The AER's current input and output specification has been developed progressively, through refinement of the methodology, the outputs and inputs used and their measurement. However, the AER recognises that TNSP benchmarking is still in its relative infancy.[2]

In this subsection, we provide an overview of the development of the AER's benchmarking methodology.

2.1.1 The inception of the current approach to TNSP benchmarking

In 2012, the Australian Energy Market Commission (AEMC) amended the National Electricity Rules (NER) to strengthen the AER's power to assess and amend network expenditure proposals.[3] These changes required the AER to develop a benchmarking program to measure the relative efficiency of electricity networks in the national electricity market (NEM).[4] In addition, the changes required the AER to have regard to the benchmarking results when assessing capital and operational expenditure allowances for network businesses. The AER's benchmarking approach was initially developed between 2012 and 2014, culminating in it publishing its November 2014 annual benchmarking report on 27 November 2014.[5]

[1] AER, *Annual benchmarking report electricity transmission network service providers*, November 2021.

[2] AER, *Annual benchmarking report electricity transmission network service providers*, November 2021, p 10.

[3] AEMC, *National Electricity Amendment (Economic Regulation of Network Service Providers) Rule 2012, National Gas Amendment (Price and Revenue Regulation of Gas Services) Rule 2012*, Final position paper, 15 November 2012, p i.

[4] AER, *Annual benchmarking report electricity transmission network service providers*, November 2018, p 4.

[5] AER, *Annual benchmarking report electricity transmission network service providers*, November 2014, p 5.

In developing its initial benchmarking model, the AER and its consultant, Economic Insights, considered various combinations of:[6]

- outputs, including:
  - energy throughput – which reflects the service consumed by the end customer;
  - system capacity (kVA*kms) – which reflects the system capacity provided by the TNSP measured in a multiplicative way;
  - circuit length – which measures network size and approximates the line length dimension of system capacity;
  - ratcheted maximum demand – which captures the demand side dimension of system capacity, ie, the need to build and operate networks with sufficient capacity to meet the expected peak demand for electricity, recognising that capacity is built to satisfy historical demand;
  - customer numbers – which is a driver of the services a TNSP must provide;
  - weighted entry and exit connections – which is a driver of the services a TNSP must provide; and
  - reliability, eg, via interruptions (customer minutes), aggregate unplanned outage duration, number of loss of supply events, and energy not supplied; and
- inputs, including:
  - opex; and
  - various measures of capital, ie, overhead MVAkms, underground MVAkms, transformers and other MVA, constant price RAB straight-line depreciation and constant price depreciated RAB value.

In a memorandum dated 31 July 2014, the AER and Economic Insights list four output and three input specifications – illustrated in table 2.1. Economic Insights' preference was a benchmarking model which adopts:

- energy, ratcheted maximum demand, weighted entry and exit connections, circuit length and reliability as outputs; and
- opex, overhead MVAkms, underground MVAkms, transformers and other MVA as inputs.

[6] Economic Insights, *Memorandum – TNSP MTFP Results*, 31 July 2014.

Table 2.1: Preferred benchmarking model

Specification	Economic Insights' preference	Justification
Output		
Output Specification #1: Energy, MVA*Kms, weighted entry and exit connections, reliability		'Output specification #3 includes the key elements of this output specification but in a non–multiplicative way and so does not artificially advantage large NSPs at the expense of small NSPs. As a result, output specification #3 is preferred to output specification #1.'
Output Specification #2: Energy, ratcheted maximum demand, weighted entry and exit connections, reliability		'While output specification #2 appears to perform relatively well, output specification #3 is similar to this specification but also includes a line length variable and is thus preferred to specification #2.'
Output Specification #3: Energy, ratcheted maximum demand, weighted entry and exit connections, circuit length, reliability	✓	'The results obtained using output specification #3 did not appear to favour any particular type of TNSP and, along with its superior in principle characteristics, this lent further support to using output specification #3 as the preferred specification.'
Output Specification #4: Ratcheted maximum demand, weighted entry and exit connections, reliability		'The results from this were considerably more dispersed than for specifications #2 and #3 with smaller TNSPs being relatively advantaged. We consequently believe this specification is less preferred than output specification #3.'
Input		
Input Specification #1: OPEX, O/H MVAkms, U/G MVAkms, Transformers & Other MVA	✓	'Input Specification #1 has the advantage of best reflecting the physical depreciation profile of TNSP assets. Movements in the quantities of each of the three capital inputs over time are relatively smooth as one would expect TNSP capital input quantities to be given the long–lived nature of TNSP assets.'
Input Specification #2: OPEX and Constant Price Depreciation		'…Because this variable is likely to be influenced by changes in reporting practices more than changes in actual capital input over time, it is less preferred than input specification #3 if a financial–based proxy of measuring capital input quantity is chosen rather than a physical proxy.'
Input Specification #3: OPEX and Constant Price Depreciated Asset Value		'…in periods of relatively high investment it grows more rapidly as the investments adds to a smaller base than is the case with a gross capital stock measure. Given the characteristics of electricity transmission assets, this is not thought to be an accurate reflection of either the change in or levels of annual capital input quantities As a result, input specification #3 is less preferred than input specification #1.'

Source: Economic Insights, Memorandum – TNSP MTFP Results, 31 July 2014.

Economic Insights' preferred option was adopted by the AER in its November 2014 annual benchmarking report.

2.1.2 Refinements since 2014

In 2017, the AER conducted its TNSP Benchmarking Review. The refinements made to its benchmarking methodology include:[7]

- the adoption of an end-user numbers output measure instead of the voltage-weighted connections output measure;
- the introduction of a cap on the weighting placed on energy not supplied (reliability); and
- the updating of the cost share weights for outputs other than reliability.

These changes reflected the AER's view, developed with regard to industry submissions, of how well the output metrics meet a range of performance standards and other functions, including under the AER's criteria for economic benchmarking that:[8]

[7] AER, *Annual benchmarking report electricity transmission network service providers*, November 2017, p 6.

[8] AER, *Annual benchmarking report electricity transmission network service providers*, November 2017, p 22.

1. the output aligns with the NEL and NER objectives
2. the output reflects services provided to consumers
3. the output is significant.

Table 2.2 provides an example of the analysis undertaken by the AER to support its decision that voltage-weighted connections should be replaced with end-user numbers.

Table 2.2: Example of AER rationale behind changing metric

Voltage weighted entry and exit connections	End user numbers
'While voltage-weighted entry and exit connection points is considered to meet the AER's first and third criteria, it less satisfactorily meets the second criterion since end-users are not direct beneficiaries of the services provided at the connection points. There are also issues identifying the number of connection points on a consistent basis, and whether voltage-weighted connections appropriately reflect the relative scale of transmission output provided by TNSPs.'	'Jurisdictional end-user numbers was considered superior to the other options because it satisfied all three criteria, and scored more highly than other outputs for the second criterion. The data on the number of end-users is also readily available, robust and provides a direct measure of the scale and complexity of the transmission services. While many of the outputs provided by TNSPs are not directly consumed by end-users, end-users are the ultimate beneficiaries of transmission services and ultimately bear the related costs. Jurisdictional end-user numbers was therefore substituted for voltage-weighted connections.'

Source: AER, Annual benchmarking report electricity transmission network service providers, November 2017, p 22.

In 2020, the AER made updates to several elements of its benchmarking methodology. Specifically, it updated:[9]

- the way output weights are calculated, correcting an error with previous analysis;
- the VCR estimates used to proxy the cost of reliability; and
- the cap applied to the reliability output weight.

2.1.3 The AER's current methodology

Presently, the AER's benchmarking model considers opex and capital (overhead lines, underground lines and transformers) inputs and a range of outputs, ie, energy throughput, ratcheted maximum demand, customer numbers, circuit length and reliability. These inputs and outputs are summarised in figure 2.1 below.

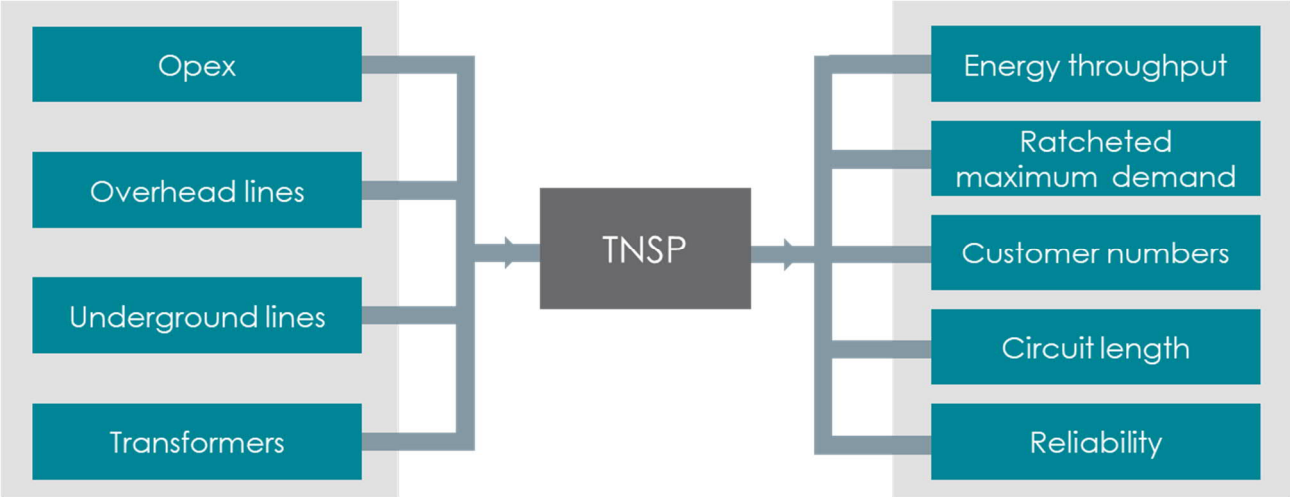
To create the output index, the following weights are applied:[10]

- energy throughput – 14.9 per cent;
- ratcheted maximum demand – 24.7 per cent;
- end-user customer numbers – 7.6 per cent; and
- circuit length – 52.8 per cent.

[9] AER, *Annual benchmarking report electricity transmission network service providers*, November 2020, pp 3-7.

[10] AER, *Annual benchmarking report electricity transmission network service providers*, November 2020, p 2.

Figure 2.1: MTPF inputs (left hand side) and outputs (right hand side)



2.2 Limitations of the AER's benchmarking for TNSPs

Since the preliminary development of the AER's transmission benchmarking in 2012-2014, the AER has noted that the conclusions which can be drawn from TNSP benchmarking are limited. For example, the AER does not use benchmarking mechanistically to make efficiency adjustments when making its determination on a TNSP's opex, in contrast to its approach for distribution network service providers (DNSPs). This reflects numerous limitations, including that:[11]

- there is a small sample of transmission businesses, which limits the range of benchmarking techniques that can be applied, ie, only index number methods can be used because more sophisticated econometric models are not tractable;
- economic benchmarking output measures require further refinement; and
- a better understanding of the impact of operating environment factors (OEFs) affecting TNSPs is needed.

In particular, a limitation which has led to the conservative application of the AER's benchmarking analysis for TNSPs was (and has continued to be) that benchmarking analysis for TNSPs is still in its relative infancy. For example, in its 2021 annual benchmarking report (and numerous reports since 2014), the AER notes that:[12]

> While transmission networks have undertaken cost benchmarking for a number of years, top-down (whole of business) benchmarking of electricity transmission networks is relatively new… There has been greater use of TNSP benchmarking by economic regulators since 2014 but we consider that transmission benchmarking is still less developed than distribution benchmarking.

[11] AER, *Powerlink transmission determination 2017−18 to 2021−22 | Attachment 7 – Operating expenditure*, Draft decision, September 2016, pp 15-16.

[12] AER, *Annual benchmarking report electricity transmission network service providers*, November 2021, p 10. Similar limitations have been noted since the inception of TNSP benchmarking. See: AER, *Annual benchmarking report electricity transmission network service providers*, November 2020, p 16; AER, *Annual benchmarking report electricity transmission network service providers*, November 2017, p 20; and AER, *Annual benchmarking report electricity transmission network service providers*, November 2014, p 6.

The discussion above highlights that the AER's benchmarking approach has undergone refinements since 2014. For example, the AER's 2017 review of economic benchmarking attempted to promote consensus in adopted output measures.[13]

Notwithstanding the fact that the AER's benchmarking model has been applied since 2014, it faces several unresolved limitations. For example:

- as noted by the AER, the small sample size makes comparison at the aggregate expenditure level difficult;[14]
- relevant parties have noted robustness issues:
  - the AER has previously noted that relative rankings are sensitive to model specification;[15]
  - industry participants and related experts have criticised the robustness of the analysis, eg, in 2015 HoustonKemp noted that:[16]
    - the output weights derived by the model are highly uncertain, even in the model's own terms;
    - the output weights are sensitive to changes in input data; and
    - alternative model specifications lead to considerable changes in results.
- there remain a number of Operating Expenditure Factors (OEFs) that may be specific to one or a subset of TNSPs and are not controlled for, eg:
  - TNSPs may apply different capitalisation policies – there are instances where one TNSP may incorporate expenditure into opex where another would capitalise it;
  - differences in network terrain may influence the expenditure necessary to maintain the network; and
  - differences in the geographic nature of networks may mean some TNSPs need to invest in particular infrastructure that another TNSP would not.

These limitations hinder the ability of transmission benchmarking to be used to compare performance across TNSPs. A similar limitation was noted by the AER in its 2014 annual benchmarking report, in which it concluded that it was confident that it could draw conclusions regarding changes in TNSP productivity over time, which avoids the 'complications' of benchmarking across networks.[17]

2.3 The role of benchmarking

The AER states that it uses economic benchmarking as one of a number of factors it considers in assessing and amending TNSPs' expenditure proposals.[18] Specifically, benchmarking provides the AER with insights into:[19]

- the relative efficiency of a TNSP's opex, capex and total expenditure against its peers; and
- changes in a TNSP's expenditure efficiency through time.

[13] Economic Insights, *Review of economic benchmarking of transmission network service providers*, Issues paper, April 2017, p 2.

[14] AER, *Annual benchmarking report electricity transmission network service providers*, November 2021, p 10. Similar limitations have been noted since the inception of TNSP benchmarking. See: AER, *Annual benchmarking report electricity transmission network service providers*, November 2020, p 16; AER, *Annual benchmarking report electricity transmission network service providers*, November 2017, p 20; and AER, *Annual benchmarking report electricity transmission network service providers*, November 2014, p 6.

[15] AER, *Annual benchmarking report electricity transmission network service providers*, November 2014, p 6.

[16] HoustonKemp, *Review of the AER transmission network benchmarking study & its application to setting TransGrid's opex rate of change*, January 2015, p 1.

[17] AER, *Annual benchmarking report electricity transmission network service providers*, November 2014, p 6.

[18] AER, *Annual benchmarking report electricity transmission network service providers*, November 2021, footnote 25, p 9.

[19] AER, *Expenditure forecast assessment guideline for electricity transmission*, Better regulation, November 2013, p 13.

Reflecting the limitations summarised above, the AER's reliance on the results produced by its productivity benchmarking has been constrained.

2.3.1 Benchmarking opex performance

The AER has regard to its benchmarking model when assessing whether a TNSP's audited base year opex costs are efficient.

It is relevant to note that the AER's approach to considering benchmarking in determining efficient base year opex for TNSPs differs from its assessment for DNSPs. Specifically, the AER does not calculate an efficiency stochastic frontier for TNSPs, nor does calculate explicit adjustments for exogenous OEFs. As a result, the link between the outcomes of the AER's benchmarking model and its assessment of the efficiency of base year opex is much less mechanistic for TNSPs than it is for DNSPs.

Rather, the AER describes the use of benchmarking for TNSPs as important for a 'first pass' assessment to identify areas that may warrant further review (although noting that it may also use the benchmarking beyond this first assessment).[20] This is consistent with the AER's recognition of the limitations of its benchmarking analysis for TNSPs (discussed above).

Consistent with the use of benchmarking in this capacity, the AER has generally applied an expectation that the regulatory framework (including the EBSS) provides incentives for TNSPs to operate efficiently and thus the presumption that revealed opex is efficient and a suitable basis to use for determining the opex allowance for forthcoming regulatory periods.[21] Based on this presumption, the AER would be expected to adjust base year opex from revealed opex only if the benchmarking results suggested that there was a reason to consider that the revealed opex may be 'materially inefficient', triggering a need for more forensic analysis of revealed cost outcomes.

If the benchmarking results do not highlight any cause to consider that a TNSP's revealed opex is materially inefficient, then the need for further detailed assessment of opex outcomes can be avoided, and the AER would be expected not to adjust revealed opex when determining base year opex for a forthcoming regulatory period.

2.3.2 Benchmarking to determine the rate of change of opex

The AER also uses the benchmarking analysis to calculate the rate of change of opex for a given year as:[22]

$$\Delta\, Opex = \Delta\, Price + \Delta\, Output - \Delta\, Productivity$$

where:

- $\Delta\, Opex$ is the proportional change in opex in that year;
- $\Delta\, Price$ is the proportional change in input prices in that year;
- $\Delta\, Output$ is the proportional change in measured outputs in that year; and
- $\Delta\, Productivity$ is the proportional change in productivity in that year.

The AER has estimated the proportional change in outputs and the proportional change in productivity using results from its benchmarking analysis.

To estimate the output rate of change, the AER has previously taken a weighted average of the forecast change in each of the TNSP's outputs, ie, delivered energy, maximum demand, weighted entry and exit of

[20] AER, *Expenditure forecast assessment guideline for electricity transmission*, Better regulation, November 2013, p 11.

[21] See, for example: AER, *Expenditure forecast assessment guideline for electricity transmission*, Better regulation, November 2013, p 8.

[22] AER, *Expenditure forecast assessment guideline for electricity transmission*, Better regulation, November 2013, p 23.

connections, and circuit length. The output weights have been derived from the benchmarking analysis and essentially determine the relative contribution of specific outputs to a TNSP's costs.[23]

To estimate the proportional change in productivity, the AER has previously estimated the trend in productivity across all five TNSPs in the NEM (as an industry) over the period for which data is available. The AER has derived the change in productivity using one of the results of the benchmarking analysis, ie, the opex partial factor productivity (PFP) index.

2.3.3 Benchmarking capital performance

The AER places less reliance on revealed costs and the benchmarking results for capex than it does for opex, because the largely non-recurrent nature of capex means that past expenditure may not be indicative of future expenditure.[24]

This is consistent with the AER's benchmarking methodology, which calculates an MPFP for *capital* (ie, asset base), rather than *capex*, ie, expenditure.

For significant capital expenditure, TNSPs are required to undertake a project-specific cost benefit analysis, the regulatory investment test for transmission (RIT-T).[25] These assessments ensure that the capital investments progressed are those that are expected to provide the greatest net benefit to the NEM.

TNSPs and the AER do apply a forecast model for some capital expenditure, such as through the AER's replacement capex (repex) model.

[23] We note that Economic Insights significantly revised the output weights in its 2018/19 benchmarking report, in which it says that "the corrected output weights are consistent with what we would expect conceptually." These revised weights are also used in its 2019/20 report. See: Economic Insights, *Economic benchmarking results for the Australian Energy Regulator's 2020 TNSP annual benchmarking report*, 15 October 2020, p 2.

[24] AER, *Expenditure forecast assessment guideline for electricity transmission*, Better regulation, November 2013, p 8.

[25] See, for example, AER, *Application guidelines, regulatory investment test for transmission*, August 2020. We note that some capital projects are not subject to the RIT-T process, such as projects with capital costs below the RIT-T cost threshold, or projects required to address an urgent and unforeseen network issue that would otherwise put at risk the reliability of the transmission network.

3. Opex efficiency

This section focuses on the efficiency of Transgrid's revealed opex for the most recent available year, ie, 2019/20. We discuss:

- the conclusions that can be drawn from the AER's most recent benchmarking report; and
- whether these conclusions are supported by a more detailed assessment of Transgrid's historical opex (both over time and compared to its peers), on a total basis and by major opex category.

3.1 Implications from AER's benchmarking analysis for the efficiency of Transgrid's revealed opex

Given the difference in capitalisation policies between the TNSPs, as well as the trade-offs between opex and capex, in assessing the efficiency of Transgrid's opex it is relevant to consider the benchmarking outcomes for total costs (ie, MTFP), as well as the relativities and movements in both opex and capex MPFPs.

In this section, we present Transgrid's benchmark outcomes across each measure together with our assessment of the implications for the efficiency of Transgrid's revealed opex, before presenting our overall assessment of the conclusions that can be drawn from the AER's benchmarking analysis in relation to the efficiency of Transgrid's opex.

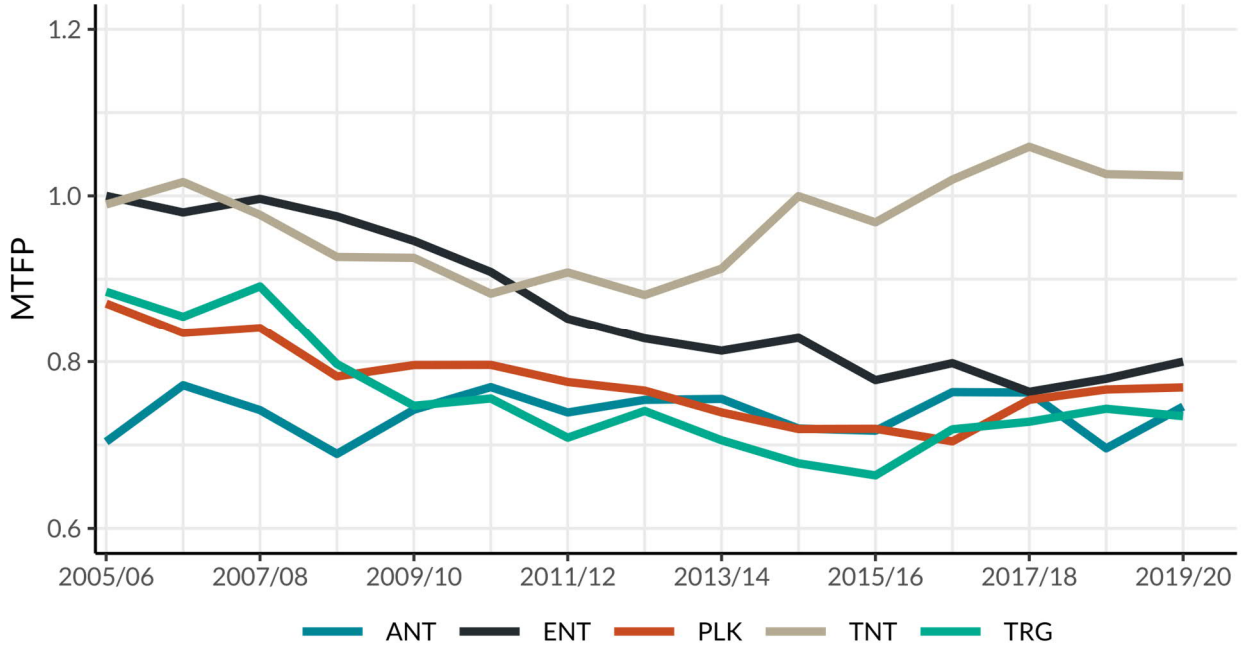
3.1.1 MTFP

Figure 3.1 below shows that Transgrid's MTFP declined marginally in 2019/20. It also shows that (with the exception of TasNetworks) the TNSPs are closely grouped in terms of MTFP outcomes. In summary, the AER's benchmarking analysis shows that Transgrid's MTFP is aligned closely with the other TNSPs (with the exception of TasNetworks), and has improved since 2015/16.

We also note that Transgrid's 2019/20 MTFP has improved slightly relative to its 2016/17 performance, when its base year opex was deemed efficient by the AER.[26]

[26] The AER said that it was "satisfied that TransGrid's estimate of its opex in 2016–17 is not materially inefficient." AER, *Draft decision TransGrid transmission determination 2018 to 2023*, Attachment 7 – Operating expenditure, September 2017, p 21.

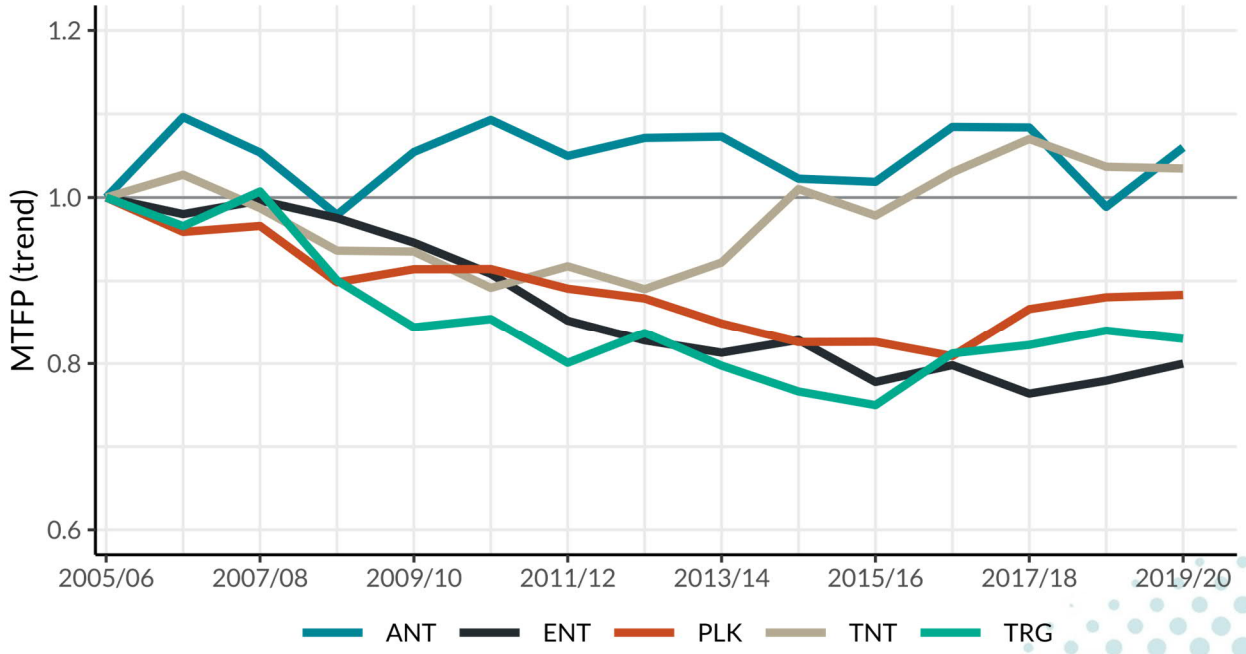
Figure 3.1: TNSP MTFP, 2005/06 to 2019/20



Source: HoustonKemp analysis of Economic Insights, Economic Insights AER TNSP benchmarking data files, 17 September 2021.

In trend terms, Transgrid's MTFP declined slightly, approximately in line with TasNetworks in 2019/20.

Figure 3.2: TNSP MTFP (trend), 2005/06 to 2019/20



Source: HoustonKemp analysis of Economic Insights, Economic Insights AER TNSP benchmarking data files, 17 September 2021.

Transgrid's relative MTFP performance therefore places it within relatively close proximity to the outcomes for other TNSPs (with the exception of TasNetworks, whose performance reflects the outcome of the merger of previously separate transmission and distribution business and is therefore not representative of the outcomes for a stand-alone TNSP – as discussed further below), and shows improvement over time consistent with the incentives it faces under the regulatory framework.

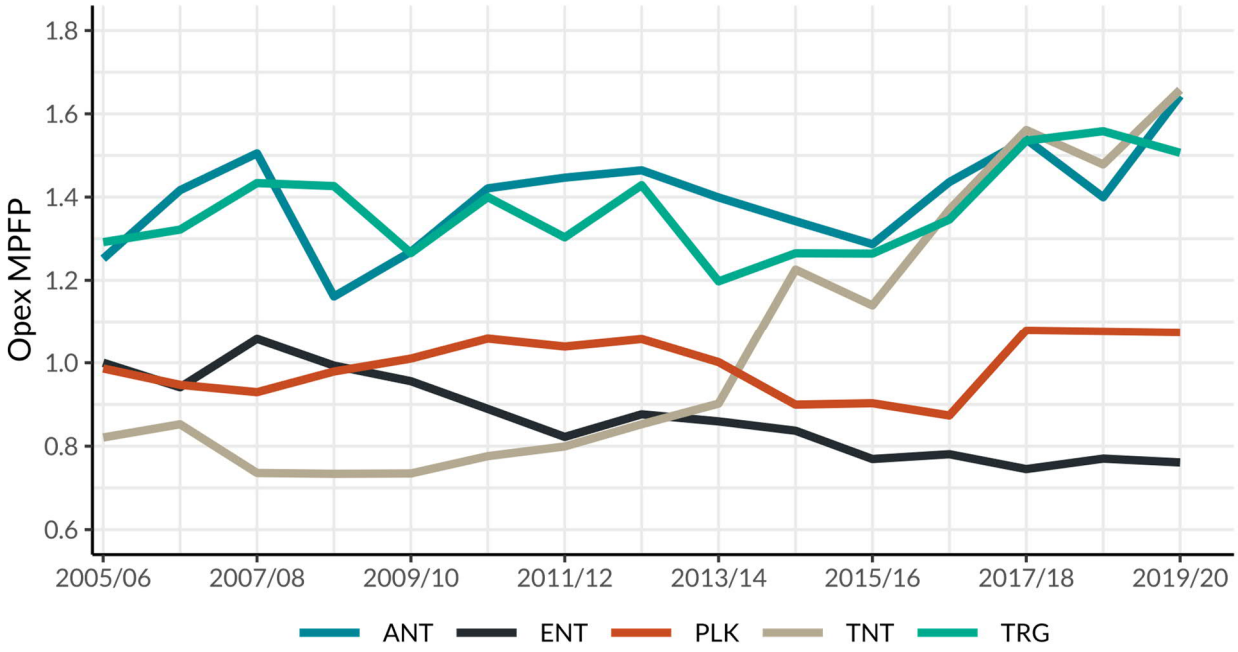
This is consistent with the AER's analysis, ie, that:[27]

> While TransGrid's productivity decreased slightly over 2020, it is significantly higher than its 2016 level.

3.1.2 Opex MPFP

Figure 3.3 shows that Transgrid's opex MPFP declined slightly in 2019/20, following significant improvement since 2013/14. The improvement since 2015/16 in Transgrid's MTFP discussed above is almost entirely due to its improvement in opex MPFP. This supports the conclusion that Transgrid is responding to the incentives in the regulatory framework, and that revealed 2019/20 opex can be presumed to be efficient.

Figure 3.3: TNSP Opex MPFP, 2005/06 to 2019/20



Source: HoustonKemp analysis of Economic Insights, Economic Insights AER TNSP benchmarking data files, 17 September 2021.

We note that TasNetworks improved its opex MPFP performance the most over the period considered in the AER's benchmarking analysis. In particular, TasNetworks' opex MPFP performance has improved significantly since 2014/15, coinciding with the merger of Tasmania's DNSP (Aurora Energy) and TNSP (Transend) to form TasNetworks. The AER notes in its latest benchmarking report that:[28]

> The positive trend [in TasNetworks' MTFP performance (and therefore its opex MPFP performance, since capital MPFP performance worsened)] from 2015 likely reflects efficiencies resulting from the merger of Tasmanian distribution and transmission networks.

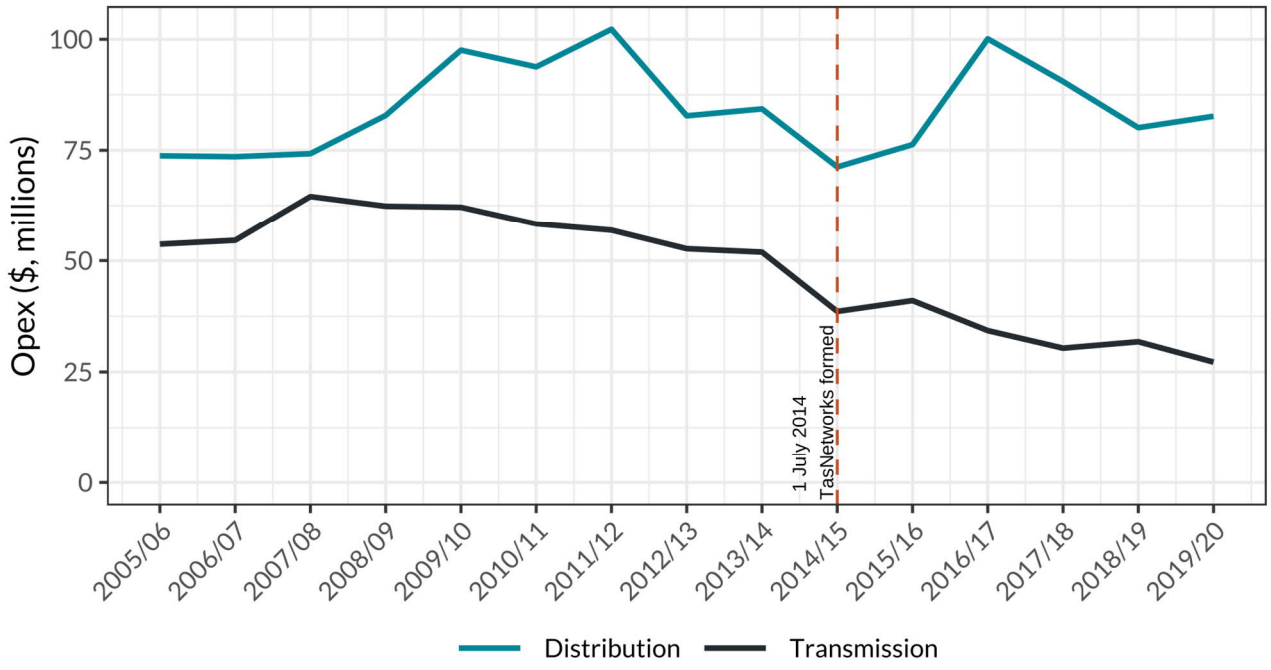
[27] AER, *Annual benchmarking report electricity transmission network service providers*, November 2021, p 18.

[28] AER, *Annual benchmarking report electricity transmission network service providers*, November 2021, p 19.

TasNetworks has adopted a 'one business' strategy, focused on delivering 'synergies and efficiencies though the rationalisation and removal of duplicated functions across [its] business operations.'[29] Figure 3.4 shows that:

- TasNetworks materially reduced both transmission and distribution opex in the year of the merger;
- transmission opex has fallen further in the following years; and
- distribution opex has not shown the same trend (suggesting that some of the observed trend in transmission opex outcomes may reflect a reallocation of costs due to the changed nature of the merged business, rather than overall cost reductions across the business as a whole).

Figure 3.4: TasNetworks opex by NSP type



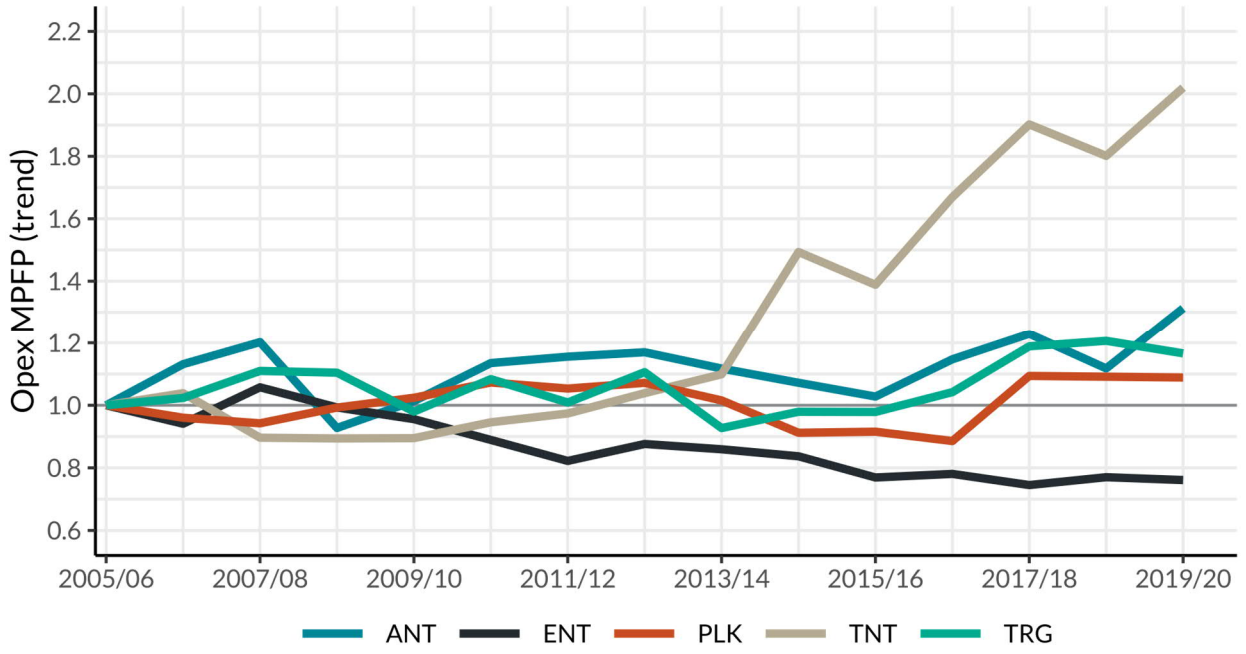
Note: Distribution opex includes standard control services only, ie, it does not include alternative control services. Values have been inflated to 2020 dollars using the composite labour, materials and service price index constructed by Economic Insights. See: Economic Insights, Economic benchmarking results for the Australian Energy Regulator's 2021 TNSP annual benchmarking report, Draft report, 17 September 2021, p 2.
Source: HoustonKemp analysis of TasNetworks economic benchmarking RINs, 2005/06 to 2019/20; Economic Insights, TNSP opex price index (2020 update), 17 September 2021.

The efficiency gains made by TasNetworks resulting from the merger, reflected in its TNSP benchmarking results, do not represent gains that are also available to a stand-alone TNSP such as Transgrid. As a consequence, it is most relevant to compare Transgrid's benchmarking outcomes to the other TNSPs excluding TasNetworks. The lack of comparability between the efficiency gains made by TasNetworks and those available to stand-alone TNSPs also has implications for the use of the benchmarking data to calculate the appropriate productivity factor for the regulatory period (discussed further in section 4).

[29] TasNetworks, *Transmission Cost Allocation Methodology and Distribution Cost Allocation Method*, June 2015, p 4.

Figure 3.5 shows that only TasNetworks and AusNet showed significant improvement in opex MPFP in trend terms in 2019/20.

Figure 3.5: TNSP Opex MPFP trend, 2005/06 to 2019/20



Source: HoustonKemp analysis of Economic Insights, Economic Insights AER TNSP benchmarking data files, 17 September 2021.

Consistent with its relative MTFP performance, Transgrid's relative opex MPFP performance places it within close proximity to the outcomes for other TNSPs (with the exception of TasNetworks, whose performance is not representative of the outcomes for a stand-alone TNSP).

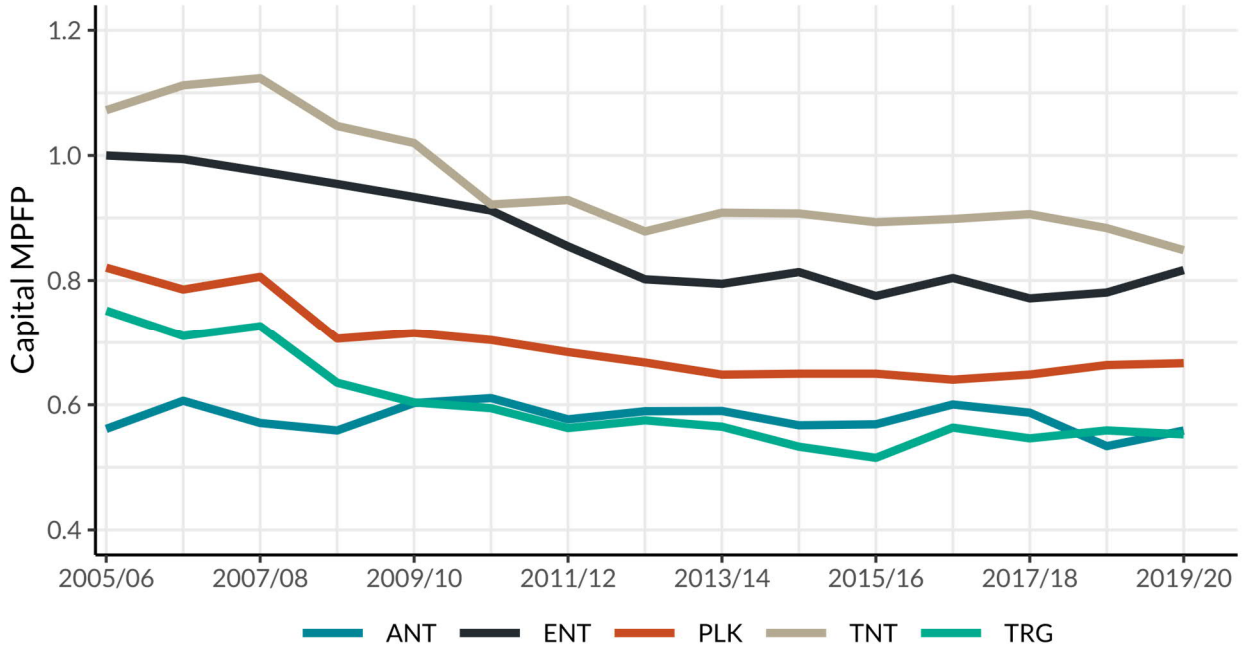
Further, Transgrid's opex MPFP shows improvement over time, consistent with Transgrid responding to the incentives it faces under the regulatory framework.

Based on this outcome, there are no 'red flags' that would indicate Transgrid revealed opex for 2019/20 is materially inefficient.

3.1.3 Capital MPFP

Transgrid's capital MPFP declined slightly in 2019/20. It has however shown general improvements since 2015/16.

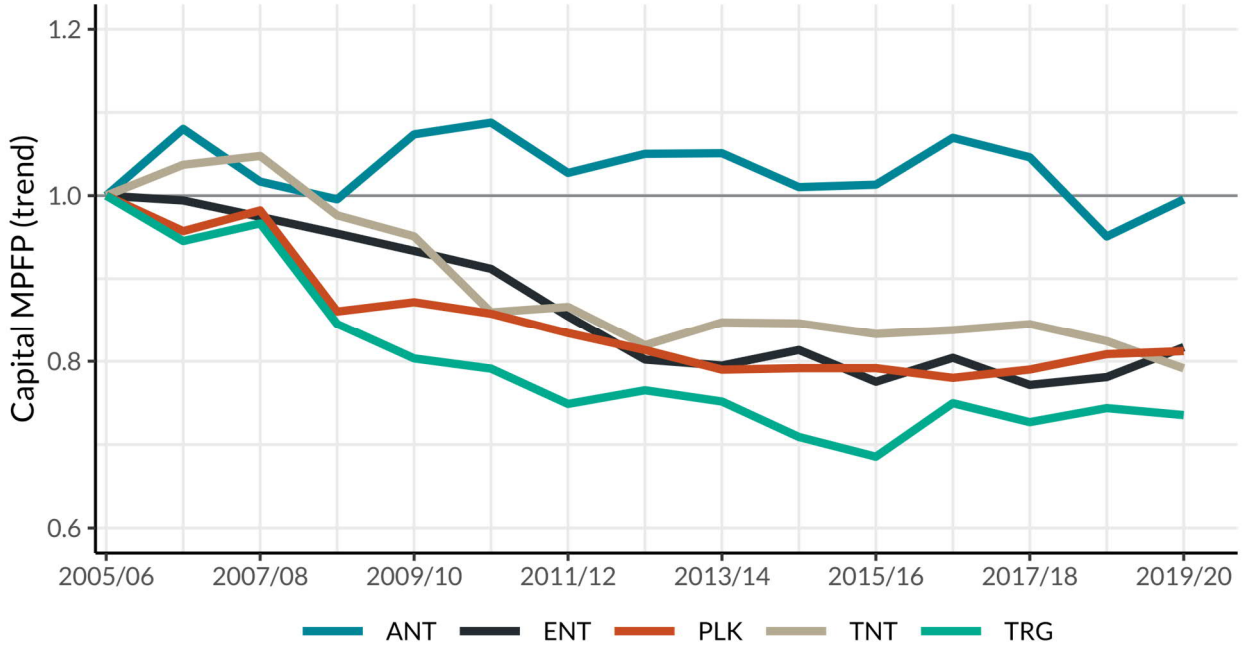
Figure 3.6: TNSP capital MPFP, 2005/06 to 2019/20



Source: HoustonKemp analysis of Economic Insights, Economic Insights AER TNSP benchmarking data files, 17 September 2021.

In trend terms, the capital MPFP performance of the TNSPs are generally closely grouped, with the exception of AusNet. AusNet operates under a different network planning model in Victoria compared to that applying to other TNSPs, whereby it does not undertake material augmentation expenditure as part of its regulated activities, and its capital MPFP performance is therefore different to other TNSPs.

Figure 3.7: TNSP capital MPFP trend, 2005/06 to 2019/20



Source: HoustonKemp analysis of Economic Insights, Economic Insights AER TNSP benchmarking data files, 17 September 2021.

Transgrid's benchmark performance for capital MPFP is relevant to the assessment of the efficiency of 2019/20 opex only to the extent that it may provide indications of the efficiency of the capex/opex trade-off made by Transgrid relative to other TNSPs. There is nothing in the latest benchmarking analysis to suggest that there are any concerns with this trade-off, as evidenced by the generally consistent capital MPFP outcomes between Transgrid and the other TNSPs, Transgrid's relative performance overall under the AER's MTFP analysis (discussed earlier) and its improvement in capital MPFP performance since 2015/16.

3.1.4 Partial performance indicators

The AER's benchmarking report also presents a number of partial performance indicators.[30]

For its 2021 annual benchmarking report for TNSPs (which draws on data up to 2019/20), the AER examined the following PPIs:[31]

- total cost per end user;
- total cost per km of transmission circuit length;
- total cost per mega volt amp (MVA) of non-coincident maximum demand; and
- total cost per MWh of energy transported.

PPIs do not take interrelationships between outputs into account and the AER acknowledges that they should therefore be assessed alongside the other benchmarking results.[32]

[30] AER, *Annual benchmarking report electricity transmission network service providers*, November 2021, section 4.2.

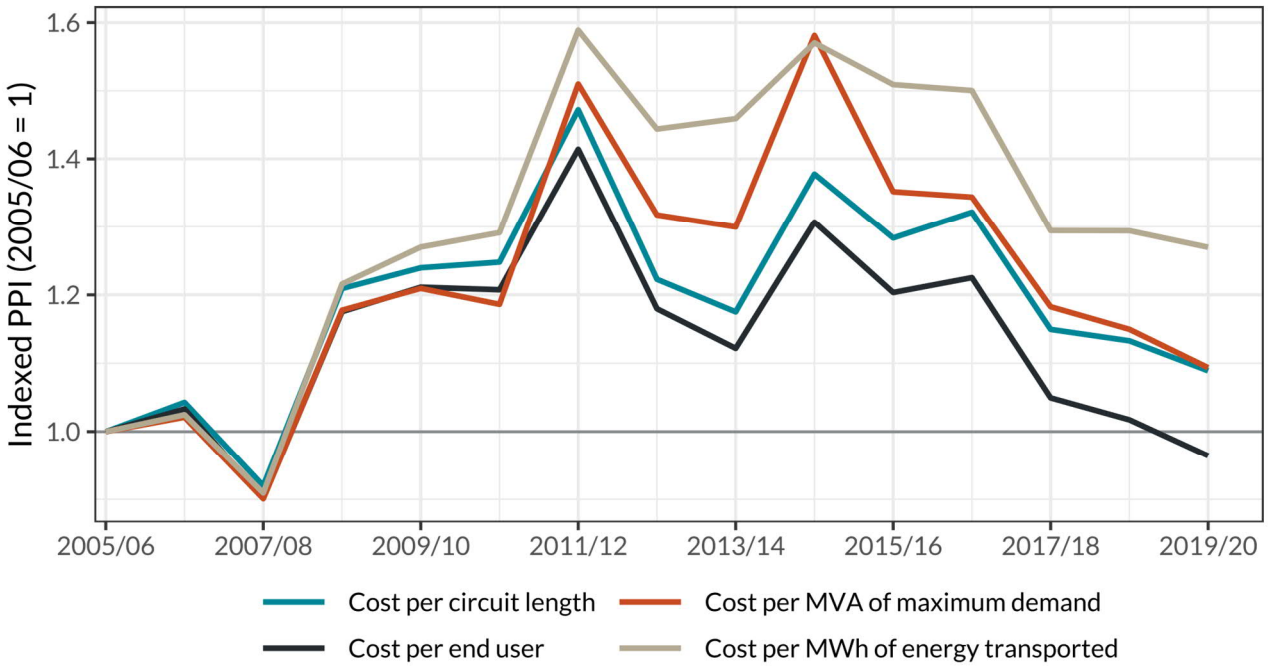
[31] AER, *Annual benchmarking report electricity transmission network service providers*, November 2021, pp 23-27.

[32] AER, *Annual benchmarking report electricity transmission network service providers*, November 2021, p 23.

The AER's benchmarking report analyses Transgrid's PPI performance relative to its peers and we do not reproduce its analysis here.[33]

Figure 3.8 shows Transgrid's relative PPI performance over time, in particular showing that Transgrid's performance in 2019/20 was improved over its 2016/17 results (Transgrid's previous base year) and its 2018/19 results. Moreover, Transgrid's cost per end user is now lower than it was (in real terms) in 2005/06.

Figure 3.8: Transgrid's PPI performance over time, 2005/06 to 2019/20



Source: HoustonKemp analysis of AER, Transmission – Data – Partial performance Indicators, Excel spreadsheet, September 2021, tab 'TNSP Analysis'.

Transgrid ranks first in total cost per MWh of energy transported and total cost per MVA of maximum demand served.[34] Its performance, once adjusted to reflect its network characteristics, is therefore strong on both of these metrics. Transgrid's cost per MWh of energy transported has decreased by 19 per cent since 2014/15.[35]

The AER's PPI analysis shows that Transgrid has the second-lowest total cost per end user.[36] The PPI analysis also shows that Transgrid's total cost per end user has been falling since 2016/17.[37]

Overall, Transgrid's PPI performance improved in 2019/20 and, consistent with the AER's acknowledgement that PPIs only provide a partial indication of TNSP performance, the PPIs, together with Transgrid's overall MTFP and opex MPFP, do not suggest material inefficiency in 2019/20 to warrant further detailed assessment of opex outcomes.

[33] See: AER, *Annual benchmarking report electricity transmission network service providers*, November 2021, section 4.2.

[34] AER, *Annual benchmarking report electricity transmission network service providers*, November 2021, pp 26-27.

[35] AER, *Annual benchmarking report electricity transmission network service providers*, November 2021, p 26-27.

[36] AER, *Annual benchmarking report electricity transmission network service providers*, November 2021, p 24.

[37] AER, *Annual benchmarking report electricity transmission network service providers*, November 2021, p 24.

To summarise, taken together, there is nothing in the AER's PPI analysis that would give rise to a concern that Transgrid's 2019/20 outturn opex is materially inefficient, warranting further detailed analysis of revealed costs.

3.1.5 Conclusion: AER benchmarking results

We discussed in section 2 that Transgrid operates under a regulatory framework, including the EBSS, which provides incentives for it to make efficiency gains over time and does not provide incentives for it to increase its opex in its proposed base year.

Transgrid's productivity benchmarking results, both in absolute and trend terms, suggest that it is operating relatively efficiently when compared to other TNSPs in the NEM,[38] particularly taking into account the non-comparability of TasNetworks' benchmarking outcomes. It also shows that Transgrid has been improving its opex performance over time, which is consistent with it responding to the incentives in the regulatory framework.

In other words, consistent with the AER's application of the benchmarking framework for TNSPs and its recognition of its limitations,[39] there is nothing to indicate that Transgrid's revealed opex is materially inefficient or that the incentive framework is not working as intended. That is, the latest benchmarking results suggest that as a 'first pass' there is nothing to raise concerns that Transgrid's opex expenditure in its proposed base year is inefficient.

Transgrid's benchmarking results have also improved relative to its 2016/17 performance, when its base year opex was deemed efficient by the AER. Further, we have re-estimated the outcomes of the benchmarking for 2016/17 taking into account Economic Insight's correction in its 2018/19 benchmarking report to the benchmarking model output weights. This analysis does not materially change Transgrid's relative performance in 2016/17, and so the AER's conclusion about the efficiency of Transgrid's 2016/17 opex would be unlikely to have changed had the corrected analysis been available. This is consistent with the AER's assessment of Transgrid's productivity in its latest benchmarking report as 'significantly higher than its 2016 level'.[40]

Our conclusion based on the consideration of the AER's benchmarking results is that there is nothing to indicate that Transgrid's opex is materially inefficient, and that as a consequence the presumption should remain that revealed actual opex reflects efficient levels, consistent with the ex-ante design of the regulatory framework and the incentive schemes.

3.2 Opex category analysis

Notwithstanding our conclusion above, we have undertaken further analysis of Transgrid's opex category performance in order to confirm that there is nothing that would become apparent in a more granular assessment that would lead to concerns around the efficiency of the proposed 2019/20 base year opex.

We note that the AER has recognised that businesses experience fluctuations in particular opex categories and so the composition of total opex changes from year to year, even when total opex is not volatile.[41] Therefore, it is important to consider changes in opex categories in the context of total opex changes.

[38] We note that the AER drew a similar conclusion regarding relative efficiency from its benchmarking results in the case of Transgrid at the time of its determination. See: AER, *Draft decision TransGrid transmission determination 2018 to 2023*, Attachment 7 – Operating expenditure, September 2017, p 21.

[39] See, for example: AER, *Draft decision TransGrid transmission determination 2018 to 2023*, Attachment 7 – Operating expenditure, September 2017, p 21.

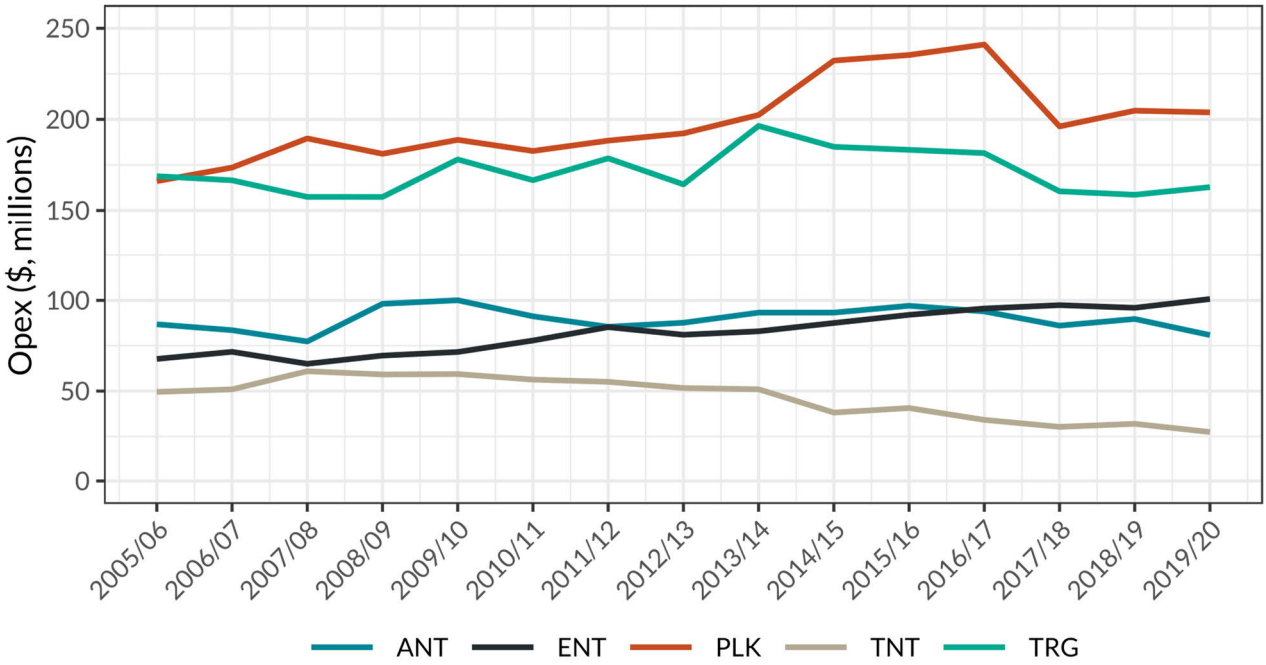
[40] AER, *Annual benchmarking report electricity transmission network service providers*, November 2021, p 26.

[41] AER, *Draft decision | TransGrid transmission determination 2018 to 2023*, Attachment 7 – Operating expenditure, September 2017, p 14.

Economic benchmarking RIN data

Figure 3.9 below shows that Transgrid's opex has fluctuated over time, but that it reduced its opex since 2013/14, and its 2019/20 expenditure was lower than in 2016/17 (which was determined by the AER to be efficient).

Figure 3.9: TNSP opex (economic benchmarking), 2005/06 to 2019/20 ($2020)



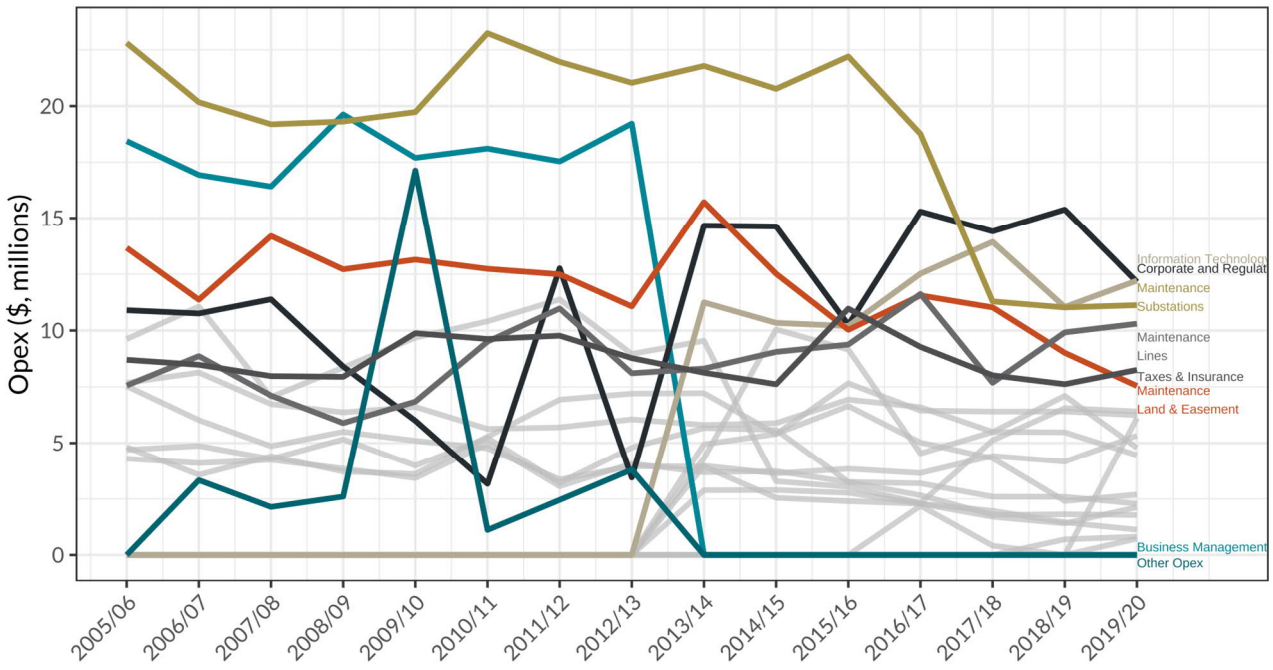
Note: Values have been inflated to 2020 dollars using the composite labour, materials and service price index constructed by Economic Insights. See: Economic Insights, Economic benchmarking results for the Australian Energy Regulator's 2021 TNSP annual benchmarking report, 12 November 2021, p 3.
Source: HoustonKemp analysis of TNSP RIN returns and Economic Insights, Economic benchmarking results for the Australian Energy Regulator's 2021 TNSP annual benchmarking report, 12 November 2021, p 3.

Transgrid provides information regarding its opex by category as part of its economic benchmarking Regulatory Information Notice (RIN) returns to the AER. It is instructive to review this breakdown, since it is the opex data that underlies the benchmarking model (which only considers total opex).

Figure 3.10 shows that expenditure has fallen or remained relatively flat since 2007/08 in many of Transgrid's opex categories, but has increased in others. For example:

- substation maintenance and land and easement maintenance costs have reduced materially since 2015/16;
- lines maintenance has remained around $10 million to $15 million per annum.

Figure 3.10: Transgrid opex by category (economic benchmarking), 2007/08 to 2019/20 ($2020)



Note: Categories have been combined where relevant to better reflect changes to categorisation over time. Categories in colour are those which had a (inflated) value of at least $15 million in at least one year. Values have been inflated to 2020 dollars using the composite labour, materials and service price index constructed by Economic Insights. See: Economic Insights, Economic benchmarking results for the Australian Energy Regulator's 2021 TNSP annual benchmarking report, 12 November 2021, p 3.
Source: HoustonKemp analysis of Transgrid economic benchmarking RIN returns to the AER, 2007/08 to 2019/20; Economic Insights, Economic benchmarking results for the Australian Energy Regulator's 2021 TNSP annual benchmarking report, 12 November 2021, p 3.

We understand from Transgrid that:

- the material reduction in substation maintenance opex since 2015/16 was due to a methodical reduction in routine inspections based on a transition to a risk-cost and performance management based method, combined with a reallocation of some costs to maintenance support costs;
- the general reduction in land and easement maintenance opex since 2013/14 is due to a similar risk-based approach to easement management, delivering cost reductions while ensuring compliance requirements for bushfire and asset risk are met;
- the increase in IT costs since 2014/15 includes the result of investment in software-as-a-service products and ongoing cybersecurity costs, as well as the rationalisation into fewer platforms to realise benefits across the wider business.

The observed changes in Transgrid's major opex categories can therefore be explained and traced back to changes occurring within the business, which has resulted in some costs moving between categories, or reductions in costs due to transitioning to risk-based inspections. These changes are therefore likely to represent efficient within-category changes to opex over time, in the context of Transgrid's overall opex performance.

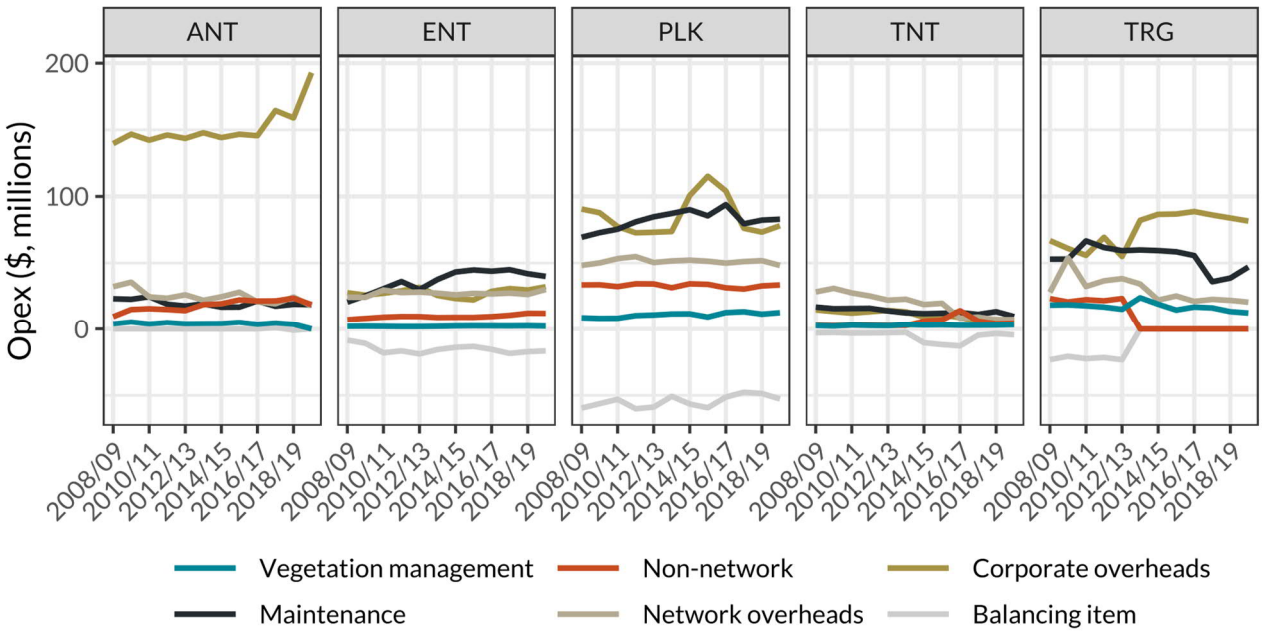
Category analysis RIN data

TNSPs do not report their opex categories consistently in their economic benchmarking RIN responses, and so we are not able to undertake a comparative category analysis based on the economic benchmarking RIN responses. However TNSPs do report opex categories consistently in their category analysis RIN responses to the AER, and so we have used these to undertake a comparative assessment.

There do remain some difficulties in comparing expenditure across TNSPs even using these RIN responses, due to the different accounting and reporting requirements across the RINs and regulatory accounts. For example, category analysis RINs may include a 'balancing item' to align different reporting practices and ensure there is no double counting.

Figure 3.11 below shows that TNSPs spend materially different amounts on different categories and report materially different balancing items.

Figure 3.11: TNSP opex (category analysis) by category, 2008/09 to 2019/20 ($2020)



Note: Values have been inflated to 2020 dollars using the composite labour, materials and service price index constructed by Economic Insights. See: Economic Insights, Economic benchmarking results for the Australian Energy Regulator's 2021 TNSP annual benchmarking report, 12 November 2021, p 3
Source: HoustonKemp analysis of TNSP category analysis RINs, 2008/09 to 2019/20; Economic Insights, Economic benchmarking results for the Australian Energy Regulator's 2021 TNSP annual benchmarking report, 12 November 2021, p 3.

To assess opex category performance more closely across TNSPs, we therefore first undertook an indicative 'adjustment' to account for the effect of specific accounting items and the balancing item. In particular, we:

- removed an easement land tax from AusNet's corporate overheads, since it is a 'pass-through' cost for AusNet, ie, it receives an equivalent amount as revenue from the Australian Energy Market Operator (AEMO);[42]
- reduced Transgrid's non-network costs by an amount equal to the size of its balancing item from 2008/09 to 2012/13, consistent with its treatment of non-network opex as network and corporate overheads from 2014;[43]
- deducted the 'non-network included in overheads' component of ElectraNet's balancing item to its non-network category, and made corresponding adjustments to its balancing item;[44]

[42] AusNet Services, *2018 tax transparency report*, p 5, available at https://www.ausnetservices.com.au/-/media/Files/AusNet/Investor-Centre/Reports/Tax-Transparency-Report-2018.ashx.

[43] Transgrid, *Category analysis RIN response – basis of preparation*, 31 October 2014, p 9.

[44] ElectraNet, *AER Category analysis – basis of preparation*, October 2019, p 10.

- deducted the 'labour in vegetation management' component of ElectraNet's balancing item to its vegetation maintenance category, and made corresponding adjustments to its balancing item; [45]
- deducted the 'vegetation management in maintenance' component of ElectraNet's balancing item to its maintenance category, and made corresponding adjustments to its balancing item; [46]
- deducted the 'capitalised corporate overheads' component of Powerlink's balancing item from its corporate overheads;[47]
- deducted the 'alignment to RIN requirements' component of Powerlink's balancing item from its corporate overheads, for the period 2008/09 to 2012/13;[48] and
- deducted the 'double counting' component of Powerlink's balancing item from its non-network opex.[49]

As a further step, to better compare across TNSPs who all operate in different environments, we evaluated the three most significant opex categories (after the adjustments described above) on a per-output basis. In particular, figure 3.12 below presents:

- corporate and network overheads per end user, reflecting that overhead costs are 'spread across' end users; and
- maintenance costs per km of circuit length, reflecting that maintenance costs may be more closely tied to lines than to other output measures.

This assessment is similar to the PPI analysis undertaken by the AER, but undertaken on a more granular basis. The same limitations that the AER recognises regarding the interpretations that can be drawn from its PPI analysis therefore also apply to this analysis.

[45] ElectraNet, *AER Category analysis – basis of preparation*, October 2019, p 10.

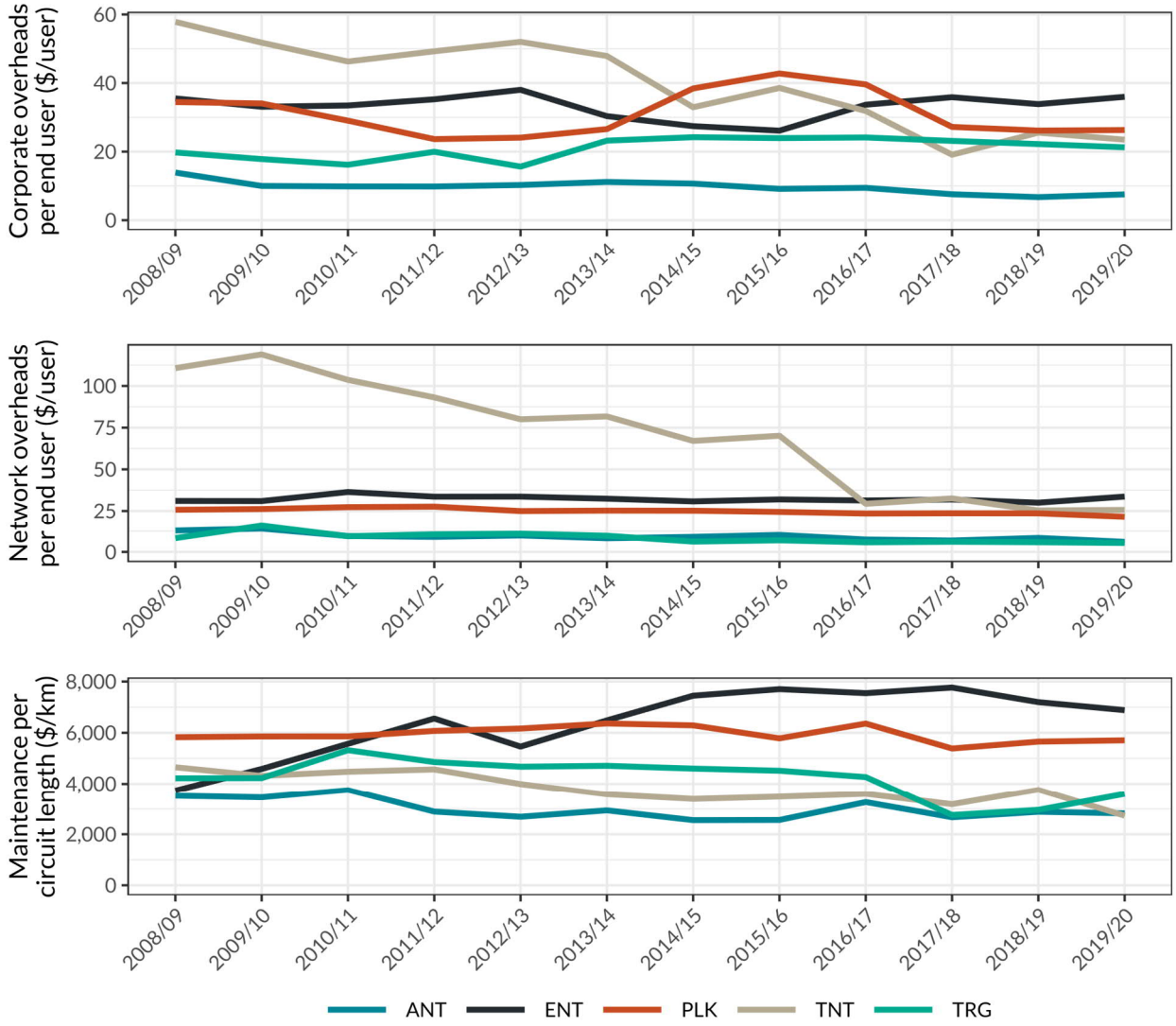
[46] ElectraNet, *AER Category analysis – basis of preparation*, October 2019, p 10.

[47] Powerlink, *Category analysis regulatory information notice basis of preparation 2018/19*, October 2019, p 55.

[48] Powerlink, *Category analysis regulatory information notice basis of preparation*, June 2014, p 74.

[49] Powerlink, *Category analysis regulatory information notice basis of preparation 2018/19*, October 2019, p 55.

Figure 3.12: TNSP opex (category analysis) by key category, adjusted, 2008/09 to 2019/2020 ($2020)



Note: Values have been inflated to 2020 dollars using the composite labour, materials and service price index constructed by Economic Insights. See: Economic Insights, Economic benchmarking results for the Australian Energy Regulator's 2021 TNSP annual benchmarking report, 12 November 2021, p 3.
Source: HoustonKemp analysis of TNSP category analysis RINs, 2008/09 to 2019/20; Economic Insights, Economic benchmarking results for the Australian Energy Regulator's 2021 TNSP annual benchmarking report, 12 November 2021, p 3.

The adjusted opex category analysis shows that:

- Transgrid's corporate overheads on a per end user basis are at its lowest in real terms since 2013/14. Transgrid has the second-lowest corporate overheads per end-user;
- Transgrid's network overheads per end user in 2019/20 were comparable to AusNet and lower than the other three TNSPs across the entire period; and
- Transgrid is third-ranked in maintenance opex per circuit length, and lower in real terms in 2019/20 than in 2008/09.

The category analysis data show no material changes to Transgrid's opex trend, and its opex category performance broadly aligns with other TNSPs on a per-output basis, taking into account the different operating environments faced by each TNSP.

3.2.1 Conclusion: opex category analysis

Transgrid's opex has fluctuated over time, but it has reduced its opex since 2013/14, and its 2019/20 expenditure was lower than in 2016/17 (which was determined by the AER to be efficient).

Further, the category analysis data show no material changes to Transgrid's opex trend, and its opex category performance broadly aligns with other TNSPs on a per-output basis, taking into account the different operating environments faced by each TNSP.

The category analysis shows that there is nothing to indicate that Transgrid's revealed opex is materially inefficient, which would warrant overturning a presumption that revealed costs are efficient.

3.3 Overall conclusion on the efficiency of Transgrid's opex

We noted in section 2 that Transgrid operates under an ex-ante regulatory framework, which provides continuous incentives (including via the EBSS) for it to make efficiency gains over time and does not provide it with an incentive to increase its opex in its proposed base year.

We also noted that the AER has typically used its benchmarking analysis for TNSPs as a 'first pass' to assess whether there is any reason to investigate the efficiency of revealed opex in more detail. The AER's use of benchmarking in this manner is consistent with the recognised limitations in benchmarking for the TNSPs, given the small sample size.

Where the benchmarking results suggest that a TNSP's revealed opex is not materially inefficient, and the TNSP's performance over time suggests that it is responding to the incentives in the regulatory framework, then the AER would be expected not to adjust revealed opex when determining base year opex for a forthcoming regulatory period. In other words, the incentive mechanisms in the regulatory framework lead to a presumption that revealed opex is an accurate reflection of efficient expenditure.

Transgrid's productivity benchmarking results, both in absolute and trend terms, suggest that it is operating relatively efficiently in comparison to its peers and is responding to incentives, as evidenced by the improvement in its opex performance over time. In other words, consistent with the AER's application of the benchmarking framework for TNSPs and the conclusions it has drawn from its benchmarking analysis for Transgrid and other TNSPs,[50] there is nothing to indicate that Transgrid's revealed opex is materially inefficient, which would warrant overturning a presumption that its revealed costs are efficient.

Further, Transgrid's benchmarking results have improved relative to its 2016/17 performance, when its base year opex was deemed efficient by the AER, and the AER has noted that its productivity is significantly higher than in 2016.

Our assessment of Transgrid's opex performance by category does not contain any 'red flags' that would indicate a need to overturn the presumption that revealed costs are efficient.

Further, the category analysis data show no material changes to Transgrid's opex trend, and its opex category performance broadly aligns with other TNSPs on a per-output basis, taking into account the different operating environments faced by each TNSP.

Our conclusion based on the consideration of the AER's benchmarking results and our category analysis is that there is nothing to indicate that Transgrid's opex is materially inefficient, and that as a consequence the presumption should remain that its revealed actual opex reflects efficient levels.

[50] See, for example: AER, *Draft decision TransGrid transmission determination 2018 to 2023*, Attachment 7 – Operating expenditure, September 2017, p 21.

4. Appropriate productivity growth factor

We explained in section 2.3.2 that the AER estimates a TNSP's efficient opex by way of a 'base-step-trend' forecasting approach, which includes a productivity growth factor over the regulatory period.

The AER explains that the productivity growth factor it applies:[51]

> …reflects our expectation of the productivity an efficient service provider in the transmission industry can achieve.

The forecast productivity growth factor represents the AER's estimate of the shift in the 'efficiency frontier' of the transmission industry.[52] As a consequence, it is the industry productivity that is relevant for calculating the productivity growth factor, not the changes in productivity of any given individual TNSP. Individual TNSPs are incentivised to make further efficiency gains by the EBSS.

Table 4.1 below shows that the productivity growth factors currently applying to the five TNSPs are either zero or 0.2 per cent.

Table 4.1: Current TNSP productivity growth factor determinations

TNSP	Regulatory period	Productivity growth factor
Powerlink	2017/18 to 2021/22	0.2%
AusNet	2017/18 to 2021/22	0%
ElectraNet	2018/19 to 2022/23	0.2%
Transgrid	2018/19 to 2022/23	0.2%
TasNetworks	2019/20 to 2023/24	0%

Source: AER, Draft decision ElectraNet transmission determination 2018 to 2023, Attachment 7 – Operating expenditure, October 2017, p 21; AER, Draft decision Powerlink transmission determination 2017-18 to 2021-22, Attachment 7 – Operating expenditure, September 2016, p 18; AER, Final decision AusNet Services transmission determination 2017 to 2022, Attachment 7 – Operating expenditure, April 2017, p 32 ; AER, Draft decision TasNetworks transmission determination 2019 to 2024, Attachment 6 – Operating expenditure, September 2018, p 15; AER, Draft decision TransGrid transmission determination 2018 to 2023, Attachment 7 – Operating expenditure, September 2017, p 21.

We note that changes in observed industry opex productivity do not just capture improvements in the productivity frontier of efficient networks (ie, the improvement in productivity of efficient networks due to improvements in technology and processes). Potentially, past changes in opex MPFP may reflect a network moving towards the efficient frontier (ie, a previously inefficient network catching up to the productivity of efficient networks), rather than a movement in the frontier itself.[53]

This distinction between a TNSP 'catching up' and increasing the frontier is that:

- if a firm that is currently less efficient than other networks improves its productivity, this does not represent an increase in the efficiency frontier, but rather a 'catch up' towards an efficient level; whereas
- if a firm that represents an efficient firm improves its productivity, then this represents an increase in the efficiency frontier.

[51] AER, *Draft decision | TransGrid transmission determination 2018 to 2023*, Attachment 7 – Operating expenditure, September 2017, p 33.

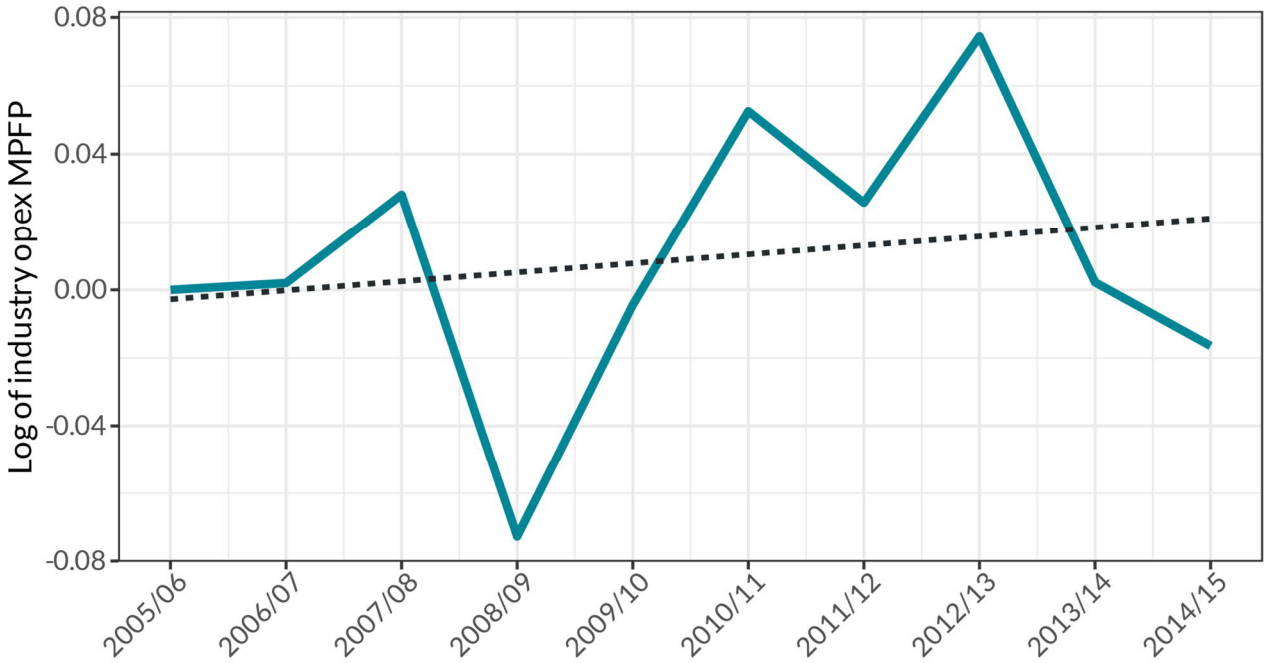
[52] AER, *Draft decision | TransGrid transmission determination 2018 to 2023*, Attachment 7 – Operating expenditure, September 2017, p 15.

[53] See, for example, HoustonKemp, *Pre-emptive productivity adjustments*, 8 May 2018, pp 8-9, which explains the difference between 'catch-up' and a shift in the frontier for distribution network service providers (DNSPs).

As shown in the table above, the AER has previously adopted a 0.2 per cent opex productivity factor for TNSPs and in Transgrid's previous determination (with the exception of AusNet and TasNetworks, with the latter's determination being more recent, see below). This productivity factor was calculated by Economic Insights from the trend change in opex MPFP over the period 2005/06 to 2014/15.[54]

Put simply, the AER's current approach calculates the opex productivity factor as the slope of the 'line of best fit' to the industry opex MPFP over time.[55] Figure 4.1 shows that over the period from 2005/06 to 2014/15, the opex productivity factor calculated by this method was positive.

Figure 4.1: Industry opex MPFP trend 2005/06 to 2014/15, 2016 data



Note: The value of 0.2 per cent applied by the AER in recent determinations is based on advice from Economic Insights from 26 April 2016. The data underlying this calculation are not available. The data presented above are those that supported the AER's 2016 benchmarking report.
Source: HoustonKemp analysis of Economic Insights, Economic Insights AER TNSP industry prod results, Excel spreadsheet, 7 November 2016.

However, the estimated opex productivity factor (0.27 per cent) based on the data presented in figure 4.1 is not statistically significant.[56] In particular, the *p*-value associated with the relevant coefficient is 0.58.[57] Based on even the most permissive commonly applied threshold for statistical significance – ten per cent – there is no evidence that the opex productivity factor over this period is different from zero.

Moreover, a mechanistic application of the AER's 2016 methodology would have suggested a negative productivity growth factor if the underlying data and model were that used by Economic Insights in its most recent benchmarking analysis (which has been corrected for some methodological issues). Figure 4.2 shows that, for the same time period but using the revised data, the line of best fit is downward sloping. This

[54] Economic Insights, *Memorandum: TNSP MTFP Results*, 29 April 2016, p 5.

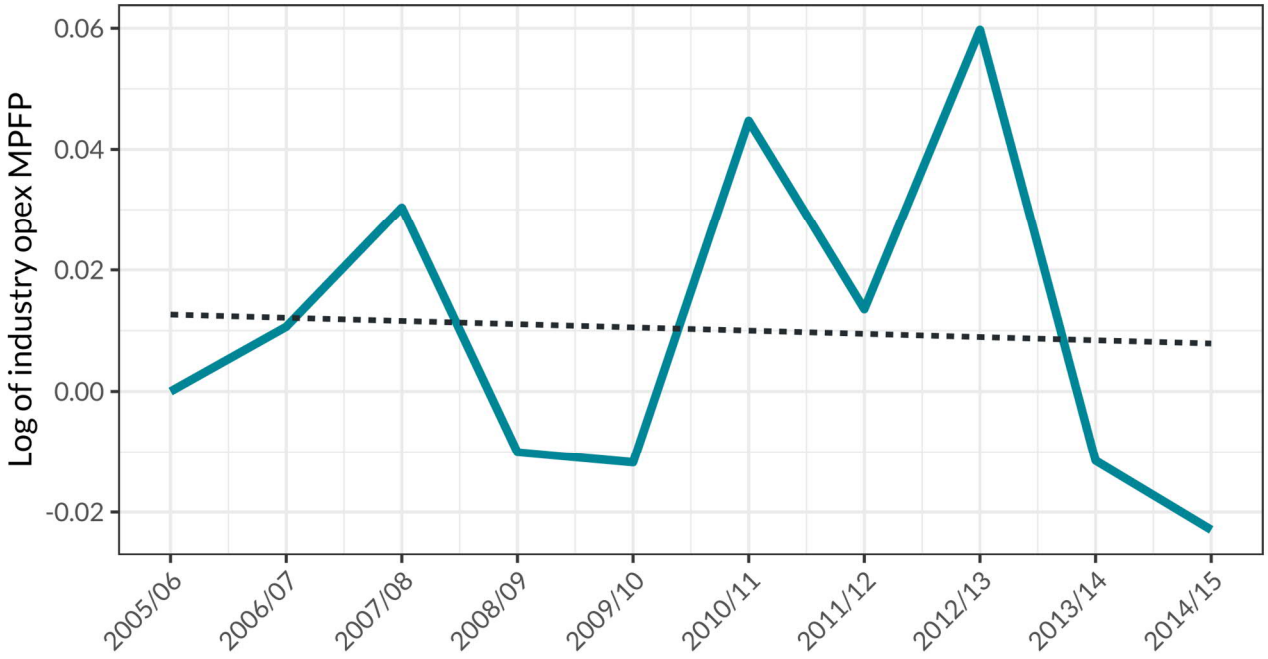
[55] We note that the AER had previously applied a point-to-point method for calculating productivity growth. See: Economic Insights, *Memorandum: TNSP MTFP Results*, 29 April 2016.

[56] HoustonKemp analysis of Economic Insights, *Economic Insights AER TNSP industry prod results*, Excel spreadsheet, 7 November 2016.

[57] HoustonKemp analysis of Economic Insights, *Economic Insights AER TNSP industry prod results*, Excel spreadsheet, 7 November 2016.

suggests that had the AER based its assessment on Economic Insights' revised modelling, it is likely that it would have adopted a value of zero for the productivity factor in its earlier determinations.

Figure 4.2: Industry opex MPFP trend 2005/06 to 2014/15, revised data



Note: The slope of the line of best fit is not statistically significant. The p-value associated with the relevant coefficient is 0.87.
Source: HoustonKemp analysis of Economic Insights, Economic Insights TNSP-MTFP Tables-Charts, Excel spreadsheet, 17 September 2021.

This is consistent with the AER's more recent decision for TasNetworks, in which it found that opex MPFP growth over the period from 2006 to 2016 was negative at the industry level, and based on earlier advice from Economic Insights it applied a productivity growth factor of zero.[58]

The AER applied a productivity factor of 0.3 per cent in its most recent draft decision for Powerlink's upcoming regulatory period, based on Economic Insights' calculation of the trend change over the 2006-2019 period.[59] Again, our analysis indicates that this value is not statistically significant.[60]

Notwithstanding these findings, we have updated the AER's trend analysis to incorporate data from 2015/16 to 2019/20. We have also considered to what extent this trend analysis may be impacted by movements for individual TNSPs which do not reflect a movement of the efficiency frontier. In particular, as discussed earlier, TasNetworks' improvements in opex performance for its transmission business are likely not to be reflective of an increase in the productivity frontier for an efficient stand-alone TNSP, since they appear to reflect synergies achieved as a consequence of the formation of the merged business as well as a reallocation of costs in line with the changed nature of the business.[61]

[58] AER, *Draft decision TasNetworks transmission determination 2019 to 2024*, Attachment 6 operating expenditure, September 2018, pp 18-19.

[59] See: AER, *Draft decision Powerlink Queensland transmission determination 2022 to 2027*, Attachment 6 operating expenditure, September 2021, p 20.

[60] HoustonKemp, *Efficiency of Powerlink's base year operating expenditure*, 1 December 2020, p 31.

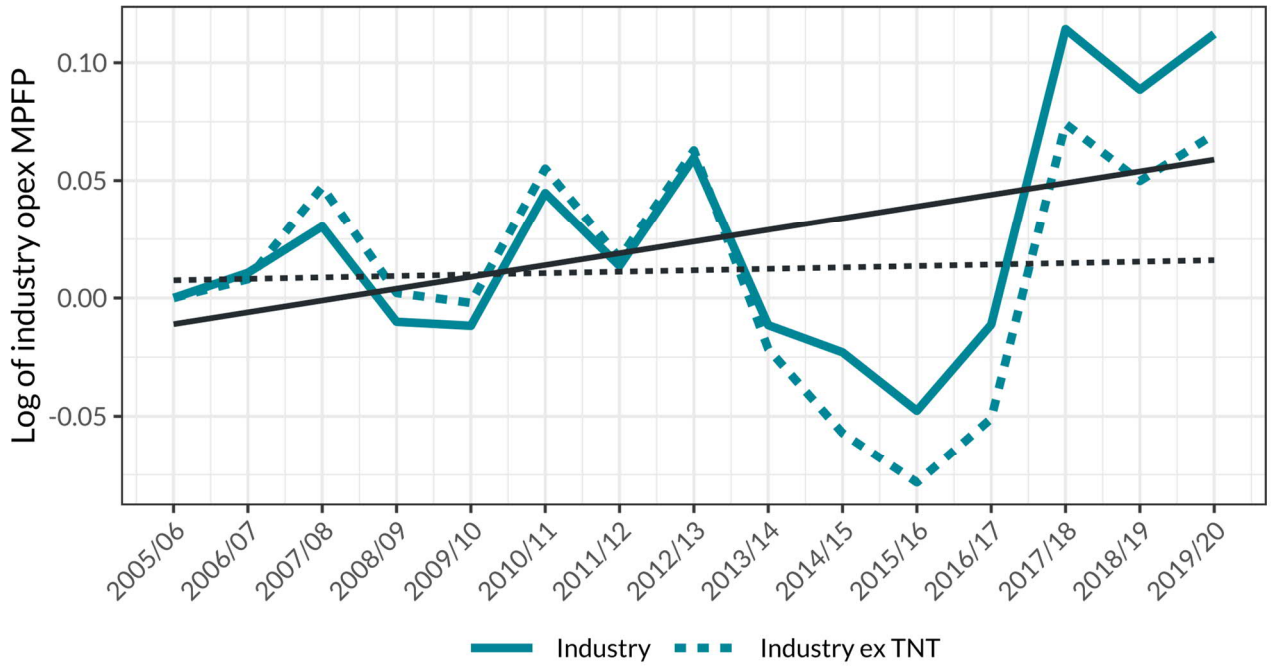
[61] See: AER, *Annual benchmarking report electricity transmission network service providers*, November 2021, p 19, where the AER says "[t]he positive trend [in its productivity] from 2015 likely reflects efficiencies resulting from the merger of Tasmanian distribution and transmission networks".

In other words, TasNetworks' opex MPFP improvements are likely to represent gains that are not available to Transgrid or other stand-alone TNSPs.[62] We have therefore also calculated the implied industry opex productivity growth factor excluding TasNetworks' contribution to industry opex and output.

Figure 4.3 shows that, including TasNetworks, the calculated industry productivity growth factor is positive (0.5 per cent). This is consistent with the latest calculations presented by Economic Insights.[63] However our analysis finds this value is only weakly statistically significant (ie, at the 10 per cent level). That is, there is only weak statistical evidence that the slope is different from zero. Further, the productivity growth factor becomes close to zero if TasNetworks is excluded (0.06 per cent).[64]

Table 4.2 presents the opex growth factors in detail, and highlights that most of the coefficients calculated are not statistically significant (with the exception being the recent 0.5 per cent value based on data to 2019/20, which is statistically significant at the ten per cent level only). That is, across the board there is only weak statistical evidence that the slope is different from zero.

Figure 4.3: Industry opex MPFP trend 2005/06 to 2019/20, with and without TasNetworks



Sources: HoustonKemp analysis of Economic Insights TNSP-MTFP Tables-Charts, Excel spreadsheet, 17 September 2021.

[62] See section 3.2.

[63] Economic Insights, *Economic benchmarking results for the Australian Energy Regulator's 2021 TNSP annual benchmarking report*, 12 November 2021, p 60.

[64] This estimate applies the output weights calculated by Economic Insights, which take into account the whole industry (ie, including TasNetworks). We have also recalculated the output weights using Economic Insights' methodology over the same period but excluding TasNetworks to produce an additional estimate. This estimate is also shown at Table 4.2.

Table 4.2: Opex productivity factors

Model	Estimate and p-value	Statistical significance
2005/06 to 2014/15 (2016 Economic Insights model)	0.27% (0.58)	Not at 1, 5 or 10 per cent level
2005/06 to 2014/15 (2021 Economic Insights model)	-0.05% (0.87)	Not at 1, 5 or 10 per cent level
2005/06 to 2018/19 (2020 Economic Insights model, applied in Powerlink draft decision)	0.3% (0.32)	Not at 1, 5 or 10 per cent level
2005/06 to 2019/20 (2021 Economic Insights model)	0.50% (0.095)	At 10 per cent level, but not 1 or 5.
2005/06 to 2019/20 (2021 Economic Insights model, excluding TNT)	0.06% (0.843)	Not at 1, 5 or 10 per cent level
2005/06 to 2019/20 (2021 Economic Insights model, excluding TNT and reweighting)	0.04% (0.906)	Not at 1, 5 or 10 per cent level

Note: p-values are shown in parentheses next to the relevant coefficient. None of the industry results are statistically significant at the one or five per cent levels. The reweighting model recalculates the output weights using Economic Insight's method over the same period (to 2017/18) and using the same data as the current weights, but removing TasNetworks. The new outputs weights are 0.1429 for energy throughput, 0.2675 for ratcheted maximum demand, 0.0307 for customer numbers and 0.5589 for circuit length.
Sources: HoustonKemp analysis of Economic Insights, Economic Insights AER TNSP industry prod results, Excel spreadsheet, 17 September 2021.

4.1.1 Conclusion: productivity growth factor for Transgrid

Our analysis shows that the value of the productivity growth factor is sensitive to changes in specification or input data and that the latest opex productivity factor of 0.5% calculated by Economic Insights is only weakly significant (ie, only weak evidence that it is different to zero).

Further, we show that the opex productivity factor is affected by TasNetworks' performance over time, and TasNetworks' opex MPFP improvements are likely to represent merger efficiency gains that are not available to Transgrid or other stand-alone TNSPs. After excluding TasNetworks from the industry calculation, the calculated opex productivity growth factor falls to close to zero.

Taken together, this analysis suggests that the benchmarking data provide little evidence to apply a positive opex productivity factor for Transgrid for the forthcoming regulatory period.

We note that the incentives provided by the design of the ex-ante regulatory framework applying to TNSPs, including the Efficiency Benefit Sharing Scheme (EBSS), provide a continuous incentive for Transgrid to make efficiency gains over time and can be expected to drive further efficiencies in the next regulatory period, even where if no positive productivity factor is applied.

5. Sensitivity of Transgrid's capital MPFP performance to alternative model specifications

In section 2.1, we highlight that the economic benchmarking methodology employed by the AER has evolved over time. These changes reflect an effort to improve benchmarking accuracy and to correct errors.

The results of the benchmarking model have been shown to be highly sensitive to model specification, as discussed in section 2.2. In order to illustrate this sensitivity we have adopted two alternative model specifications in order to observe how Transgrid's capex MPFP trend and its ranking relation to the performance of other TNSPs would change with specification changes.

In this section, we discuss two capital MPFP model sensitivities, drawn from alternative model output specifications that were considered by Economic Insights at the time of developing the original benchmarking model. Specifically we discuss:

- sensitivity of the capex MPFP results to removal of circuit length from the model output specification; and
- sensitivity to removal of circuit length and throughput from the model output specification.

In each case we recognise that Economic Insights provided a valid reason to not progress these alternative output specifications (as set out in section 2.1.1). Nonetheless these specifications provide a readily available and informative reference point for considering the sensitivity of the capex MPFP results to different model specifications.

The AER has also recognised that there may be a need to revisit the model specification in the context of a continually changing transmission environment:[65]

> We acknowledge that there is change occurring in the transmission environment, particularly driven by increasing connection of renewable generation. This is resulting in new transmission network investment and the need to manage how the transmission system is operated to ensure system strength and reliability requirements are maintained. In this context we consider it is timely to consider whether the benchmarking model specification that is currently being used continues to be appropriate. This will include whether the current outputs included in the model specification are appropriate.

5.1 Removal of circuit length

In this subsection, we consider how adopting an updated version of output specification #2 affects Transgrid's capital MPFP performance. This specification utilises four outputs, including:[66]

- energy;
- ratcheted maximum demand;
- customer numbers; and
- reliability.

[65] AER, *Annual benchmarking report electricity transmission network service providers*, November 2021, p 6.

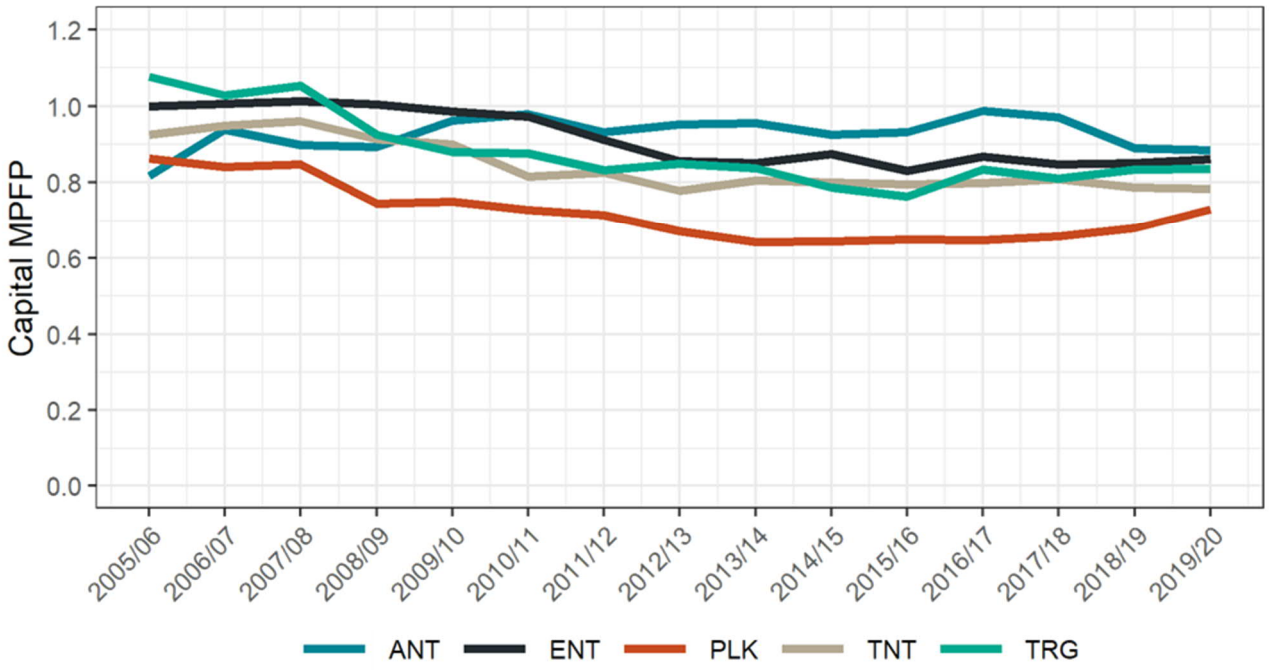
[66] The update being that we utilise customer numbers rather than weighted entry and exit connections, in line with the change in approach in 2017.

Simply put, the difference between this specification and the present specification adopted by the AER is that circuit length is omitted. Economic Insights provides justification for not adopting this approach, ie, because a specification that also incorporates circuit length would be preferable to recognise the supply side of system capacity.[67]

To model this sensitivity, we remove circuit length from the list of output metrics utilised to construct the output index. Because output weights are contingent on the outputs used, we estimate new output weights for the remaining non-reliability outputs (energy throughput, maximum ratcheted demand and customer numbers).[68] Finally, we estimate MTFP and capital MPFP using the AER's current model, updated to include data spanning 2006 to 2020.

Our analysis (Figure 5.1) indicates that the removal of circuit length sees an upwards shift in Transgrid's performance relative to the other TNSPs, compared with the current benchmarking model. Although Transgrid is now closely grouped with the other TNSPs, its own historical capital MPFP trend remains similar to that produced under the current methodology.

Figure 5.1: Capital MPFP – circuit length removed



Source: HoustonKemp analysis.

5.2 Removal of circuit length and energy throughput

In this subsection, we consider how adopting an updated version of output specification #4 affects Transgrid's capital MPFP performance. This specification utilises three outputs, including:[69]

- ratcheted maximum demand;

[67] Economic Insights, *Memorandum – TNSP MTFP Results*, 31 July 2014, p 3.

[68] To be consistent with the AER's current approach, we adopt customer numbers rather than weighted entry and exit connections. The output weights are calculated using a regression which includes all data available, ie, from 2006 to 2020.

[69] The update being that we utilise customer numbers rather than weighted entry and exit connections, in line with the change in approach in 2017.

- customer numbers; and
- reliability.

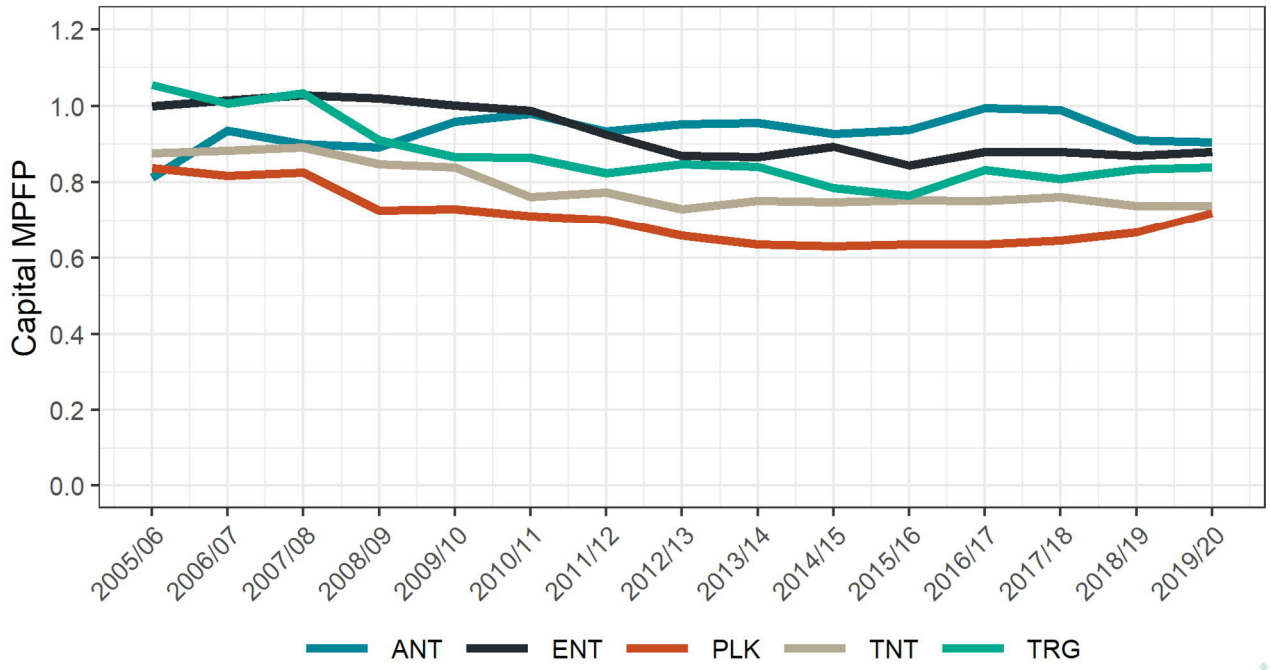
Simply put, the difference between this specification and the present specification adopted by the AER is that both circuit length and energy throughput are omitted. Economic Insights provides justification for not adopting this approach, ie, because it considers that:[70]

- it has the significant disadvantage of omitting energy throughput, which is a potentially important billable output for TNSPs;
- it does not recognise the supply side of system capacity, ie, circuit length; and
- it results in relatively dispersed results, with smaller TNSPs being relatively advantaged.

To model this sensitivity, we remove circuit length and energy throughput from the list of output measures utilised to construct the output index. Because output weights are contingent on the outputs used, we again estimate new output weights for the remaining non-reliability outputs (maximum ratcheted demand and customer numbers).[71] Finally, we estimate MTFP and capital MPFP using the AER's current model, updated to include data spanning 2006 to 2020.

Our analysis (Figure 5.2) indicates that the removal of circuit length and energy throughput sees an upwards shift in Transgrid's performance relative to the other TNSPs, compared with the current benchmarking model. Transgrid is now closely grouped with the top three performers. However, Transgrid's own historical capital MPFP trend remains similar to that produced under the current methodology.

Figure 5.2: Capital MPFP – energy and circuit length removed



Source: HoustonKemp analysis.

[70] Economic Insights, *Memorandum – TNSP MTFP Results*, 31 July 2014, p 4.

[71] To be consistent with the AER's current approach, we adopt customer numbers rather than weighted entry and exit connections. The output weights are calculated using a regression which includes all data available, ie, from 2006 to 2020.

5.3 Our capital MPFP sensitivity analysis indicates a level shift, but not a change in own-performance trend

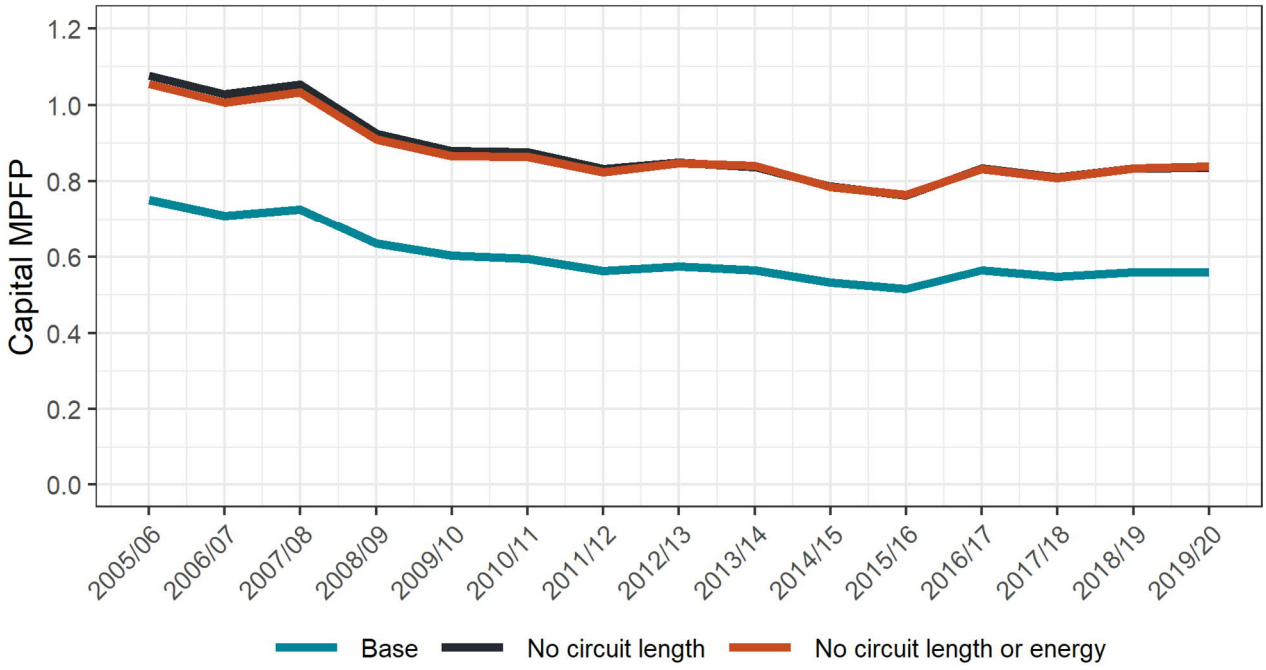
In the subsections above, we highlight that the level of MPFP performance of Transgrid is sensitive to the output specification adopted. For example, removing circuit length results in Transgrid's capital MPFP ranking increasing from fourth to a close third.

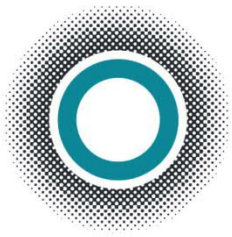
However we also highlight that the trend in Transgrid's own capital MPFP performance over time is largely invariant to these specification changes. This is elucidated in figure 5.3 below, which illustrates Transgrid's performance under the various capital MPFP specifications. Specifically, we observe that Transgrid's performance in all cases has trended:

- downwards since 2006; but
- upwards over the past five years.

We consider that this result lends credence to the current balance of weight given to by the AER in considering the results of its benchmarking analysis for capex, in focusing on changes in a TNSP's own performance over time, rather than its relative rankings compared to other TNSPs.

Figure 5.3: Transgrid's capital MPFP performance under base and sensitivities





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