Annual Benchmarking Report

Electricity transmission network service providers

November 2018

AUSTRALIAN ENERGY REGULATOR

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Shortened forms

Shortened form	Description
AEMC	Australian Energy Market Commission
AER	Australian Energy Regulator
ANT	AusNet Services (transmission)
Capex	Capital expenditure
ENT	ElectraNet
MW	Megawatt
NEL	National Electricity Law
NEM	National Electricity Market
NER	National Electricity Rules
Opex	Operating expenditure
PLK	Powerlink
RAB	Regulatory asset base
TNSP	Transmission network service provider
TNT	TasNetworks (Transmission)
TRG	TransGrid

Glossary

Term	Description
Efficiency	A Transmission Network Service Provider's (TNSP) benchmarking results relative to other TNSPs reflect that network's relative efficiency, specifically their cost efficiency. TNSPs are cost efficient when they produce services at least possible cost given their operating environments and prevailing input prices.
Inputs	Inputs are the resources TNSPs use to provide services.
MPFP	Multilateral partial factor productivity is a PIN technique that measures the relationship between total output and one input. It allows both partial productivity levels and growth rates to be compared between entities (networks).
MTFP	Multilateral total factor productivity is a PIN technique that measures the relationship between total output and total input. It allows both total productivity levels and growth rates to be compared between entities (networks).
Prescribed transmission services	Prescribed transmission services are the services that are shared across the users of transmission networks. These capture the services that TNSPs must provide under legislation.
OEFs	Operating environment factors are factors beyond a TNSP's control that can affect its costs and benchmarking performance.
Opex	Operation and maintenance expenditure
Outputs	Outputs are quantitative or qualitative measures that represent the services TNSPs provide.
PIN	Productivity index number techniques determine the relationship between inputs and outputs using a mathematical index.
PPI	Partial performance indicator 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 TNSP, observed in the time period up to the year in question. It recognises capacity that has been used to satisfy demand and gives the TNSP credit for this capacity in subsequent years, even though annual maximum demand may be lower in subsequent years.
TFP	Total factor productivity is a PIN technique that measures the relationship between total output and total input over time. It allows total productivity growth rates to be compared across networks but does not allow productivity levels to be

	compared across networks. It can be used to decompose productivity change into its constituent input and output parts.
VCR	Value of Customer Reliability. VCR represents a customer's willingness to pay for the reliable supply of electricity.

Executive Summary

Economic benchmarking is a quantitative or data driven approach used widely by governments, regulators, businesses and consumers around the world to measure how efficient firms are at delivering services over time and compared with their peers.

This benchmarking report measures the productivity and efficiency of transmission network service providers (TNSPs), and the electricity transmission industry as a whole. We focus on the productive efficiency of the TNSPs. TNSPs are productively efficient when they produce their goods and services at least possible cost given their operating environments and prevailing input prices. The relative productivity of the TNSPs reflects their efficiency.

This is our fifth benchmarking report and covers the 2006–17 period. This report is informed by expert advice provided by Economic Insights.

What is a TNSP?

The electricity industry in Australia is divided into four parts — generation, transmission, distribution and retail. As electricity generators (i.e. coal, gas, hydro, wind etc.) are usually located near fuel sources and often long distances from electricity consumers, extensive networks of poles and wires are required to transport power from the generators to end use consumers. These networks include:

- High voltage transmission lines operated by TNSP which transport electricity from generators to distribution networks in urban and regional areas.
- Transformers, poles and wires operated by distribution network service providers which convert electricity from the high voltage network into medium and low voltages to transport electricity to residential and business consumers.

Transmission network costs typically account for between 4 to 12 per cent of what consumers pay for their electricity as part of their retail electricity bill.

This benchmarking provides consumers with useful information about the relative efficiency of the transmission networks that transport electricity to their door. It also helps them better understand how the performance of these networks has improved over time, and how it compares to the businesses that transport electricity to consumers in other states.

Benchmarking also provides managers and investors with information on the relative efficiency of network businesses, and provides the governments who set regulatory standards with information about the impacts of regulation on network efficiency, charges and ultimately electricity prices.

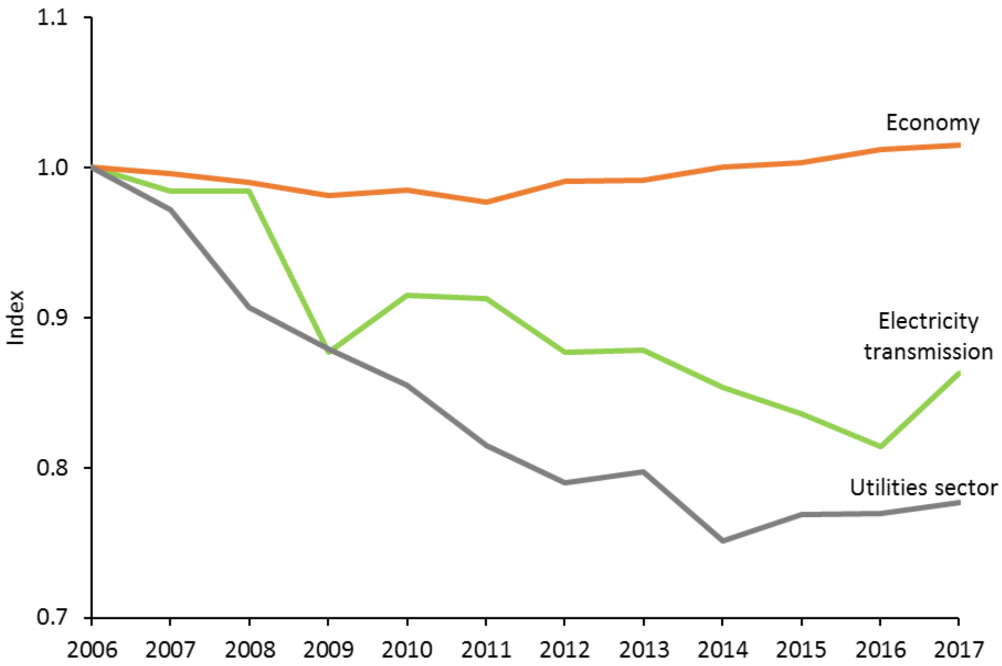
Benchmarking is one of the key tools the Australian Energy Regulator (AER) draws on when setting the maximum revenues networks can recover through consumers' bills. It helps us understand why network productivity is increasing or decreasing, how efficient service providers are, and where best to target our expenditure reviews.

1. Transmission network productivity has improved over 2017

The primary benchmarking technique we use to measure the productivity of the electricity transmission industry is total factor productivity (TFP). This is a technique that measures the productivity of businesses over time by measuring the relationship between the inputs used and the outputs delivered. Where businesses are able to deliver more outputs for a given level of inputs, this reflects an increase in productivity.

Our analysis indicates that electricity transmission productivity grew by 5.8 per cent over 2016–17, exceeding productivity growth rates for the overall economy and the utility sector (covering electricity, gas, water and waste services). This is the biggest improvement in productivity over the last 12 years, and the first industry increase since 2013. This is illustrated in figure 1.

Figure 1 Electricity transmission industry, utilities sector, and economy productivity indices, 2006–17



2. Improved network reliability drove productivity improvements over 2017

Figure 2 shows the percentage point contributions of each input and output to the change in TFP between 2016 and 2017.[1] The contributions appear from the most positive on the left to most negative on the right. If all the positive and negative contributions in Figure 2 are added together, they sum to the TFP change given by the green bar on the right of the figure.

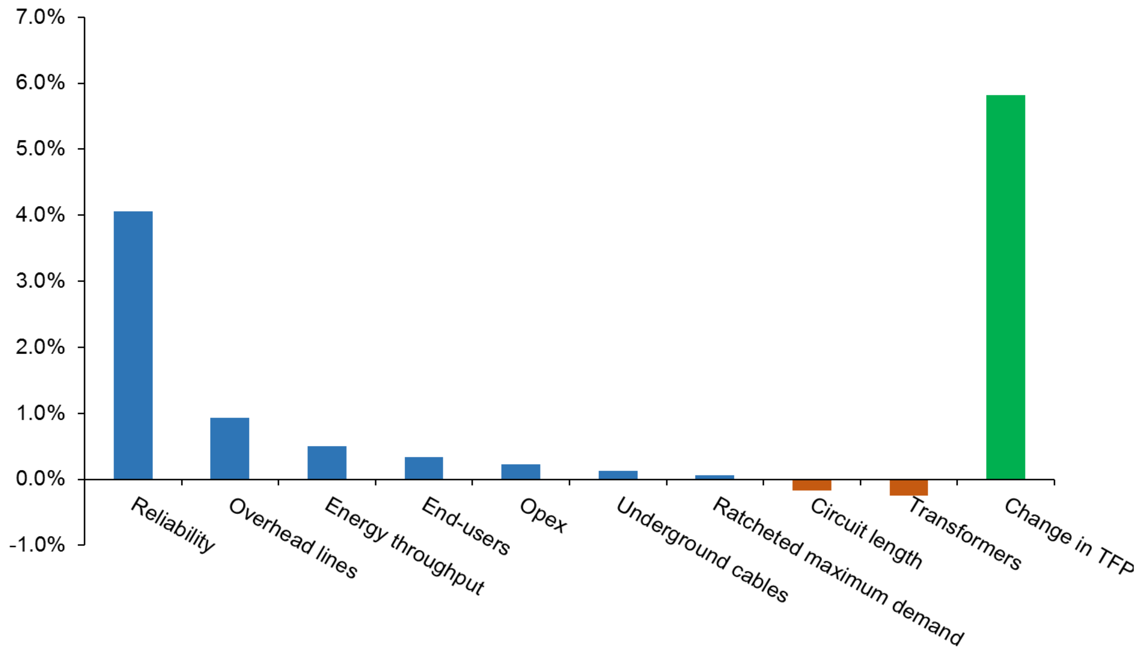
[1] A full set of the input/output analysis at the industry level and for each transmission business is available in the Economic Insights report and associated spreadsheets available at the AER's benchmarking page online.

The primary drivers of the 5.8 per cent increase in TFP over 2017 were:

- an increase in network reliability (energy not supplied), which contributed 4.1 percentage points (ppts)[2]
- a decline in overhead lines, which contributed 0.9 ppts, and
- growth in energy throughput, which contributed 0.5 ppts.

A growth in transformers and a decline in circuit length made the only negative contribution to industry TFP over 2017, at –0.3 and –0.2 ppts respectively. Overall, the transmission industry has been able to deliver energy more reliably at a lower cost.

Figure 2 TNSP output and input percentage point contributions to average annual TFP change, 2016 to 2017



3. All TNSPs except for Powerlink made productivity gains over 2017

Multilateral total factor productivity (MTFP) is the headline technique we use to measure and compare the relative productivity of jurisdictions and individual TNSPs. This technique allows us to compare total productivity levels between TNSPs and informs our assessment of the relative efficiency of each service provider.

Figure 3 shows the relative MTFP ranking of each TNSP in the National Electricity Market (NEM) from 2006 to 2017. This shows that AusNet, ElectraNet, TasNetworks and TransGrid all recorded an increase in MTFP over 2017.

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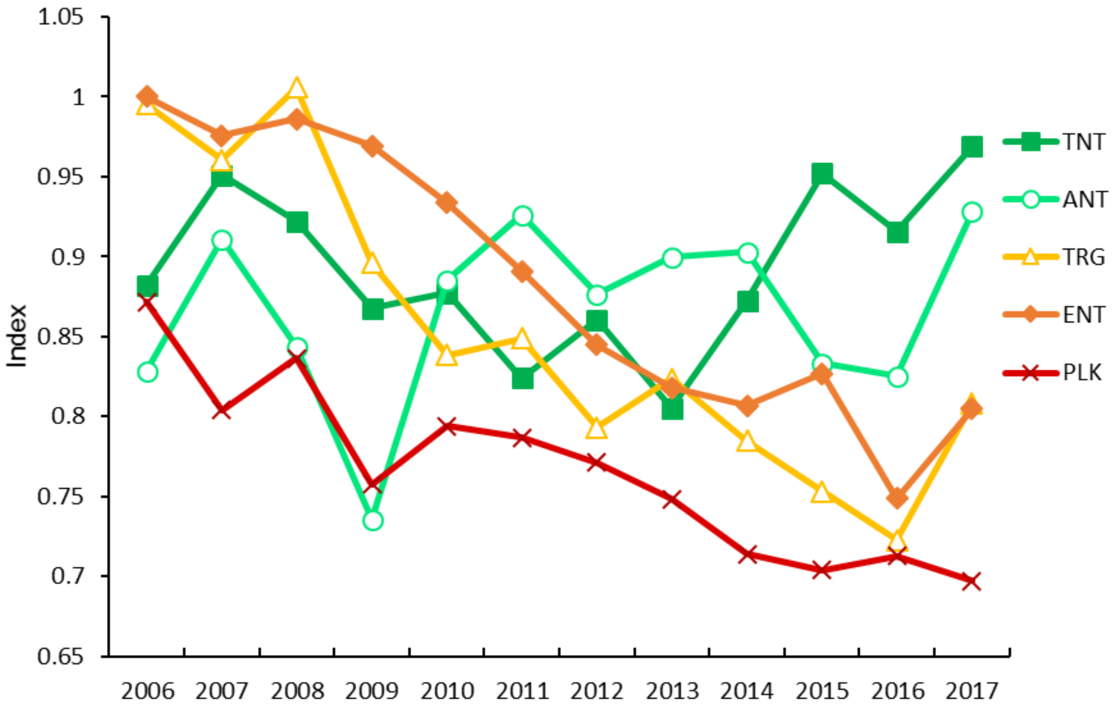
[2] That is, 4.1 of the 5.8 per cent increase in TFP is due to an increase in network reliability.

Figure 3 TNSP MTFP indexes, 2006–2017



The relative rankings of each TNSP from 2016 to 2017 are shown in table 1.

Table 1 TNSP MTFP scores, rankings and change, 2016 and 2017[3]

TNSP	Rank (2017)	Rank (2016)	MTFP Score (2017)	MTFP Score (2016)	% change between 2016-17
TasNetwork	1	1	0.97	0.92	+6%
AusNet Services	2	2	0.93	0.83	+12%
TransGrid	3 ↑	4	0.81	0.72	+12%
ElectraNet	4 ↓	3	0.80	0.75	+7%
Powerlink	5	5	0.70	0.71	–2%

Despite some significant movement in TNSP productivity scores, the rankings of the five networks remain largely unchanged in 2017 relative to 2016. TasNetworks

3 The rankings in Table 1 are only indicative of relative performance because there may be other operating environment variables not captured in the MTFP model. There may be small differences between MTFP and TFP rates of change for a given firm due to differences between the two methodologies. Appendix A of the 2017 Economic Insights Report contains an explanation for these differences.

continued to be the highest ranked transmission network in terms of MTFP score, while Powerlink continues to be the lowest ranked network. The only change is the MTFP rankings of TransGrid and ElectraNet, which switched positions. However, both TNSPs achieved similar MTFP scores in 2017.

1 Introduction

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.

The National Electricity Rules (NER) require the AER to publish network benchmarking results in an annual benchmarking report.[4] This is our fifth annual benchmarking report for transmission network service providers (TNSPs). This report is informed by expert advice provided by Economic Insights.[5]

National Electricity Rules reporting requirement

6A.31 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 Transmission Network Service Provider in providing direct control services over a 12 month period.

Our benchmarking report presents results from two types of 'top-down' benchmarking techniques.[6] Each technique uses a different method for relating outputs to inputs to measure and compare TNSP efficiency:[7]

- **Productivity index numbers (PIN)**. These techniques use a mathematical index to determine the relationship between outputs and inputs, enabling comparison of productivity levels over time and between networks.
- **Partial performance indicators (PPIs)**. These techniques are partial efficiency measures that relate one input to one output.

A TNSP's benchmarking results relative to other TNSPs reflect that network's relative efficiency, specifically their cost efficiency. TNSPs are cost efficient when they produce services at least possible cost given their operating environments and prevailing input prices.[8] A more productive network is likely to have lower costs compared with less

4 NER cl. 6A.31(a) & (c).

5 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.

6 Top down techniques measure a network's overall efficiency, taking into account any synergies and trade-offs that may exist between input components. Alternative bottom up benchmarking techniques are more resource intensive in that they examine each input component separately then aggregate them to form a total input. Bottom up techniques do not take into account potential efficiency trade-offs between input components of a TNSP’s operations. This is particularly the case with opex.

7 Appendix A provides reference material about the development of our economic benchmarking techniques. Appendix B provides information on the specific benchmarking models and data we use.

8 Cost efficiency (also known as productive efficiency) is made up of technical efficiency and allocative efficiency. Technical efficiency means that an input cannot be further reduced to produce a given quantity of output without

productive networks (controlling for its operating environments and the prices it pays for its inputs).

1.1 What's in this year's report?

Consistent with the NER, this report describes the relative efficiency of each TNSP in the national electricity market (NEM) for the 2017 reporting period. It also examines long-term trends and changes in network productivity and efficiency over 2006–17.

Chapter two of this report describes why the AER benchmarks electricity networks, and the uses of these economic benchmarking results. It also summarises the limitations of benchmarking transmission networks.

Chapter three presents the key total factor productivity (TFP) results at the industry level over the 2006–17 period, and for the 12 month reporting period of 2017. It also decomposes the observed changes in TFP into its constituent input and output drivers to show the changes in TNSP inputs and outputs that drove industry-wide productivity over 2017.

Chapter four presents the multilateral total factor productivity (MTFP) results for TNSPs over 2006–17. It also ranks each TNSP's relative performance in 2017 using MTFP scores, and compares this to the scores TNSPs achieved in 2016. Further, results from supplementary benchmarking techniques, including operational and capital multilateral partial factor productivity (MPFP), and the partial performance indicators (PPIs) are reported. These provide alternative measures of comparative performance.

A complete set of the benchmarking results at the industry and individual TNSP level is available in the Economic Insights Report available at the AER's benchmarking webpage online.[9]

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increasing the use of another input. Allocative efficiency requires inputs to be used in the proportions that would minimise cost given prevailing input prices.

9 Economic Insights, *Economic Insights TNSP Report – Economic Benchmarking Results for the AER*, 16 August 2018.

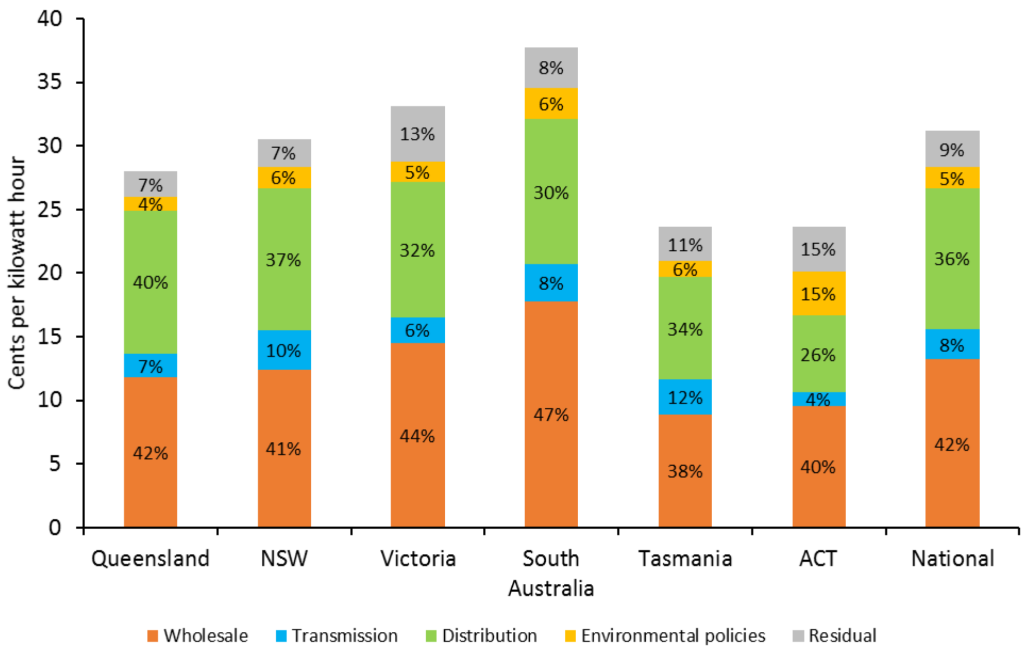
2 Economic benchmarking and its uses

2.1 Why do we benchmark electricity networks?

Electricity networks are 'natural monopolies' which do not face the typical commercial pressures experienced by firms in competitive markets. 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. Transmission network costs typically account for between four to twelve per cent of what consumers pay for their electricity while distribution costs account for 30 to 40 per cent (with the remainder covering the costs of generating, and retailing electricity, as well as various environmental policies). Figure 4 provides an overview of the typical electricity retail bill.[10]

Figure 4 Network costs as a proportion of retail electricity bills



Source: AEMC, AER analysis.

Under 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. This is done though a periodic regulatory process (known as revenue determinations or resets) which typically occurs every five years. The

10 AEMC, *2017 Residential Electricity Price Trends data*, 18 December 2017.

electricity network provides the AER with a revenue proposal outlining its forecast expenditures or costs over the five year period.

The AER assesses and, where necessary, amends the proposal to ensure it represents efficient costs. Based on these costs, the AER then sets the network's revenue allowance for the five year period, which is the maximum amount the network can recover from their retail customers through electricity bills.

In 2012, the Australian Energy Market Commission (AEMC) amended the rules to strengthen the AER's power to assess and amend network expenditure proposals.[11] The rule changes were made in response to concerns raised by the AER and other industry participants that restrictions in the NER had resulted in inefficient increases in capital and operating expenditure allowances of network service providers (NSPs) and higher charges for consumers.[12]

The rule changes required the AER to develop a benchmarking program to measure the relative efficiency of all electricity networks in the NEM and to have regard to the benchmarking results when assessing capital expenditure (capex) and operational expenditure (opex) allowances for network businesses. The new rules also required the AER to publish the benchmarking results in an annual benchmarking report.[13]

2.2 The uses of economic benchmarking

The AER uses benchmarking in various ways when assessing and amending network expenditure proposals. [14] We use it to measure the efficiency of network opex, capex and total expenditures and changes in the efficiency of these expenditures over time. This gives us an additional source of information on the efficiency of historical network opex and capex expenditures 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. As we have done in this year's report, this can help us understand why network productivity is increasing or decreasing and where best to target our expenditure reviews.[15]

The benchmarking results provide network owners and investors with useful information on the relative efficiency of the electricity networks they own and invest in.

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11 See: 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 (AEMC Rule Determination), p. vii.

12 AEMC, *final rule determination 2012*, p. viii.

13 NER, cl. 6A.31(a) & (c).

14 The benchmarking presented in this report is one of a number of factors we consider when making our revenue determinations. For a revenue determination, we examine the efficiency of an individual TNSP's forecast opex and capex. In this report we primarily examine the efficiency of transmission networks overall. Though the efficiency of networks as a whole is relevant to our determinations, we also undertake further analysis when reviewing opex and capex forecasts.

15 AER, *Explanatory Statement - Expenditure Forecast Assessment Guideline,* November 2013: https://www.aer.gov.au/system/files/Expenditure%20Forecast%20Assessment%20Guideline%20-%20Explanatory%20Statement%20-%20FINAL.pdf, p. 78-79.

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 in particular, allow consumers to clearly see what factors are driving network efficiency and the network cost component of their retail electricity bills. This helps to inform their participation in our regulatory processes and broader debates about energy policy and regulation.

2.3 Limitations of benchmarking transmission networks

When undertaking economic benchmarking, it is important to recognise that TNSPs operate in different environments. Certain factors arising from a TNSP's operating environment are beyond its control. These 'operating environment factors' (OEFs) may influence a TNSP's costs and, therefore, its benchmarking performance. The benchmarking techniques presented in this report capture key OEFs. For example, MTFP accounts for a TNSP's assets, number of end users, its ratcheted maximum demand and energy throughput. By including these outputs, we also allow for key network density measures, including throughput per kilometre and maximum demand per customer. However, not all OEFs can be captured in the models.

Further, 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. Compared to electricity distribution networks there have not been many top-down benchmarking studies of transmission networks and, consequently, MTFP analysis for transmission networks is still in a relatively early stage of development. The small number of electricity transmission networks in Australia (five) also makes efficiency comparisons at the aggregate expenditure level difficult.

However, we consider the benchmarking analysis presented in this report is reasoned and comprehensive. We have consulted extensively with industry participants to refine our transmission benchmarking as part of our ongoing development work program. We have also collected data on all major inputs and outputs for transmission businesses, and we consider the dataset used is robust.

3 Industry productivity results

Key points

- Industry-wide productivity, as measured by TFP, increased by 5.8 per cent over 2017.[16] This is the first year-on-year industry TFP increase since 2013. It is also a significant improvement relative to the long-term industry rate of a 1.3 per cent annual average decline in productivity.
- An improvement in network reliability (energy not supplied) for AusNet, ElectraNet and TransGrid drove the increase in TNSP productivity over 2017. This contributed 4.1 percentage points (ppts) of the 5.8 per cent industry TFP growth rate.[17] Growth in transformers and a decline in circuit length made the only negative contributions to industry TFP over 2017, at –0.3 and –0.2 ppts respectively.

This chapter presents the industry TFP results over the 2006–17 period, and for the 12 month reporting period of 2017. It also decomposes the observed changes in TFP into its constituent input and output drivers to show the changes in TNSP inputs and outputs that drove industry-wide productivity change over 2017.[18]

TFP relates total inputs to total outputs and provides a measure of overall productivity growth for a single entity, such as an individual TNSP, or the transmission industry.[19] It is also used to decompose productivity change into its respective drivers.

3.1 Overall industry results

Industry-wide transmission network productivity, as measured by TFP, increased by 5.8 per cent over 2017. This is the first year-on-year industry TFP increase since 2013, and is the biggest improvement in TFP over the last 12 years. It is also a significant improvement relative to the long-term industry rate of a 1.3 per cent annual average decline in productivity.

Figure 5 shows that electricity transmission productivity has outgrown the overall economy and the utilities sector (electricity, gas, water and waste services) productivity in 2010 and 2017.[20]

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16 The 5.8 per cent increase in TFP over 2017 refers to the percentage change in productivity scores between the 2015–16 and 2016–17 financial years or the calendar years 2016 and 2017, as relevant. In this report, this change can be referred to as 'a change over 2017' or 'a change over 2016–17'.

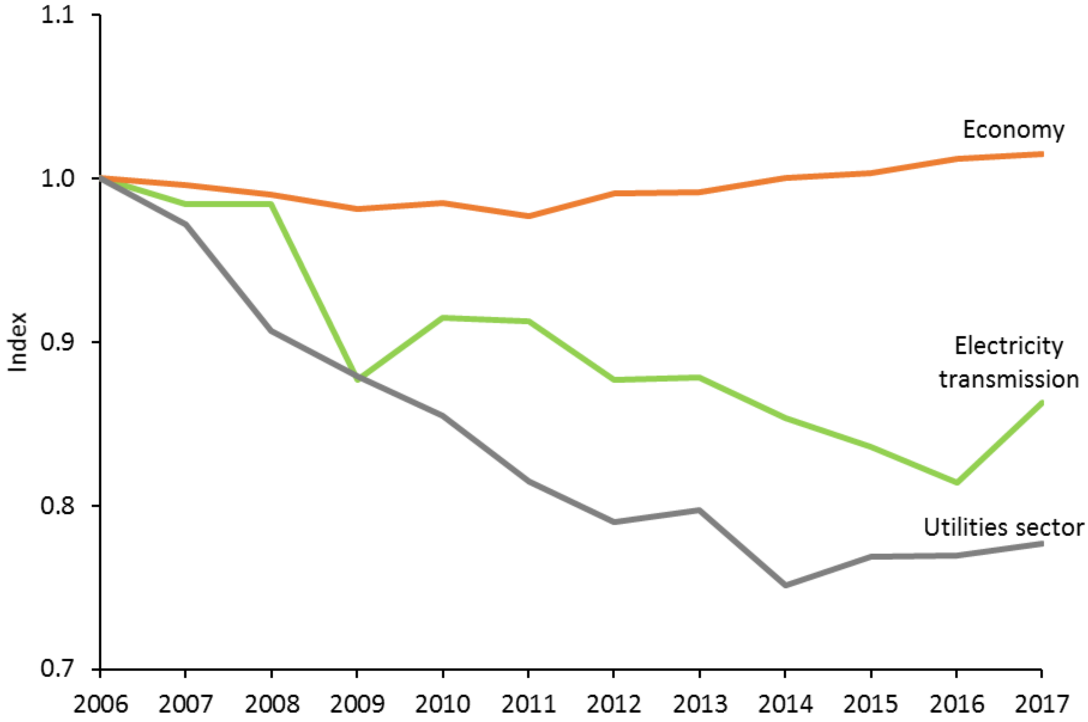
17 That is, 4.1 of the 5.8 per cent increase in TFP is due to an increase in reliability.

18 Appendix A includes a link to the methodology that allows us to decompose a given productivity change into its input and output components.

19 A summary of the inputs and outputs we use are reported in Appendix B.2.

20 Utilities include electricity, gas, water and waste services.

Figure 5 Electricity transmission industry, utilities sector, and economy productivity indices, 2006–17

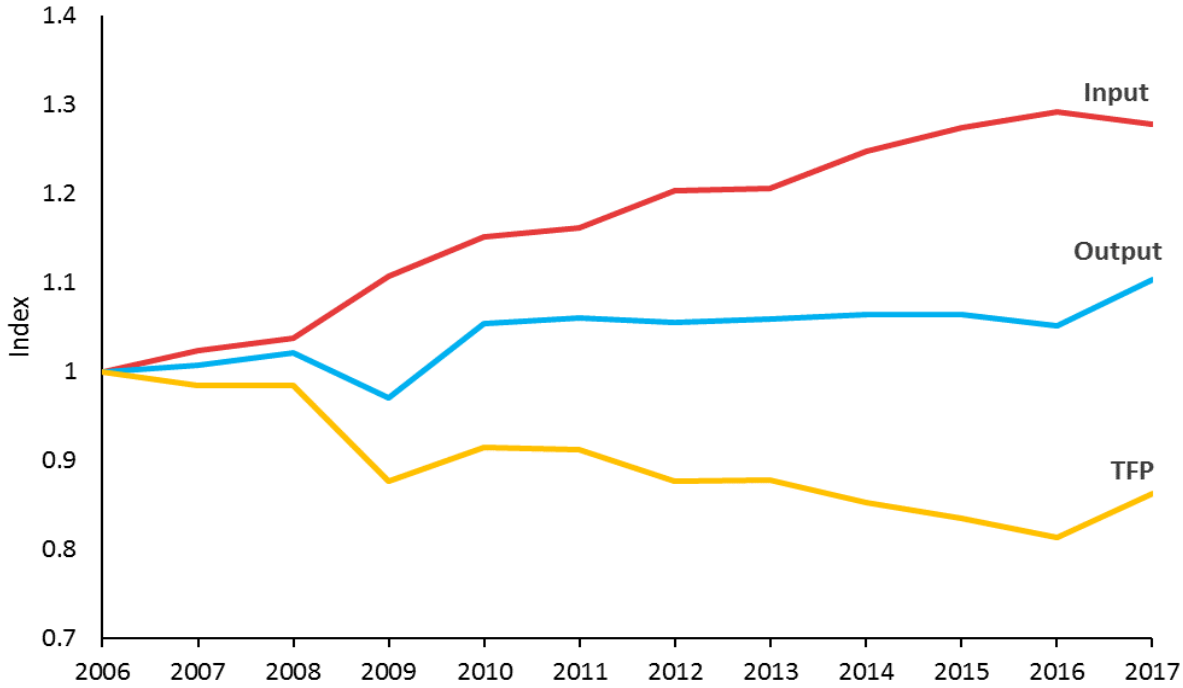


Source: Economic Insights; Australian Bureau of Statistics.

Note: The productivity of the Australian economy and the utility 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 TFP increase over 2016–17 is due to total inputs falling by one per cent and total outputs increasing by 4.8 per cent (Figure 6). In comparison, inputs grew faster than outputs over the 2006–17 period, resulting in a fall in long-term TFP. The factors contributing to the long-term input and output changes over the full 2006–17 period are reported in Appendix B.2.

Figure 6 Electricity transmission input, output and productivity indices, 2006 to 2017

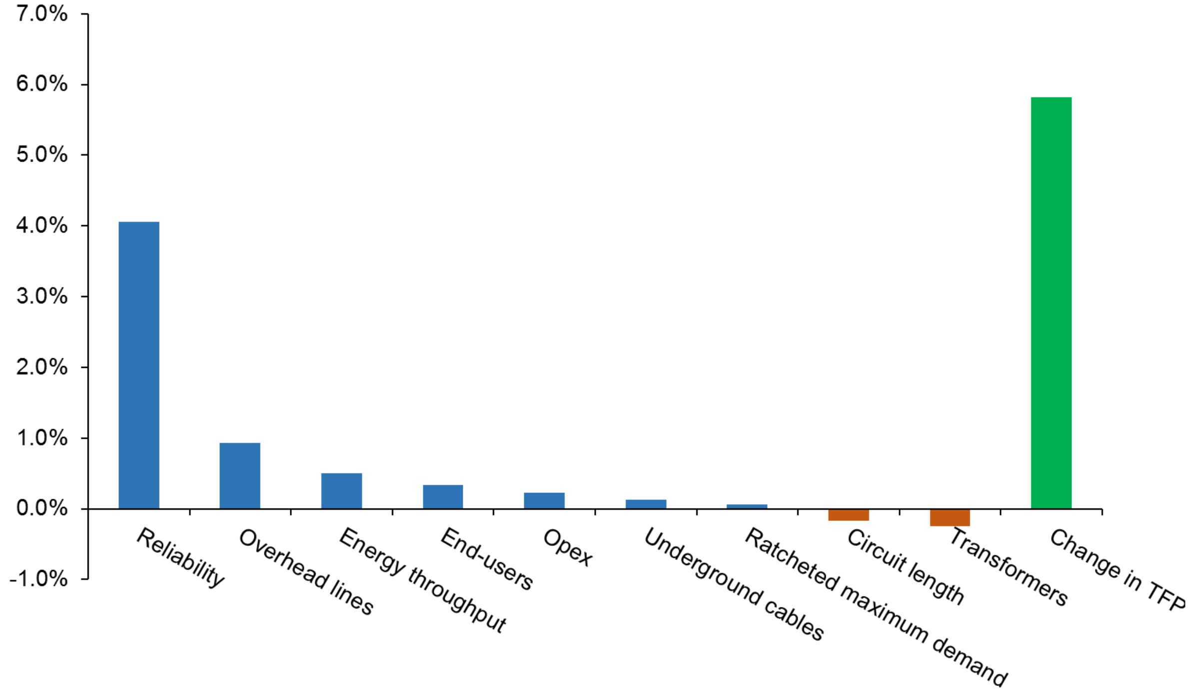


Source: Economic Insights.

Input and output contributions to changes in 2017 TFP

Figure 7 shows each output's and input's contribution to the annual rate of TFP change over 2016–17. The contributions appear from the most positive on the left to the most negative on the right. If all the positive and negative contributions in Figure 7 are added together, they sum to the TFP change given by the green bar on the right of the figure.

Figure 7 TNSP output and input percentage point contributions to annual TFP change, 2016–17



Source: Economic Insights.

The primary driver of the reversal in declining TFP over 2016–17 was improved industry reliability. This contributed 4.1 ppts to the industry TFP growth rate of 5.8 per cent, and is discussed further below. A decline in overhead lines, and a growth in energy throughput further contributed 0.9 and 0.5 ppts to TFP, respectively. Growth in transformers and a decline in circuit length made the only negative contributions to industry TFP over 2017, at –0.3 and –0.2 ppts, respectively.

Individual TNSP contributions to productivity growth

Table 2 presents a decomposition of each TNSP's productivity growth over 2017, which collectively drives industry input and output changes. We chose to focus on four components: reliability, overhead lines, energy throughput, and opex. This is due to the materiality of their positive contributions to industry TFP over 2017.[21]

[21] We have not presented end-user numbers because it has grown at a steady rate over the 2006–17 period, and has therefore made similar positive contributions to TFP each year.

Table 2 Input and output contributions to individual TFP growth rates, by TNSP, 2017

	2017				
	Annual change in TFP (%)	Reliability contribution (ppts)	Overhead lines contribution (ppts)	Energy throughput contribution (ppts)	Opex contribution (ppts)
Industry	**5.8**	**4.1**	**0.9**	**0.5**	**0.2**
AusNet (Vic)	7.2	7.7	–0.0	–0.5	1.0
ElectraNet (SA)	5.6	6.5	–0.1	0.5	–1.0
PowerLink (QLD)	–0.4	–0.4	0.5	0.6	–0.6
TasNetworks (Tas)	5.5	–0.4	0.0	1.5	4.1
TransGrid (NSW)	10.3	5.6	2.0	0.9	0.4

Source: Economic Insights, AER analysis.

AusNet, ElectraNet and TransGrid all reported higher reliability in 2017, which materially contributed to their TFP. AusNet reported the biggest improvement in reliability. AusNet stated this was due to it only experiencing one loss of supply event in 2017. This was comparatively smaller than the significant events it faced in 2015 and 2016 which impacted its large customers.[22]

In comparison, TasNetworks and Powerlink's reliability had a negative impact on their 2017 TFP. TasNetworks' 2017 TFP result was driven by its decrease in opex usage, which contributed 4.1 ppts, while Powerlink's increase in opex usage was one of the largest contributors to its TFP decline.

Overall, all five TNSPs achieved higher TFP growth in 2017 compared to the average annual industry-wide TFP decline of 1.3 per cent over 2006–17. The full set of input and output contributions to TFP over the 2006–17 and 2017 period can be found in the Economics Insights report online.[23]

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22 AusNet email response to AER questions, 6 June 2018.

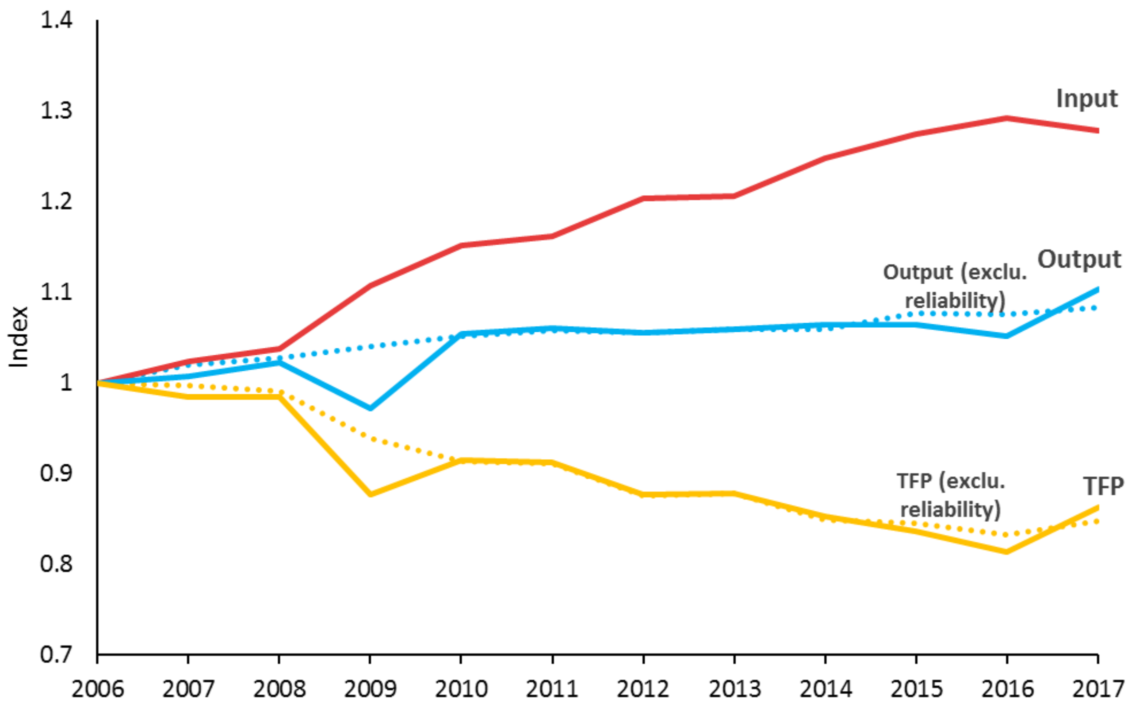
23 Economic Insights, *Economic Benchmarking Results for the Australian Energy Regulator's 2018 TNSP Annual Benchmarking Report*.

Reliability's contribution to TFP growth

The TFP results are relatively sensitive to reliability at the firm-specific level. As discussed above, reliability improvements over 2017 contributed to a large proportion of AusNet, ElectraNet and TransGrid's TFP growth in 2017.

There are also noticeable differences in output and TFP growth at the industry level depending on whether we include reliability in our output specification. However, industry TFP is less sensitive to reliability than firm-specific TFP because it is an average measure across all TNSPs. Figure 8 shows industry output and TFP over the 2006–17 period with and without the reliability measure.

Figure 8 Electricity transmission input, output and productivity indices, with and without reliability, 2006 to 2017[24]



Source: Economic Insights.

These differences reflect periods where rare but large impact network outages have occurred. It can be seen that worse than average reliability depressed both industry output and TFP in 2009 and 2016, while a return to better than average reliability in 2010 and 2017 boosted both output and TFP. However, industry TFP has increased over 2017 regardless of whether reliability is included.[25]

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24 The 2018 Economic Insights Transmission report further reports productivity results with and without reliability at the individual TNSP level.

25 Industry TFP without the reliability output measure increased by 1.8 per cent over 2017.

In 2017, we reviewed the output specifications of our transmission benchmarking models. Among the issues we considered was the measure of network reliability. We decided to cap the impact of TNSP reliability on productivity due to stakeholder concerns that the weight we applied was too large.[26]

As part of our ongoing benchmarking development work, we will continue to monitor the appropriateness of this output, and whether any further changes are necessary.

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[26] A more detailed description of the updated TNSP benchmarking specifications, stakeholder comments and our rationale for the changes can be found in the TNSP Benchmarking Review documents listed in Appendix A of this document, and online here: https://www.aer.gov.au/networks-pipelines/guidelines-schemes-models-reviews/annual-benchmarking-report-2017/initiation.

4 Relative efficiency of individual transmission networks

Key points

- AusNet, ElectraNet, TasNetworks and TransGrid all recorded an increase in multilateral factor productivity (MTFP) over 2017. AusNet and TransGrid recorded the biggest increase of 12 per cent. Powerlink saw a decline in MTFP of two per cent.
- TasNetworks and AusNet continued to be the highest ranking TNSPs by MTFP score over 2017. TransGrid and ElectraNet are in the mid-range, achieving similar scores. Powerlink continue to be ranked lowest by MTFP score over 2017.

This chapter presents the MTFP results for each TNSP over the 2006–17 period, and for the 12 month reporting period of 2017. It also ranks each TNSP's relative performance in 2017 using MTFP scores.

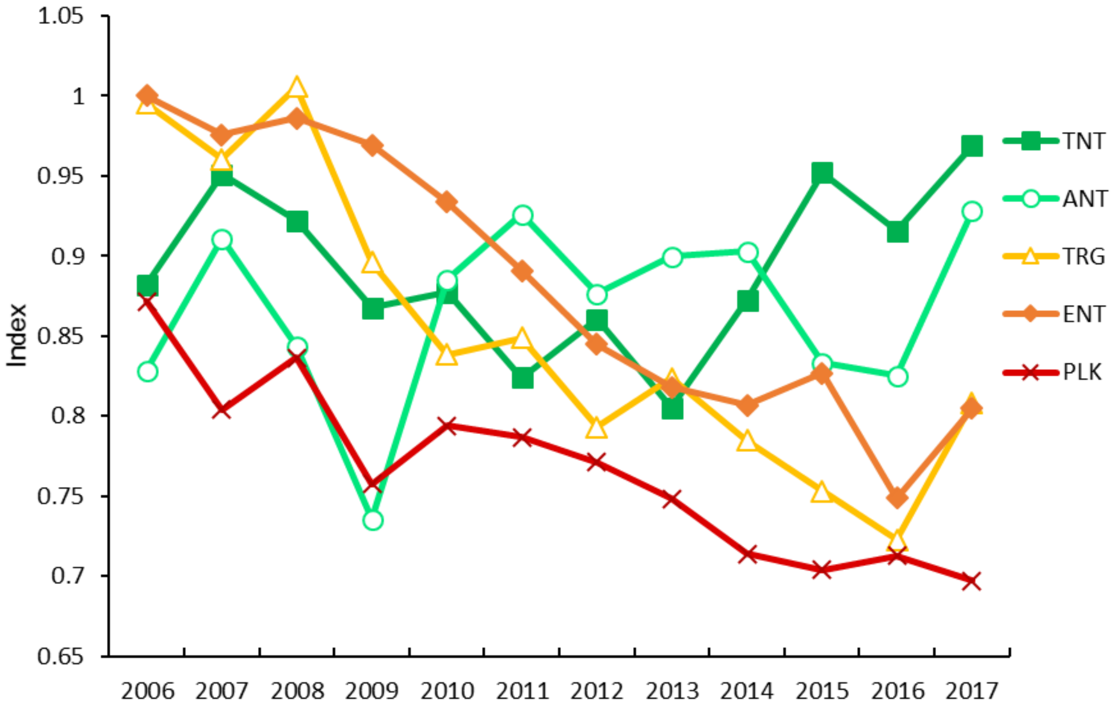
MTFP relates total inputs to total outputs and provides a measure of overall network efficiency relative to other networks. It is the primary indicator we use to measure and compare the relative efficiency of TNSPs in this report.

We support these results using MPFP metrics and PPIs. Collectively, they assist in interpreting the MTFP results and provide a range of measures to assess the relative efficiency of service providers. MPFP metrics examine the contribution of capital and opex to overall productivity in isolation, while PPIs provide a general indication of comparative performance in delivering one type of output.

4.1 MTFP results by TNSP

The MTFP index for each TNSP over the 2006 to 2017 period is shown in Figure 9.

Figure 9 TNSP MTFP indexes, 2006–2017



Source: Economic Insights.

Over 2017, TasNetworks, AusNet, TransGrid and ElectraNet all achieved an increase in MTFP, with AusNet and TransGrid recording the largest increases of 12 per cent. Powerlink was the only TNSP to record a decrease in MTFP over 2017 of 2 per cent. It continues to be the lowest ranked transmission network in terms of its MTFP score. Overall, these results are an improvement from 2016, where all TNSPs except for Powerlink reported a decline in MTFP.

The relative ranking of each TNSP according to its 2016 and 2017 MTFP scores is shown in Table 3.

Table 3 TNSP MTFP scores and rankings and changes, 2016 and 2017

TNSP	Rank (2017)	Rank (2016)	MTFP Score (2017)	MTFP Score (2016)	% change between 2016-17
TasNetwork	1	1	0.97	0.92	+6%
AusNet Services	2	2	0.93	0.83	+12%
TransGrid	3	4	0.81	0.72	+12%
ElectraNet	4	3	0.80	0.75	+7%
Powerlink	5	5	0.70	0.71	–2%

Source: Economic Insights.

Note: 1. All scores are calculated using the 2017 output specifications and are calibrated relative to the 2006 ElectraNet score which is set equal to one.

2. There may be small differences between MTFP and TFP rates of change for a given firm due to difference between the two methodologies. Appendix A of the 2018 Economic Insights Report contains an explanation for these differences.

Despite movement in some TNSP productivity scores, the rankings of the five networks remain largely unchanged in 2017. The only change is the relative MTFP ranking between TransGrid and ElectraNet. However, we note that both TNSPs achieved similar MTFP scores in 2017. Further, the rankings in Table 3 are only indicative of relative performance.[27]

TransGrid, ElectraNet and Powerlink's MTFP scores have steadily decreased over the longer 2006–17 period, down 19 per cent, 20 per cent and 20 per cent, respectively. As a result, TransGrid and ElectraNet, which started the period with the highest MTFP scores, are now in the mid-range. On the other hand, AusNet Services increased its MTFP score by 12 per cent, and TasNetworks increased its MTFP score by 10 per cent over the same period, making them now the most productive TNSPs by MTFP score.

4.2 Supporting benchmarking techniques

We have used a range of supplementary benchmarking techniques to support the MTFP results reported in the previous section. Supplementary measures reported here include capital and operating expenditure MPFP and a range of PPIs.

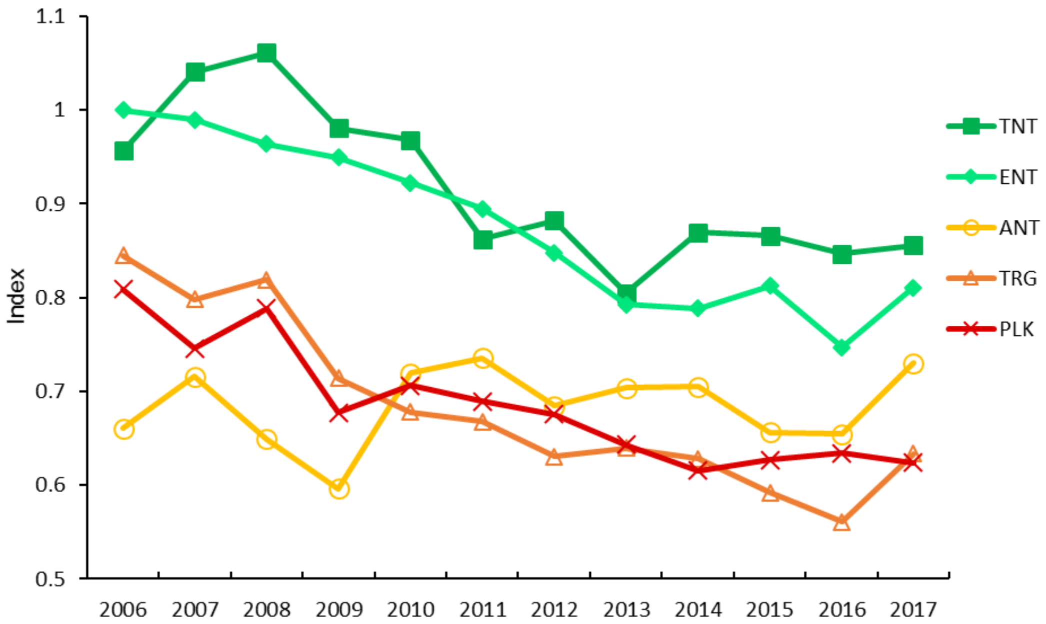
[27] The comparison of productivity levels between TNSPs should be treated with caution because the benchmarking of transmission networks is relatively new, and because our models do not directly incorporate all relevant operating environment factors.

Multilateral partial factor productivity

The MPFP metrics assist in interpreting the MTFP results by examining the contribution of capital and operating expenditure to overall productivity in isolation. This 'partial' approach uses the same output specification as MTFP and provides more detail on the contribution of opex and the individual components of capital to changes in productivity.

Capital MPFP (Figure 10) considers the productivity of the TNSP’s use of overhead lines, underground cables and transformers.

Figure 10 Capital MPFP index, 2006–2017

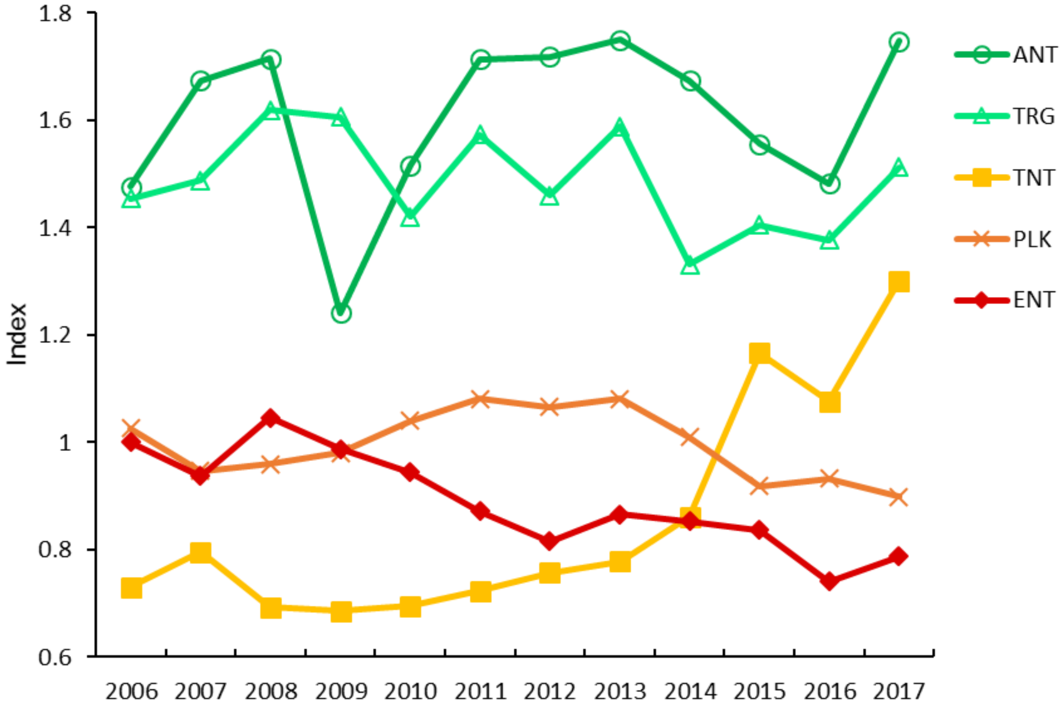


Source: Economic Insights.

Despite some volatility, each TNSP's capital productivity has generally declined since 2006. The exception is AusNet, which achieved slightly higher capital productivity in 2017 than in 2006. Over the past year, capital productivity for Powerlink decreased slightly. The other four TNSPs achieved an improvement in capital productivity. This is consistent with the MTFP results, where an improvement in reliability led to an increase in 2017 productivity.

Figure 11 presents the opex MPFP indexes for all TNSPs.

Figure 11 Opex MPFP index, 2006–2017



Source: Economic Insights.

AusNet and TransGrid have the highest opex MPFP levels over the 2006–17 period. While there has been some volatility, TransGrid's opex MPFP in 2017 remains similar to its level in 2006. Powerlink, despite a solid improvement in opex productivity between 2007 and 2011, is 12 per cent below its 2006 level in 2017. This follows a decline in opex MPFP in 2014, 2015 and 2017. Notwithstanding a notable decline in opex MPFP in 2015–16 (down 8 per cent), TasNetworks improved its opex productivity over the 2006–17 period, up 78 per cent from 2006. Similarly, AusNet's opex MPFP increased by 18 per cent over the period. Despite an improvement in opex MPFP in 2017, ElectraNet is the only TNSP to experience a significant decline in opex MPFP of 21 per cent over the 2006–17 period.

Partial performance indicators

PPIs provide a simple visual representation of the input costs used to produce particular outputs. The PPIs we use support the MTFP analysis, providing a general indication of comparative performance in delivering one type of output. However, PPIs do not take interrelationships between outputs into account. Therefore, PPIs are most useful when used in conjunction with other benchmarking techniques, such as MTFP.

The inputs we use are the TNSPs' total cost, made up of opex and asset costs. Asset cost is the sum of annual depreciation and return on investment on the TNSP's regulatory asset base.[28] 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 TNSPs and over time. The outputs we use are number of end users, circuit line length, maximum demand served and energy transported. We examine each of these outputs below.

Total cost per end user

The total cost per end user is presented in Figure 12. In 2017, AusNet maintains the lowest cost per end user. Conversely, TasNetworks continues to have the highest cost per end user of all the transmission networks at over four times that of AusNet Services. Total costs per end users have grown for all TNSPs over the past 12 years, with the strongest growth by ElectraNet of 40 per cent and Powerlink of 32 per cent. This is due to TNSPs' regulatory asset base (RAB) and opex increasing faster than the increase in end users. Over 2016–17, TasNetworks and Powerlink decreased their total cost per end user, while TransGrid and AusNet's stayed relatively constant. ElectraNet's total costs per end user continued to increase, up a further 2 per cent.

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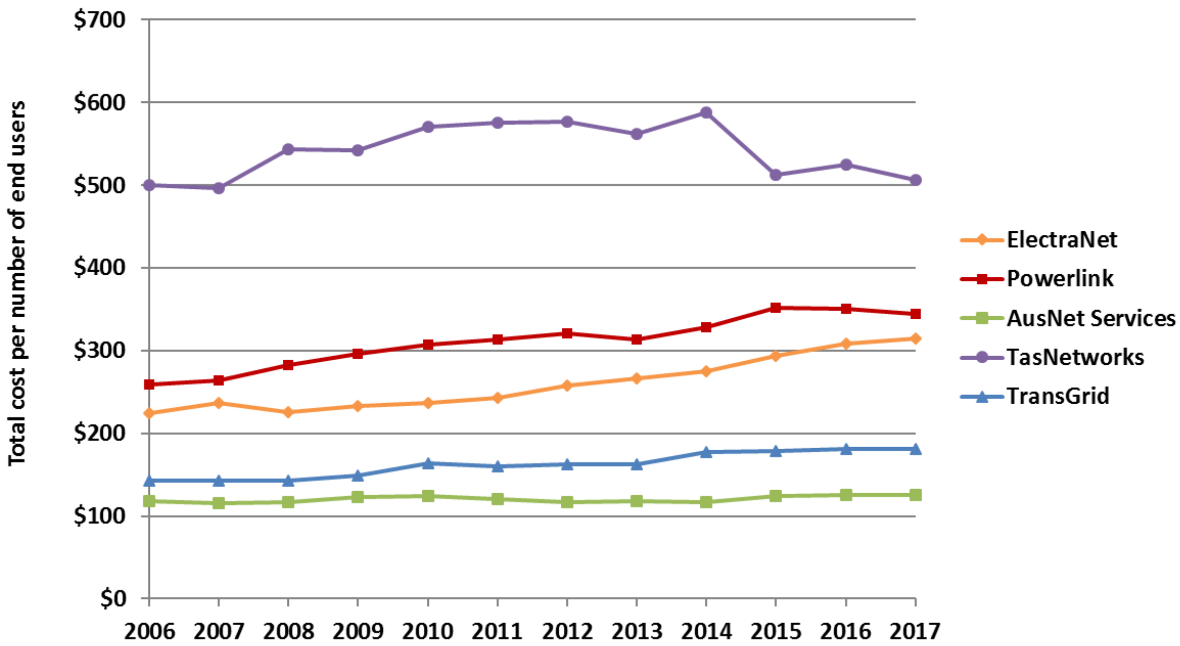
[28] To calculate asset costs relevant to PPIs, MTFP and Capital MPFP, where possible we have applied annual weighted average cost of capital values calculated in accordance with the AER's approach to setting rate of return in the most recent determination. See Ausnet Services, *Draft Decision Ausnet Services Transmission Decision*, *Rate of return factsheet*, July 2016. 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.

Figure 12 Total cost per end user ($2017), 2006–2017

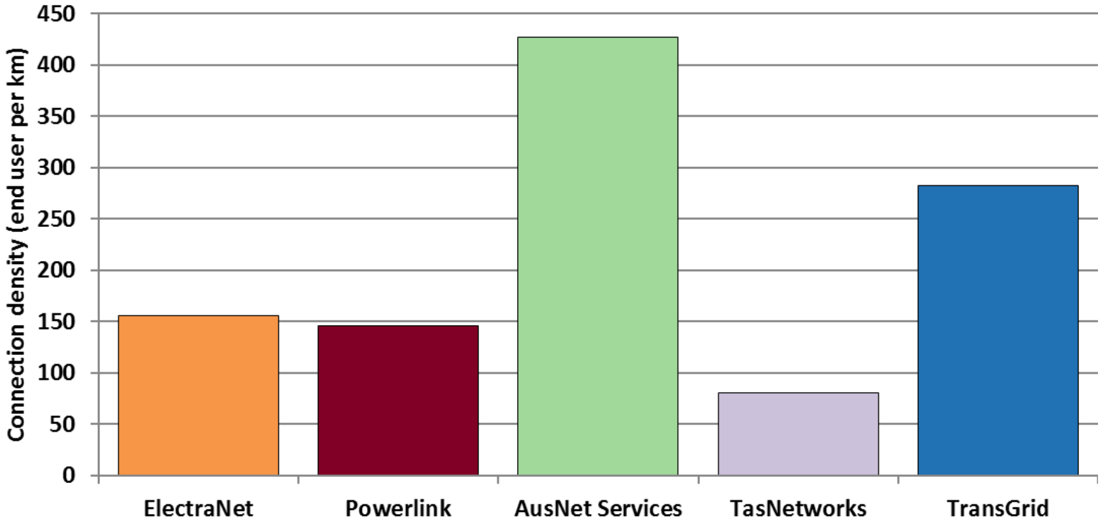


Source: AER analysis, Economic Benchmarking RINs

We note this measure potentially favours denser transmission networks (where density is measured in terms of end users per circuit kilometre). This is because denser transmission networks tend to have more customers per kilometre and hence are required to maintain fewer lines per connection point. The average connection density of TNSPs over 2013–17 is presented in Figure 13.

Figure 13 illustrates that AusNet Services has the highest average connection density, followed by TransGrid, ElectraNet, Powerlink and TasNetworks respectively. This is consistent with the cost per end-user rankings in Figure 12.

Figure 13 Connection density (end user per circuit km, 2013–17 average)



Source: AER analysis, Economic Benchmarking RINs.

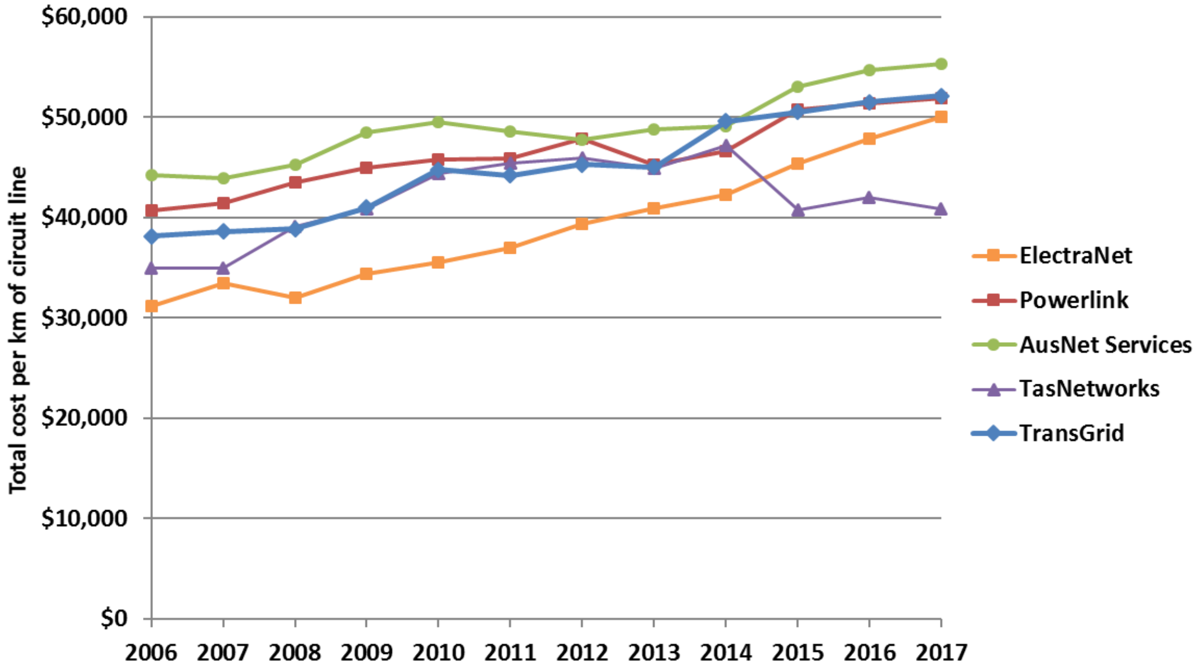
Total cost per km of transmission circuit length

The cost per kilometre of circuit length is shown in Figure 14. TasNetworks has the lowest cost per kilometre of circuit length in 2017, whereas AusNet has the highest cost per kilometre of circuit length. We note this measure potentially favours transmission networks with lower connection densities because they have to service fewer connections per km.

All TNSPs experienced relatively strong growth in total costs per kilometre of transmission circuit length between 2006 and 2017. This is due to increases in the RAB and opex exceeding the growth in transmission circuit length. The largest increase in cost per kilometre of circuit length was by Electranet (60 per cent), followed by Transgrid (37 per cent). The lowest growth was by TasNetworks, but it was still a substantial 17 per cent.

The difference in costs between the TNSPs with the highest and lowest cost per km narrowed over the intervening years, from a peak of $14,087 in 2009, to a low $7,317 in 2014. However, following a sharp decline in costs by TasNetworks in 2014–15 and a levelling off from 2015 when the costs of all other networks continued to increase, the gap in total cost per kilometre of transmission circuit length has again widened to $14,393 in 2017.

Figure 14 Total cost per km of transmission circuit length ($2017), 2006 to 2017



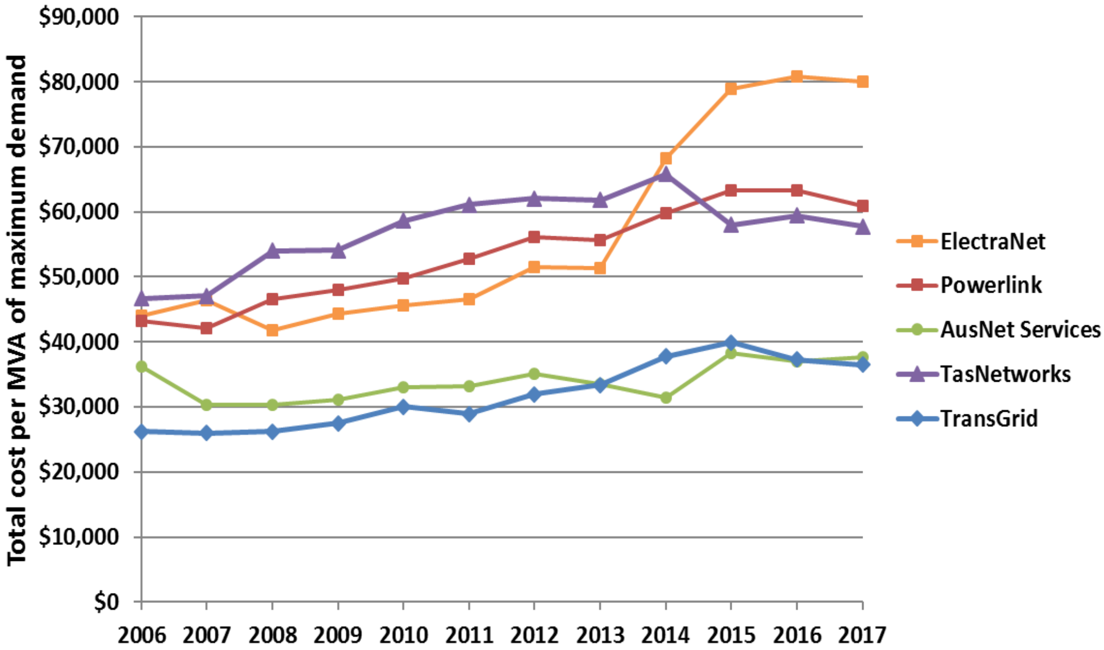
Source: AER analysis, Economic Benchmarking RINs.

Total cost per Mega Volt Amp (MVA) of non-coincident maximum demand

Figure 15 shows TNSPs' total cost per MVA of non-coincident maximum demand. ElectraNet has the highest cost per MWA of maximum demand in 2017. This follows very strong cost growth between 2013–14 and 2014–15 as a result of a substantial drop in maximum demand with no offsetting decrease in TNSPs’ total costs. ElectraNet's costs in 2017, at around $80,000 per MVA of maximum demand, are more than double that of better performing TNSPs, TransGrid ($36,465/MVA) and AusNet Services ($37,609/ MVA).

Generally, there has been moderate growth in total costs per MVA of maximum demand over 2006 to 2017, with TasNetworks up 24 per cent to $57,732/MVA, TransGrid up 39 per cent and Powerlink up 41 per cent to $60,903/MVA. ElectraNet was the exception, due to the surge in 2014 and 2015, with an increase of 82 per cent. On the other hand, AusNet Services had very little change in total cost per MVA maximum demand over the period (4 per cent).

Figure 15 Total cost per MVA of maximum demand served ($2017), 2006–2017



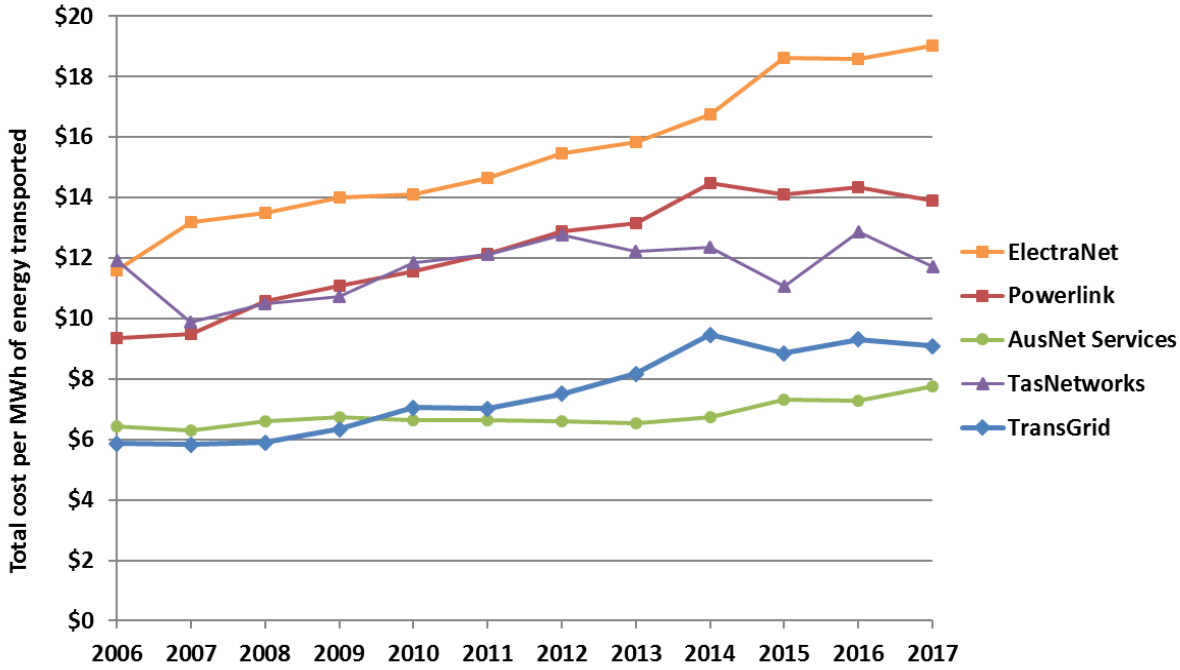
Source: AER analysis, Economic Benchmarking RINs.

Total cost per MWh of energy transported

Total cost per MWh of energy transported is shown in Figure 16. Under this measure, ElectraNet again sits well above the other TNSPs, with the highest cost per MWh of energy transported, at over $19/MWh in 2017. AusNet Services and Transgrid are again the best performers by this measure, at around half the total cost per MWh of ElectraNet, at $7.7/MWh and $9.1/MWh respectively.

Costs increased steadily for most TNSPs over the period from 2007 to 2014, but have since remained at similar levels for Powerlink, TasNetworks and TransGrid. AusNet has experienced a small increase in total cost per MWh of energy transported from 2014–17, but this is relatively small compared to ElectraNet's increase over the same period.

Figure 16 Total cost per MWh of energy transported ($2017), 2006–2017



Source: AER analysis, Economic Benchmarking RINs.

A References and further reading

This benchmarking report is informed by several sources.

Economic Insights publications

The following publications explain in detail how Economic Insights developed and applied the economic benchmarking techniques we used:

- Economic Insights *Report – Economic Benchmarking Results for the Australian Energy Regulator's 2018 TNSP Benchmarking Report,* November 2018
- Economic Insights *Report – Economic Benchmarking Results for the Australian Energy Regulator's 2017 TNSP Benchmarking Report,* November 2017 (link)
- Economic Insights, *Memorandum – TNSP MTFP Results*, November 2016 (link).
- Economic Insights, *Memorandum – TNSP MTFP Results*, November 2015 (link).
- Economic Insights, *Economic Benchmarking Assessment of Operating Expenditure for NSW and Tasmanian Electricity TNSPs*, 10 November 2014 (link).
- Economic Insights, *AER Response to HoustonKemp for TransGrid determination*, 4 March 2015 (link)
- Economic Insights, *Economic Benchmarking of Electricity Network Service Providers*, 25 June 2013 (link).

AER 2017 TNSP Benchmarking Review

All documents related to the AER's 2017 TNSP Benchmarking Review can be found on line at: https://www.aer.gov.au/networks-pipelines/guidelines-schemes-models-reviews/annual-benchmarking-report-2017/initiation.

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*, December 2011.

AER transmission determinations

The AER uses economic benchmarking to inform its regulatory determination decisions. A full list of these decisions to date can be found on the AER's website: https://www.aer.gov.au/networks-pipelines/determinations-access-arrangements

B Benchmarking models and data

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

B.1 Benchmarking techniques

This report presents results from two types of 'top-down' benchmarking techniques:

- **Productivity index numbers**. These techniques use a mathematical index to determine the relationship between outputs and inputs:
    - 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 for different periods of time for the one entity. It also 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 to total outputs and provides a measure of overall network efficiency relative to other networks. It thus allows total productivity levels to be compared between networks. It is applied to combined time-series and 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 against total output. It allows partial productivity levels to be compared between networks.
- **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) used to produce one unit of a given output (such as total customer numbers, megawatts of maximum electricity demand or kilometres of circuit line length).

B.2 Benchmarking data

The inputs and outputs used in the benchmarking techniques for this report are described below. The inputs represent the resources (such as capital and labour) a TNSP uses to provide electricity transmission services. The outputs represent the electricity services delivered (such as the line length and how much electricity they transport).

Data for each of these input and output categories is provided each year by the TNSPs in response to economic benchmarking regulatory information notices (EB RINs). The EB RINs require all TNSPs to provide a consistent set of data which is verified by the TNSP’s chief executive officer and independently audited. We separately test and validated the data. The complete data sets for all inputs and outputs from 2006 to

2017, along with the Basis of Preparation provided by each TNSP, are published on our website.[29]

An overview of the inputs and outputs are in box 1 below.

Box 1: Categories of inputs and outputs used in TNSP benchmarking

Outputs

Outputs are measures that represent the services the TNSPs provide. The outputs we use to measure service provision are:

- Energy throughput (GWh)
- Ratcheted maximum demand (RMD)
- Circuit length (Circuit kms)
- End–user numbers (End User nos)
- (minus) Minutes off–supply/Energy not supplied (ENS) (weight based on current AEMO value of customer reliability (VCRs) capped at a maximum absolute value of 5.5 per cent of gross revenue).

Inputs

- TNSPs use a mix of physical assets and operational spending to deliver services.
- Capital stock (assets) include:
    - Overhead lines (quantity proxied by overhead MVAkms) (O/H lines)
    - Underground cables (quantity proxied by underground MVAkms) (U/G cables)
    - Transformers and other capital (quantity proxied by transformer MVA) (Trfs)
- Operating expenditure (expenditure TNSPs spend to operate and maintain their assets) (opex).

B.2.1 Outputs

Outputs are measures that represent the services the TNSPs provide. TNSPs exist to provide customers with access to a safe and reliable supply of electricity. We explain the outputs we use in more detail in this section.

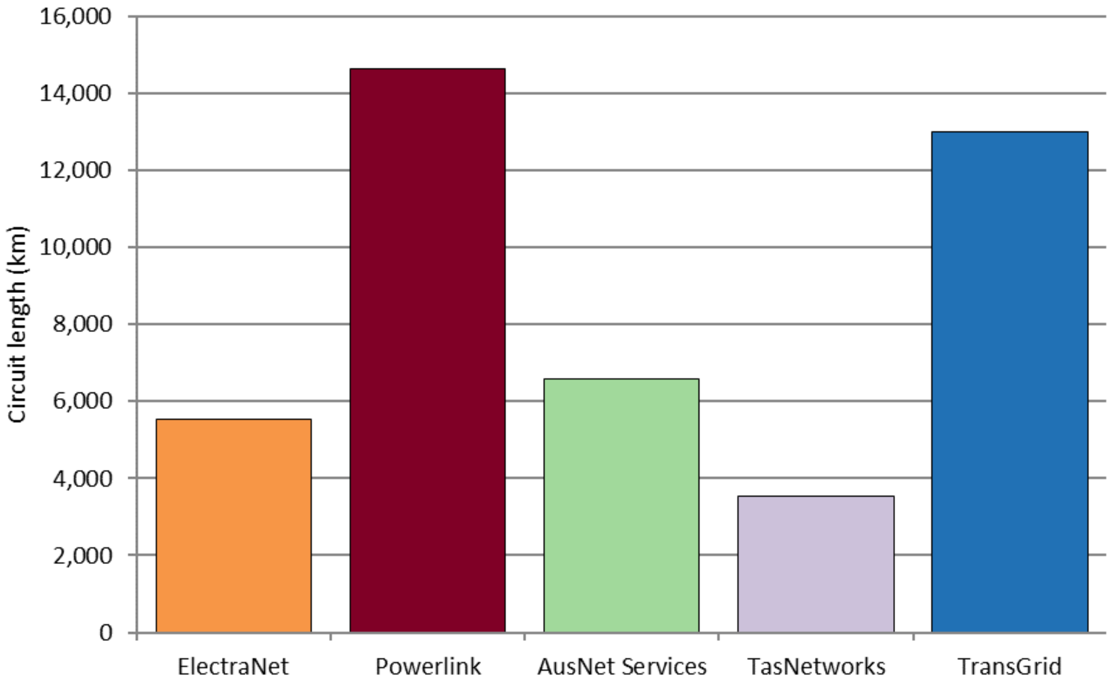
Circuit length

Circuit length reflects the distances over which TNSPs deliver electricity to downstream users from generators, which are typically over thousands of kilometres. We measure line length in terms of circuit line length. This is the length in kilometres of lines, measured as the length of each circuit span between poles and/or towers and underground. This represents the distance over which transmission networks are required to transport electricity.

29 This dataset is available at: https://www.aer.gov.au/node/483.

We use circuit length because, in addition to measuring network size, it also approximates the line length dimension of system capacity. System capacity represents the amount of network a TNSP must install and maintain to supply DNSPs who in turn supply consumers with the quantity of electricity demanded at the places where they are located. Figure B.1 shows each TNSP's circuit length, on average, over the five years from 2013 to 2017.

Figure B.1 Five year average circuit length by TNSP (2013 to 2017)

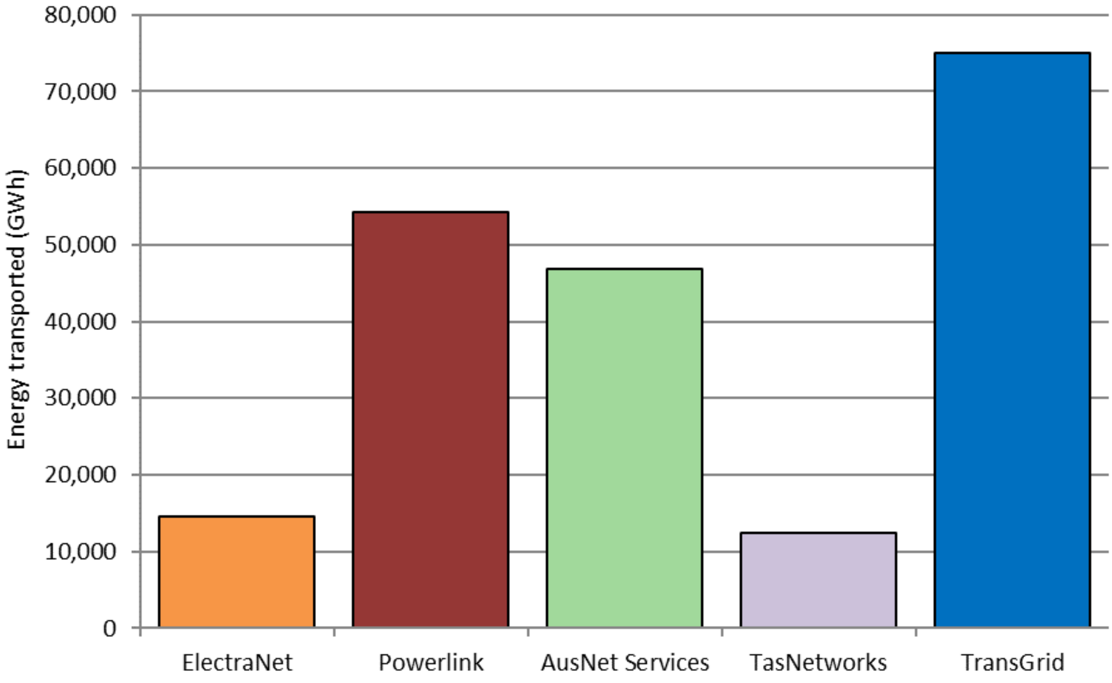


Source: Economic Benchmarking RINs.

Energy transported

Energy transported is the total volume of electricity throughput over time through the transmission network, measured in gigawatt hours (GWh). We use it because energy throughput is the TNSP service directly consumed by end–customers. Therefore, it reflects services provided to customers. However, if there is sufficient capacity to meet current energy throughput levels, changes in throughput are unlikely to have a significant impact on a TNSP's costs. Figure B.2 shows each TNSP's energy transported in 2017.

Figure B.2 Energy transported in 2017 (GWh)



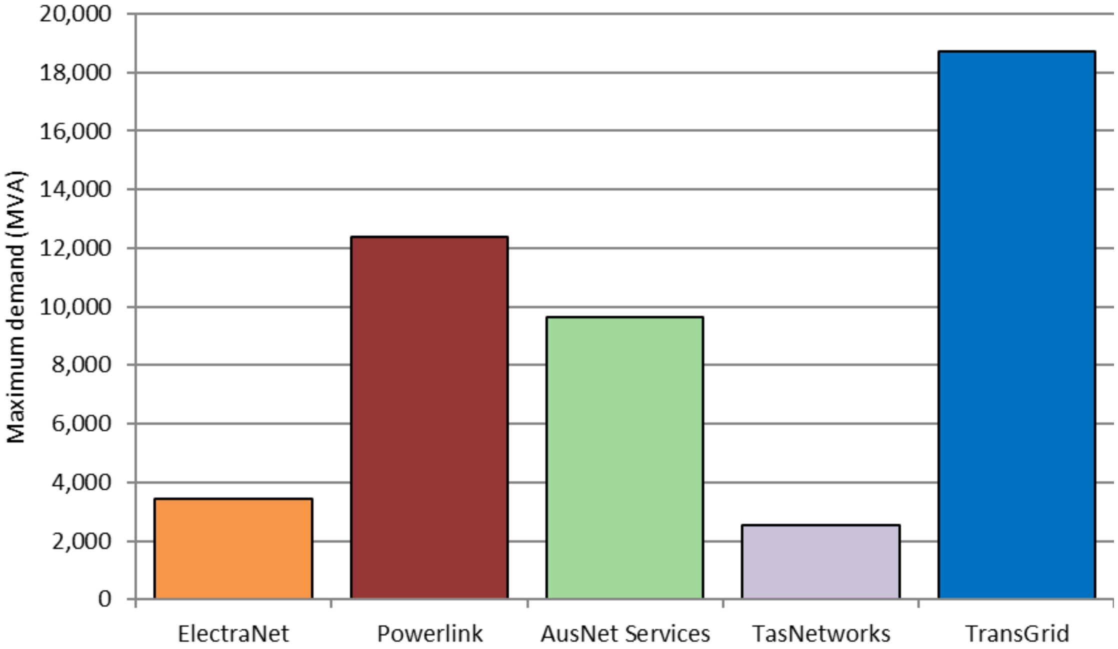
Source: Economic Benchmarking RINs.

Maximum demand

TNSPs are required to meet and manage the demand of their customers. This means 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.

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 TNSP. It recognises capacity that has been used to satisfy demand and gives the TNSP credit for this capacity in subsequent years, even though annual maximum demand may be lower in subsequent years. Figure B.3 shows each TNSP's maximum demand in in 2017.

Figure B.3 Maximum demand for 2017 (MVA)



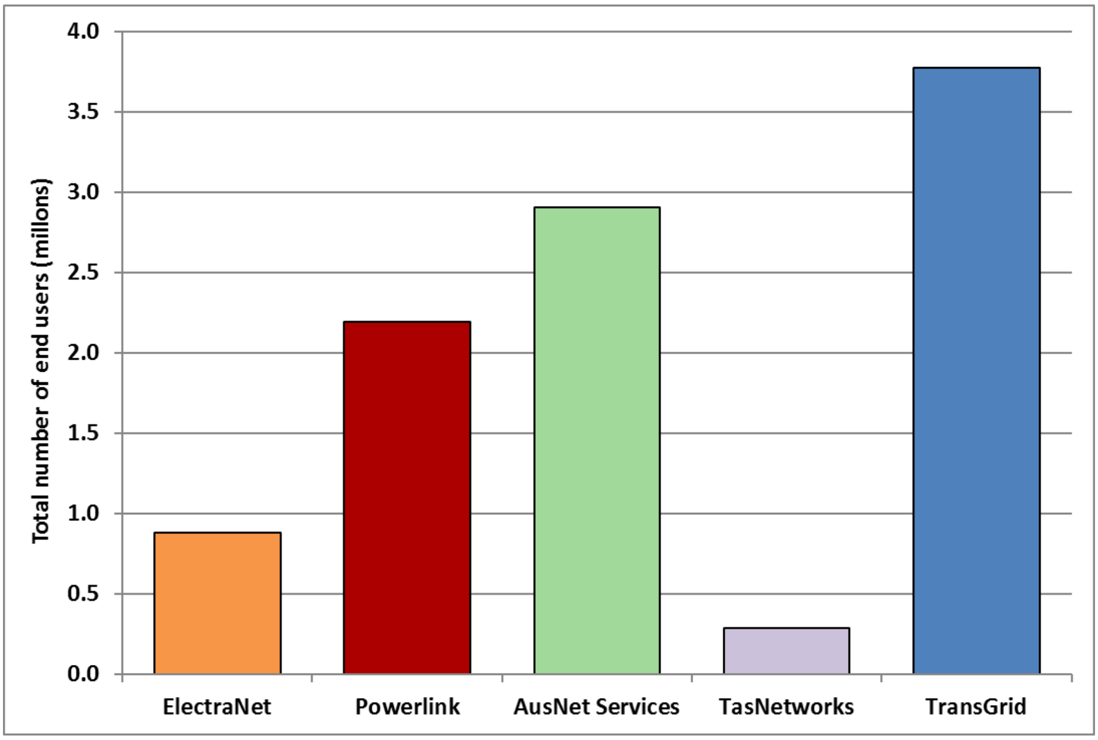
Source: Economic Benchmarking RINs.

End user numbers

The end user number output measures the number of customers TNSPs are required to service. This is used to represent the demand within the transmission networks. Specifically, the greater the number of end users, the more assets required to service demand. Figure B.4 presents the number of end users serviced by each of the TNSPs.

As expected, the size of the network aligns with the population in each state. NSW is the largest network, with TransGrid servicing over 3.7 million end users in NSW, followed by Victoria, with AusNet Services servicing over 2.9 million end users. Tasmania has the smallest network, with TasNetworks servicing around 287,000 end users.

Figure B.4 End user numbers for 2017 (millions)



Source: Economic Benchmarking RINs.

Reliability

Another dimension of TNSP outputs is the reliability of their electricity supply. Transmission networks are designed to be very reliable because interruptions to supply at the level of transmission networks can affect a large number of consumers. One of the measures of transmission reliability is energy not supplied as a result of network outages (unsupplied energy). Unsupplied energy is a very small proportion of total energy (generally less than 0.005 per cent of all energy transported). However, the cost of transmission outages can be great. We have estimated the costs of unsupplied energy using AEMO's VCR values.[30] Figure B.5 presents the estimated cost of unsupplied energy.

In the MTFP analysis, reliability has been measured using unsupplied energy as a negative output. It is a negative output because a decrease in supply interruptions is equivalent to an increase in output. From 2010 to 2014, unsupplied energy is relatively low for most transmission businesses. In figure B.5, we have excluded the cost of customer interruptions in AusNet Services' network for 2009 as these are anomalously large (about $400 million) and dwarf the other results.

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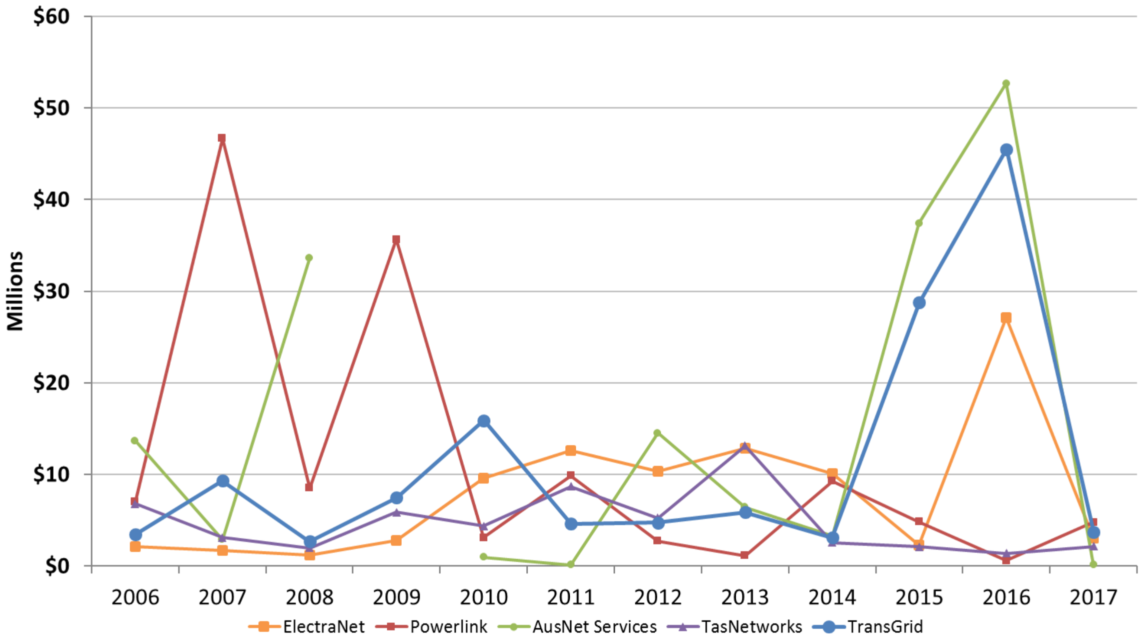
[30] AEMO released its final report of its VCR review in September 2014, which provides updated state-level VCRs. Residential VCR values have not substantially changed since the 2007–08 values, although the values for the commercial sector are notably lower. AEMO, Value of customer reliability review: Final report, September 2014.

Figure B.5 Estimated customer cost of energy not supplied due to supply interruptions ($million, nominal)



Source: AER analysis.

Note: We excluded the cost of customer interruptions in AusNet Services' network for 2009 as these are anomalously large and dwarf the other results.

Total outputs

Table B.1 presents the average network outputs from 2013 to 2017 for TNSPs, with the exception of reliability.

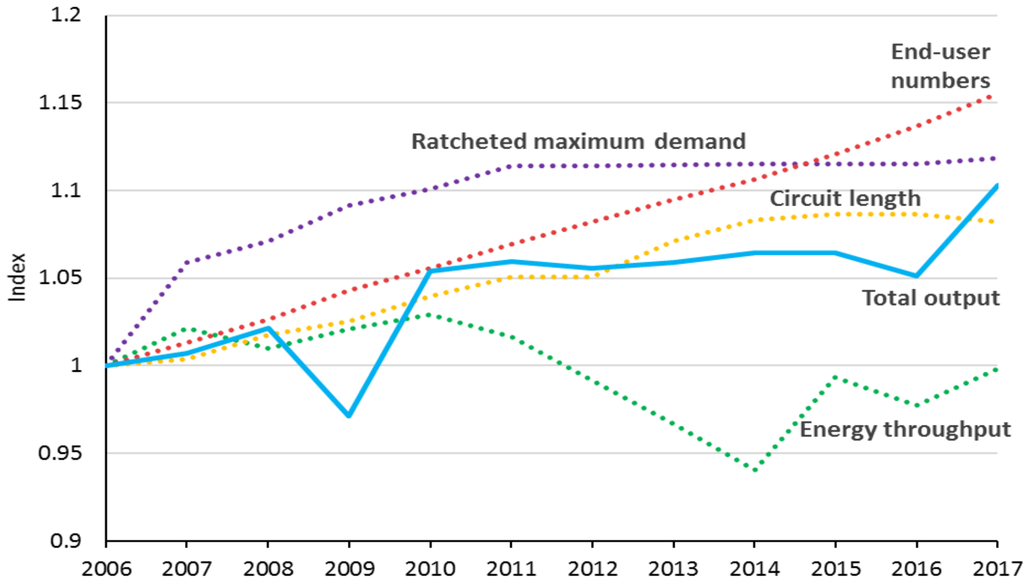
Table B.1 TNSP outputs 2013–2017 average

	Circuit line length (km)	Energy transported (GWh)	Maximum demand (MVA)	Number of end users
ElectraNet	5,524	14,093,785	3,545	858,083
Powerlink	14,626	51,432,154	11,879	2,129,732
AusNet Services	6,568	48,165,164	9,649	2,806,323
TasNetworks	3,540	12,683,403	2,520	283,331
TransGrid	12,993	72,100,000	17,520	3,673,906

Source: Economic Benchmarking RINs.

Figure B.6 presents the change in industry output over the 2006–17 period.

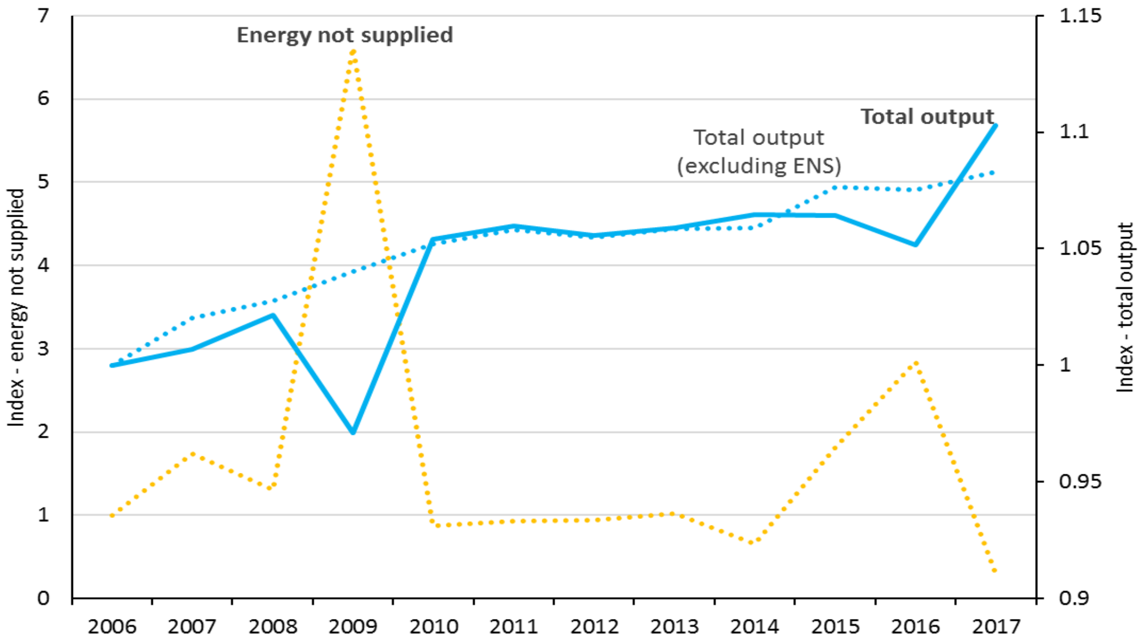
Figure B.6 Factors contributing to total outputs 2006–2017



Source: Economic Insights.

ENS has a negative contribution to total output (Figure B.7). Because transmission outage rates are usually low, it can appear to be very volatile in years where rare but large impact events happen.

Figure B.7 Energy not supplied and total output, 2006–17



Source: Economic Insights.

B.2.2 Inputs

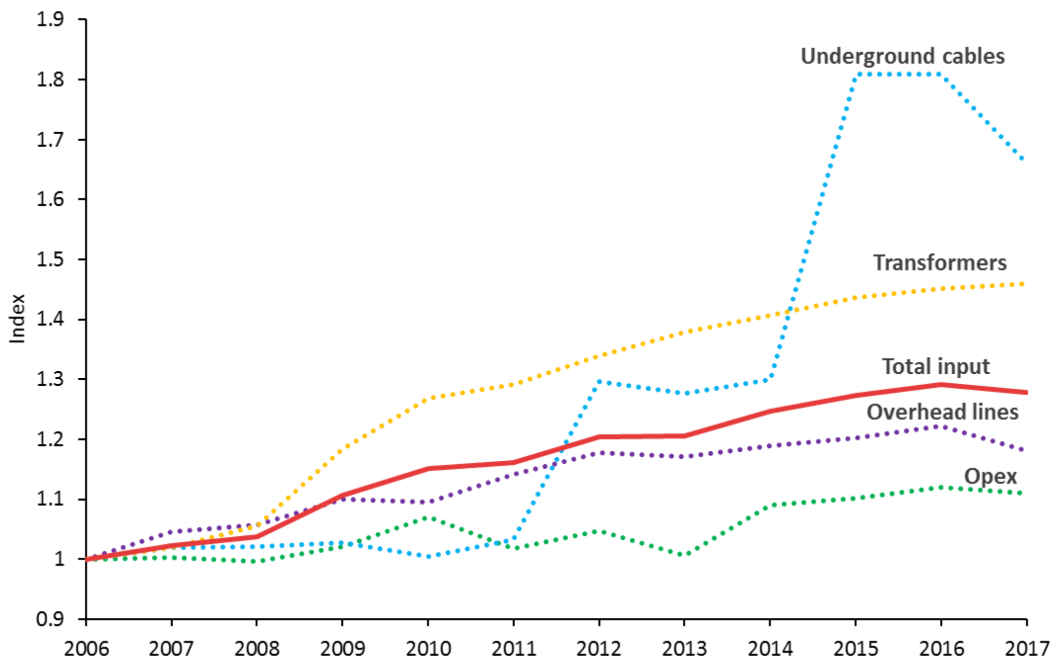
The inputs used in this report are assets and opex. TNSPs use a mix of assets and opex to deliver services. Electricity assets can provide useful service over several decades. However, benchmarking studies typically focus on a shorter period of time.

The two inputs we use in our MTFP technique are:

- Operating expenditure (opex). This is the expenditure TNSPs spend on operating and maintaining their assets. We use the observed opex spent on prescribed services.
- Capital stock (assets). The physical assets TNSPs use to provide services and invest in to replace, upgrade or expand their network. We split capital into overhead lines, underground cables and transformers.
  - For our MTFP analysis we use physical measures of capital inputs. Using physical values for capital inputs has the advantage of best reflecting the physical depreciation profile of TNSP assets.[31]
  - For the PPIs 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.

Figure B.8 presents the change in industry input over the 2006–17 period.

Figure B.8 Factors contributing to total inputs, 2006–2017



Source: Economic Insights.

[31] Economic Insights, *Memorandum TNSP MTFP Results*, July 2014, p. 5.

Table B.2 presents measures of the cost of network inputs relevant to opex and assets for all TNSPs. 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.2 Average annual costs for network inputs for 2013–17 ($'000, 2017)

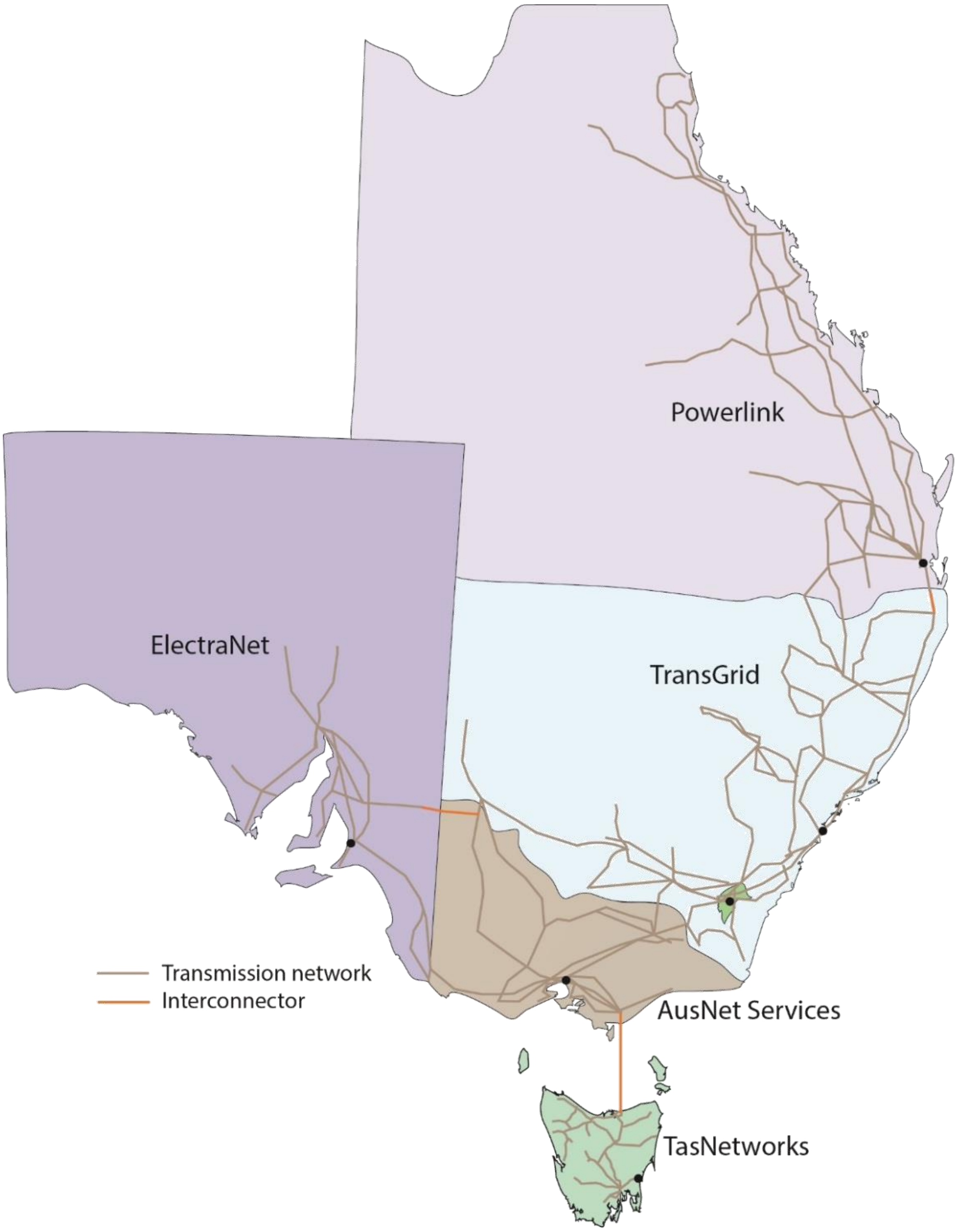
	Opex	Capex	RAB	Depreciation	Asset cost
ElectraNet	83,983	173,211	2,071,393	91,308	166,229
Powerlink	211,082	348,990	6,736,555	265,040	508,697
AusNet Services	88,956	168,658	2,831,975	151,440	253,871
TasNetworks	41,250	73,992	1,402,331	60,663	111,384
TransGrid	174,187	358,823	6,046,589	253,916	472,617

Source: Economic Benchmarking RINs.

C Map of the National Electricity Market

This benchmarking report examines the efficiency of the five TNSPs in the NEM. The NEM connects electricity generators and customers from Queensland through to New South Wales, the Australian Capital Territory, Victoria, South Australia and Tasmania. Figure C.1 illustrates the network areas for which the TNSPs are responsible.

Figure C.1 Electricity transmission networks within the NEM



D Submissions

We sought comment from TNSPs on a draft version of this report and received a submission from AusNet Services. It stated the significant productivity improvement achieved by the industry between 2016 and 2017 should be a welcome result for electricity customers. It also submitted the transmission benchmarking results is most useful for providing high-level observations, such as insights into trends over time.[32]

This submission is available on the AER's 2018 benchmarking website.

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[32] AusNet Services – *Submission on draft distribution and transmission benchmarking reports 2018*, 17 October 2018, p.2.