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ESTIMATION OF OPEX INPUT WEIGHTS

REPORT PREPARED FOR CITIPOWER, POWERCOR AND UNITED ENERGY

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1 INTRODUCTION

1.1 Background

The Australian Energy Regulator (AER) applies a base-step-trend approach when assessing the operating expenditure (opex) forecasts of network service providers (NSPs), where the trend term takes into consideration changes in the components of opex, including labour, materials and contract services, where each component is classified as either labour or non-labour.

A number of NSPs have in the past proposed to use their actual historical opex on labour and non-labour inputs to calculate the input price weights used to determine the trend component of the opex allowance. (For brevity, we refer to input weights calculated on this basis as 'actual input weights.') By way of example, CitiPower and Powercor proposed the use of actual input weights for the 2016-20 regulatory control period, as did ElectraNet and TransGrid for the 2018-23 regulatory control period. The primary rationale advanced by CitiPower and Powercor was that input weights that reflect their actual recent expenditure represent the efficient, prudent and realistic mix of inputs they require to deliver standard control services as networks that the AER itself identified as "frontier performers."

However, the AER's consistent approach to date has been to apply what it considers to be 'benchmark' input weights rather than actual input weights. The AER calculates the benchmark input weights as the *industry average* share of all labour and non-labour opex. In all decisions since 2017, the AER has applied:

- A labour share of 59.7% and a non-labour share of 40.3% for all DNSPs;[1] and
- A labour share of 70.4% and a non-labour share of 29.6% for all TNSPs.[2]

These industry average input weights are based on three years (2014 to 2016, inclusive) of opex data collected by the AER from DNSPs and TNSPs in 2017. This is an update of the input weights computed by Pacific Economics Group in 2004 using DNSP data, which the AER had used in its decisions for DNSPs and TNSPs prior to 2017. Section 3 of this report discusses in more detail the data and calculations the AER has relied on to determine the input price weights it has applied in its most recent decisions for DNSPs.

1.2 Terms of reference

CitiPower and Powercor have engaged Frontier Economics to:

- Consider and provide an opinion on the AER's current approach and assess the AER's key reasons for using the benchmark input weights rather than actual input weights (Section 2); and
- Assess the robustness of the AER's benchmark input weights, by using estimates of industry average input weights (Section 3).

[1] See, for example, Ausgrid draft decision, November 2018, Attachment 6, p. 37.

[2] See, for example, TransGrid final decision, AER opex model, May 2018.

1.3 Summary of key findings

In our view, there is no sound basis for the AER to apply industry average input weights to all NSPs when setting future opex allowances, rather than the actual input weights of individual NSPs.

Adoption of actual input weights is unlikely to weaken efficiency incentives

The AER's main argument against the use of actual input weights is that using the revealed input mix of NSPs to set future allowances would create an incentive for NSPs to adopt an inefficient input mix to secure higher opex allowances for the next regulatory period. In our view, this rationale is incorrect because the current regulatory framework provides strong incentives for NSPs to adopt an efficient, rather than inefficient, input mix. These incentives include financial payoffs and penalties under the Efficiency Benefit Sharing Scheme (EBSS) and the reputational benefits of being identified by the AER's benchmarking analysis as an efficient NSP.

The AER's approach is not consistent with the opex criteria or objectives under the NER

By focussing exclusively on efficiency, the AER appears to have ignored the possibility that the actual input mix adopted by individual NSPs is prudent and realistic for the purposes of delivering regulated services. The opex criteria in the National Electricity Rules (NER) require the AER to consider the efficiency, prudency and realism of a NSPs forecasts. The NER does not direct the AER to consider just one of these criteria to the exclusion of the others. If the input mix adopted by individual NSPs is prudent and realistic, and the differences are due to operational differences, then applying an arbitrary industry average input mix to all NSPs (regardless of their individual circumstances) when setting opex allowances may result in some NSPs being overcompensated and others undercompensated. This would be unreasonable.

Further, if the actual input mix adopted by some NSPs is efficient given their circumstances, but this input mix differs from the industry average, then use of industry average input weights when setting opex allowances may incentivise such NSPs to adopt an inefficient input mix. This would not, in our view, be consistent with the NER's opex objectives.

The AER uses revealed historical costs to set future allowances in some circumstances

Underpinning the AER's key concern about the use of actual input weights is a view that future regulatory allowances should not be a function of factors within the direct control of NSPs as this would give NSPs the incentive and ability to manipulate future allowances in their favour. However, the AER does set opex allowances using revealed costs in some circumstances. For example, the AER accepts revealed base year opex as the starting point for forecasting future allowances unless its benchmarking analysis identifies that level of opex to be "materially inefficient." It is unclear why the AER adopts fundamentally different approaches to assessing base year opex and input weights.

In our view, the AER should adopt the actual input mix of individual NSPs unless it is satisfied, through proper evidence and analysis, that the revealed input mix is materially inefficient. The AER has made no attempt to assess the efficiency (or prudency or realism) of the input mix of individual NSPs, preferring instead a blunt, 'one-size-fits-all' approach to the whole industry that may over/undercompensate individual NSPs.

The AER's benchmarking analysis is not as sensitive to the use of actual input weights as claimed by the AER

The AER argues that for internal consistency it should apply the same input weights when conducting its benchmarking analysis and when determining the 'trend' component of future opex allowances, and that were it to use actual input weights in its benchmarking analysis, some DNSPs it found to be efficient using industry average input weights might no longer be identified as efficient. However, the AER simply asserted this contention without testing it empirically. We have tested this claim and find no empirical evidence that the results of the AER's benchmarking results are as sensitive to the use of actual input weights as the AER claims.

The input weights used by the AER in recent decisions are unreliable

We have investigated the data and calculations used by the AER to derive the input weights used in decisions since 2017. We find evidence that:

- The data relied upon by the AER to calculate industry average input weights have not been reported consistently or completely by DNSPs. The AER appears to have undertaken no due diligence to identify this. Nor has it followed up with DNSPs to improve the quality of the information it relies upon;
- There are major shortcomings in the methodology used by the AER to calculate industry average input weights (e.g., the historical time period the average input weights relate to represents a period of very material cost restructuring for some NSPs which may never be repeated; the AER has applied an inappropriate 'rule-of-thumb' to fill in missing/unreported data; average cost shares are biased towards large DNSPs and DNSPs that report data across all categories); and
- The AER's calculations appear to contain some errors.

In our view, the AER's current estimate of input weights should not be used to set opex allowances for DNSPs until these shortcomings have been addressed properly.

2 ASSESSMENT OF AER'S REASONS FOR USING BENCHMARK RATHER THAN ACTUAL INPUT WEIGHTS

Based on a review of past AER decisions, it appears that the AER has three main reasons for using benchmark input weights rather than actual input weights, as discussed below. The AER claims:

1. Use of actual input weights would provide a disincentive to NSPs to pursue a more efficient input mix;
2. It is necessary to use a consistent price index when measuring historical efficiency and when forecasting future opex; and
3. Total cost efficiency rather than productive efficiency should be the key consideration when setting future opex allowances.[3]

The sections below assess, in turn, the strength of each of these reasons given by the AER for using benchmark input weights rather than actual input weights.

Before doing so, to provide context for the remainder of this section, we discuss briefly the requirements imposed on the AER by the National Electricity Rules (NER) when it assesses opex forecasts put forward by NSPs in a building block proposal.

2.1 The NER's requirements of the AER when assessing opex forecasts

The NER specifies various requirements that the AER must meet when making building block revenue determinations, including the criteria for assessing NSPs' opex forecasts. The NER provides that a building block proposal must include the total forecast opex for the relevant regulatory control period which an NSP considers is required in order to achieve each of the following *operating expenditure objectives*:[4]

> *(1) meet or manage the expected demand for standard control services over that period;*
>
> *(2) comply with all applicable regulatory obligations or requirements associated with the provision of standard control services;*
>
> *(3) to the extent that there is no applicable regulatory obligation or requirement in relation to:*
>
> *(i) the quality, reliability or security of supply of standard control services; or*

[3] The AER describes cost efficiency as a firm producing a given level of output at lowest cost, and productive efficiency as a firm producing the most output it can produce with a given combination of inputs.

[4] NER 6.5.6(a).

> *(ii) the reliability or security of the distribution system through the supply of standard control services,*
>
> *to the relevant extent:*
>
> *(iii) maintain the quality, reliability and security of supply of standard control services; and*
>
> *(iv) maintain the reliability and security of the distribution system through the supply of standard control services; and*
>
> *(4) maintain the safety of the distribution system through the supply of standard control services.*

The NER then requires that:[5]

> *The AER must accept the forecast of required operating expenditure of a Distribution Network Service Provider that is included in a building block proposal if the AER is satisfied that the total of the forecast operating expenditure for the regulatory control period reasonably reflects each of the following (the operating expenditure criteria):*
>
> *(1) the efficient costs of achieving the operating expenditure objectives; and*
>
> *(2) the costs that a prudent operator would require to achieve the operating expenditure objectives; and*
>
> *(3) a realistic expectation of the demand forecast and cost inputs required to achieve the operating expenditure objectives.*

That is, the NER requires that first and foremost the opex proposal must achieve the opex objectives. The efficiency of costs required to achieve the opex objectives is only one criterion amongst three that the AER must use when assessing NSPs' opex proposals (the others being prudency and realism of the opex forecast).

CitiPower and Powercor (among other NSPs) have previously argued the use of actual input weights would reflect an efficient, prudent and realistic forecast of opex over the regulatory control period. However, the AER's reasons for rejecting those weights in the forecasts (and instead adopting forecasts based on benchmark, industry average input weights) focus only on efficiency without any apparent regard to prudency or realism. That is, when setting aside NSPs' proposals, the AER has not explained why actual input weights do not result in prudent and realistic forecasts, nor why industry average weights do result in prudent and realistic forecasts.

The AER's approach imposes on all NSPs an industry average input mix. Yet, the AER has recognised that input mix varies between NSPs, including for those it has found to be productively efficient. For example, the AER states in its 2016 final decision for CitiPower that:[6]

> *CitiPower's proposal that we should use its revealed input mix because we found it not to be materially inefficient ignores the input mixes of other DNSPs we also found to not be materially*

[5] NER 6.5.6(c).

[6] CitiPower final decision, Attachment 7, May 2016, p. 87.

> *inefficient. The input mixes of the DNSPs we found not to be materially inefficient varied. Some used a lower proportion of labour than others.*

The AER does not appear to have considered that the differences in the observed input mix could reflect differences in the prudent and realistic opex requirements of individual NSPs. If differences in input mix do in fact reflect differences in operating circumstances—and therefore, the prudent and realistic opex requirements of individual NSPs—then imposing a uniform input mix on all NSPs may result in some NSPs being overcompensated (relative to their efficient, prudent and realistic costs) and other NSPs being undercompensated.

2.2 Use of actual input weights is unlikely to weaken efficiency incentives

2.2.1 The AER's argument

The AER argues that the use of the actual input mix to forecast future opex allowances may undermine NSPs' incentives to pursue a more efficient input mix.

For example, the AER states the following in its October 2017 draft decision for ElectraNet:[7]

> *We consider that using a network business' actual input price weights would distort its incentive to use the most efficient mix of labour and non-labour inputs. The revenue and pricing principles require that we provide a regulated network business with effective incentives in order to promote economic efficiency. It is important, in our revealed cost approach to forecast opex, that the past performance of a network business does not influence the rate of change used to trend forward the base year revealed opex. Forecasting the rate of change based on a network business' past performance, including its past input mix, would not provide a business an incentive to reveal its efficient costs. Using a business' revealed input mix provides a disincentive to use less of an input that is increasing more rapidly in price because it would reduce the forecast rate of change.*

Similarly, in its September 2017 draft decision for TransGrid, the AER argued that:[8]

> *…under our approach, a change in a service provider's input mix has no impact on its future opex forecasts. TransGrid's approach [of using actual input weights to forecast opex] does not provide it an incentive to adopt the most efficient input mix because any change to its input mix will also change its opex forecast in future control periods. Instead, its approach would provide it an incentive*

[7] ElectraNet draft decision, Attachment 7, October 2017, pp. 14-15.

[8] TransGrid draft decision, Attachment 7, September 2017, p. 30.

> *to utilise more of the input that [sic] increasing more rapidly in price, even if it is not efficient to do so, because this will increase its future opex forecasts.*

2.2.2 Assessment of AER's argument

The AER's argument above is flawed because:

- When considering efficiency, the AER appears to have conflated two distinct concepts: the total level of opex; and the rate of change in the price of inputs. This confusion seems to have led the AER to conclude erroneously that an input mix that does not weight most those inputs with the slowest price growth is an inefficient input mix;
- NSPs face strong incentives under the AER's framework to minimise costs, including by finding and adopting the most efficient input mix;
- The AER's key concern rests on unrealistic assumptions about how rapidly NSPs can adjust their input mix from one year to the next;
- Strong prohibitions on the submission of misleading information to the AER would prevent NSPs from gaming by misreporting data; and
- Whilst the AER has rejected the use of actual input weights on the grounds that this may create poor efficiency incentives, the AER uses revealed historical costs to set future allowances in some other circumstances.

The AER has conflated the total level of opex and the rate of change in the price of inputs when considering efficiency

In its recent decisions the AER implies that an efficient input mix is one that minimises usage of the inputs that are expected to have the highest price growth. For example, in its 2017 draft decision for TransGrid the AER argued that the use of actual input weights would not provide NSPs with an incentive to "adopt *the* most efficient input mix" (emphasis added), and that such an approach "would provide [an NSP with] an incentive to utilise more of the input that [sic] increasing more rapidly in price, even if it is not efficient to do so..."

These statements suggest that the AER has conflated incorrectly two distinct concepts:

- The total level of opex; and
- The rates of change in the prices of the inputs to production.

In our view, an efficient input mix is one that minimises the total level of opex. An input mix that uses larger quantities of inputs with low price growth will not necessarily minimise total costs. To see this, consider the following simple example. Suppose that an NSP uses two inputs to production with the following characteristics:

- Input 1 costs $1 per unit, and the price of this input grows at a rate of 100% per year; and
- Input 2 costs $100 per unit, and the price of this input grows at 1% per year.

If the NSP uses 1 unit of Input 1 and 10 units of Input 2 in all years, then its total cost over five years would be $5,132.01, as shown in **Table 1** below.

Table 1: Total cost incurred by an NSP using large quantities of slow growing but expensive input

YEAR	PRICE		QUANTITY		COST PER INPUT		TOTAL COST
	Input 1	Input 2	Input 1	Input 2	Input 1	Input 2	Inputs 1 + 2
1	$1.00	$100.00	1	10	$1.00	$1,000.00	$1,001.00
2	$2.00	$101.00	1	10	$2.00	$1,010.00	$1,012.00
3	$4.00	$102.01	1	10	$4.00	$1,020.10	$1,024.10
4	$8.00	$103.03	1	10	$8.00	$1,030.30	$1,038.30
5	$16.00	$104.06	1	10	$16.00	$1,040.60	$1,056.60
Total							**$5,132.01**

Source: Frontier Economics

Now, consider another NSP that is identical to the first in all respects (including that it produces the same level of output) except that it uses 10 units of Input 1 but only 1 unit of Input 2 in all years. The total cost incurred by that NSP over five years would be just $820.10, as shown in **Table 2** below.

Table 2: Total cost incurred by an NSP using large quantities of fast growing but cheap input

YEAR	PRICE		QUANTITY		COST PER INPUT		TOTAL COST
	Input 1	Input 2	Input 1	Input 2	Input 1	Input 2	Inputs 1 + 2
1	$1.00	$100.00	10	1	$10.00	$100.00	$110.00
2	$2.00	$101.00	10	1	$20.00	$101.00	$121.00
3	$4.00	$102.01	10	1	$40.00	$102.01	$142.01
4	$8.00	$103.03	10	1	$80.00	$103.03	$183.03
5	$16.00	$104.06	10	1	$160.00	$104.06	$264.06
Total							**$820.10**

Source: Frontier Economics

This stylised example demonstrates the point that organising production by favouring inputs with the slowest price growth does not guarantee the most efficient (i.e., minimum cost) outcome. Therefore, when the AER is evaluating different approaches to determining input weights, the overriding consideration should be whether NSPs face appropriate incentives to adopt an input mix that minimises total opex, rather than whether NSPs face incentives to select an input mix that favours those inputs with the slowest price growth.

NSPs face strong incentives under the AER's framework to minimise costs

The AER's key contention is that "using a network business' actual input price weights would distort its incentive to use the most efficient mix of labour and non-labour inputs." [9] It is not clear to us that this claim is necessarily true.

Under the NER, the AER sets an ex ante opex allowance, using input weights that are fixed for the duration of the regulatory control period. These input weights do not adjust through the regulatory control period. Therefore, the input weights used to determine the opex allowance (if set using the actual input mix of the NSP in question) would not update through the regulatory control period in a 'pass-through' fashion. Under these circumstances, an NSP will *always* have a financial incentive to minimise its actual costs during the regulatory period once the allowance has been set—including by seeking out a more efficient input mix—because the NSP would be allowed to keep the benefit of any savings relative to the regulatory allowance for a defined period of time.

This incentive would be just as strong whether the input weights fixed upfront represent the actual input mix of the business, or the average input mix for the industry.

In a 2015 report we prepared for CitiPower and Powercor, we explained that a number of mechanisms within the AER's regulatory framework provide strong incentives for NSPs to optimise their actual input mix. For example:[10]

- NSPs face incentive mechanisms, such as the Efficiency Benefit Sharing Scheme (EBSS), that provide incentives to make savings whenever the opportunity arises. The EBSS rewards NSPs that make incremental efficiency gains in relation to opex and penalises NSPs that make incremental efficiency losses. This means that any input mix choice made by an NSP that fails to maximise its incremental efficiency gains (or minimise its incremental efficiency losses) over the regulatory period would result in a genuine financial loss to the business via the EBSS; and
- The use of benchmarking in regulatory decisions, and the regular publication of benchmarking results, creates reputational risk for NSPs that encourages the pursuit of efficiency, and disincentivises inefficiency.[11] Any input mix choice that were to result in a reduction in an NSP's measured efficiency or saw that NSP lag behind its peers in the AER's benchmarking analysis would by design impose reputational costs on that NSP.

In our view, these mechanisms provide strong incentives for NSPs to adjust their actual input mix over the regulatory control period, to the extent feasible, to minimise the actual opex they incur.

The AER's key concern rests on unrealistic assumptions about how rapidly NSPs can adjust their input mix from one year to the next

The AER did not disagree with us that these mechanisms incentivise NSPs to minimise their opex once the AER has set opex allowances. However, the AER argued that we had failed to recognise the distinction between the dollar value of opex and its composition. Specifically, the AER contended that:[12]

[9] ElectraNet draft decision, Attachment 7, October 2017, p. 14.

[10] Frontier Economics, Review of AER's Preliminary Decision on opex input weights, December 2015, p. 16.

[11] The AER has stressed reputational effects as one of the key benefits of its benchmarking analysis. For details (quoted in our December 2015 report), see: AER, Expenditure Forecasts Assessment Guideline – Explanatory Statement, December 2013, p.126.

[12] CitiPower final decision, Attachment 7, May 2016, p. 87.

> *The incentives to which Frontier Economics referred all operate at the total opex level. With all of these incentives in place, if a DNSP knows we will use its revealed input mix to forecast opex then it has an incentive to use more of the input in the base year that will increase in price more rapidly.*

The AER appears to acknowledge that NSPs would indeed be incentivised by the EBSS and regulatory benchmarking to reduce their *total level of opex* over the regulatory control period. However, the AER suggests that an NSP might maintain an inefficient input mix in order to secure higher opex allowances in the next regulatory period if the AER were to use actual input weights in order to set the price growth component of opex allowances for the next regulatory control period.

This argument ignores the fact that an NSP with an inefficient input mix could lower its overall opex by adopting a more efficient input mix.[13] By choosing to maintain an inefficient input mix, an NSP would be foregoing the opportunity to lower its total revealed opex, thereby sacrificing the financial rewards that would accrue from realising and revealing cost savings under the EBSS. The NSP would also forego the reputational advantages of being assessed a more efficient NSP relative to its peers. In our view, there are strong incentives under the AER's regulatory framework for NSPs to lower revealed costs by various means, including by finding a feasible input mix that would minimise the total level of opex incurred.

The AER's main concern seems to be that if an NSP knows that the AER will use its actual input mix to set opex allowances for the next regulatory control period, the NSP would have an incentive to use in the *base year* (as opposed to earlier years) of the current regulatory control period more of the input with the fastest price growth.[14] As we explained in our 2015 report, this concern overstates how easy it is in practice for NSPs to alter their input mix materially from one year to the next. It does not seem realistic that NSPs could, for example, scale up their labour quickly, in order to skew the labour/non-labour split in the base year for the next regulatory control period, and then scale that workforce back down again during the next regulatory control period to secure savings relative to the allowance.[15]

Such a strategy supposes that there is a pool of surplus labour (including highly skilled and specialised labour) that NSPs can draw on quickly to inflate their workforces. The AER presents no evidence that this is the case. Such a strategy also supposes that NSPs are able to release workers quickly once the next regulatory control period has started. This ignores the significant costs associated with restructuring the workforce, including the potential costs associated with making redundancy payments. A number of NSPs have recently restructured their workforces in response to the AER's last round of regulatory decisions. Such restructuring was highly unusual for this industry, and very costly for those NSPs that underwent the process. In short, we consider that the flexibility in inputs required to implement the gaming strategy outlined by the AER is unrealistic. There is no evidence that such a strategy could be implemented in practice in the way implied by the AER's concerns.

Furthermore, the AER's contention is that use of actual input weights would create incentives for NSPs to distort revealed costs in the base year. However, CitiPower and Powercor have previously proposed that the AER should determine the input weights for each NSP using actual data averaged over a

[13] Suppose a NSP could minimise its opex by doing two separate things: (a) using less of all inputs; and (b) changing its input mix (e.g., by using less labour relative to non-labour inputs than it had previously been using). The NSP would not be following a profit-maximising strategy if it undertook (a) alone since minimisation of costs would require it to undertake (a) and (b). Hence, if altering the input mix could result in efficiencies, then it is reasonable to accept that a profit-maximising NSP would change its input mix.

[14] For the reasons explained above, NSPs face strong incentives to maintain an inefficient input mix in any other year within the regulatory control period because doing so would surrender an opportunity to lower revealed opex and secure the financial and reputational benefits incentivised by the regulatory framework.

[15] In order to minimise costs (maximise profits), NSPs would have to shed the excess workers employed after inflating base year expenditure.

number of historical years, rather than a single year.[16] When computing industry average input weights, the AER averages input mix data over up to three years for each NSP. In our view, averaging actual input mix data over a number of years as suggested by CitiPower and Powercor would remove any incentive for NSPs to distort their revealed input mix to secure higher allowances in future periods because such a strategy would require NSPs to distort their actual input mix for a number of years. This seems very unlikely given the incentives created by the EBSS.

Strong prohibitions on the submission of misleading information to the AER would prevent NSPs from gaming by misreporting data

The AER's adviser on this issue, Economic Insights, agreed with us that "there may indeed be costs in reallocating the actual composition of opex". However, Economic Insights went on to suggest that:[17]

> *…there is much more scope to alter the reporting of the composition of opex so that reported opex is skewed towards the components with higher growing prices.*

Essentially, Economic Insights suggests that NSPs may wilfully mislead the AER by misreporting data on its actual input mix with the aim of securing higher allowances in the next regulatory period. This seems a fanciful claim for two reasons:

- Firstly, the National Electricity Law (NEL) expressly forbids the submission of information to the AER that the submitter "knows is false or misleading in a material particular."[18] Economic Insights' contention appears to be that if actual input weights are used, NSPs may violate the law by deliberately submitting false and "skewed" information to the AER to secure more favourable future regulatory allowances and, therefore, alternative input weight assumptions should be used to prevent such conduct by NSPs. Such reasoning implies the that NEL is either redundant or ineffective and therefore action by the AER, rather than the provisions of the NEL, is required to insulate regulatory decisions from the effects of data that have been intentionally misreported by NSPs.
- Secondly, if there is a genuine concern that NSPs may deliberately skew and misreport data to secure higher future allowances, it is unclear why the AER should rely on *any* information reported by NSPs. There are any number of opportunities for NSPs to misreport data to secure more favourable financial outcomes. For example, the AER relies (in part) on actual opex, capex and performance data submitted by NSPs to determine the payoffs of the EBSS, CESS and STPIS incentive mechanisms. NSPs could, in principle, violate the NEL by deliberately manipulating these data to secure higher payoffs. Yet, the AER uses the information submitted by NSPs to determine incentive mechanism payoffs without questioning whether the data submitted has been falsified. Why should the AER trust the data submitted by NSPs in some instances, but express scepticism in other cases—such as truthful reporting of the composition of costs?
- Thirdly, to the extent that the AER collects the data required to compute input weights through Regulatory Information Notices (RINs), the AER requires that NSPs' completed RIN templates and Basis of Preparation reports be subject to independent audit, and the audit reports must be provided to the AER. We made this point in our 2015 report to CitiPower and Powercor.

Economic Insights argues that even audited RIN data, at a disaggregated level, can be sensitive to widely varying reporting practices driven by legacy state-based reporting.[19] We accept that different

[16] CitiPower final decision, Attachment 7, May 2016, p. 88.

[17] Economic Insights, Memorandum to AER, Opex input price index weights, 19 February 2016, p. 8.

[18] NEL, Part 3, Division 1, s.28(4) and Division 4, Subdivision 5, s.28R.

[19] Economic Insights, Memorandum to AER, Opex input price index weights, 19 February 2016, p. 7.

businesses might have different information reporting policies that could result in the same costs being classified differently across businesses. However, we see differences in cost allocation practices as quite distinct from the main concern Economic Insights expresses—namely, deliberate alteration of the composition of reported opex by NSPs to secure higher opex allowances for the next regulatory period.

We also note that if there are genuine differences in cost allocation practices that may distort the measurement of input weights for individual NSPs, such distortions would affect the industry average input weights as well. That is, if cost allocation differences are a reason to mistrust the actual input weights of individual NSPs, it is also a reason to mistrust the industry average input weights computed by the AER using individual NSPs' data.

In our view, if the AER suspects that cost allocation practices differ between NSPs, the appropriate response would be for the AER to engage with NSPs to confirm this, issue clear guidance on how costs ought to be allocated and reported, and then follow up with NSPs to ensure that the guidance has been followed properly.[20] To our knowledge, the AER has not done this in relation to the data used to compute input weights. Concerns about possible inconsistencies in reporting practices should not be used as a reason to dismiss the use of actual input weights—because this problem (if it exists) could be addressed through AER action, and because genuine inconsistencies in allocation and reporting practices is just as much a problem for the robustness of the benchmark (industry average) input weights determined by the AER.

The AER uses revealed historical costs to set future allowances in some circumstances

A key concern the AER has expressed is that if an NSP knows the AER will use its revealed input mix to forecast opex, then it would have an incentive to use more of the input that will increase in price most rapidly in the base year for the next regulatory control period, as this would result in higher future opex allowances.

The essence of this argument is that future regulatory allowances should not be a function of factors within the direct control of regulated businesses because this would give regulated businesses incentives in the current regulatory control period to behave in a way that maximises future allowances to the detriment of consumers. This is why incentive regulators typically set allowances on the basis of benchmark efficient costs, rather than actual costs.

However, the AER *does* set opex allowances using NSPs' actual revealed costs, in certain circumstances. The most notable example of this is that, under its base-step-trend approach, the AER accepts the revealed level of opex of an NSP as the starting point for forecasting future opex allowances unless its benchmarking analysis suggests that this revealed opex is "materially inefficient."[21]

The same concern the AER has expressed about adopting actual input weights—that is, NSPs may game by adopting an inefficient approach in the base year in order to secure higher future allowances—could apply equally to revealed base year opex. However, the AER considers that using revealed costs as the basis for forecasting future allowances is appropriate because various features of its incentive framework—notably, the EBSS—encourages NSPs to strive towards an efficient level of expenditure:[22]

> *Consistent with past practice, we prefer using a revealed cost approach to assess most opex cost categories (which assumes opex is largely recurrent). Specifically we intend to use the 'base-step-*

[20] We discuss this issue further in section 3.

[21] See for example: Ausgrid draft decision, Attachment 6, November 2018, Figure 6.3, p. 14.

[22] AER, Expenditure forecast assessment guideline – Explanatory statement, November 2013, p. 61.

trend' approach. If a NSP has operated under an effective incentive framework, and sought to maximise its profits, the actual opex incurred in a base year should be a good indicator of the efficient opex required.

The AER explains further that:[23]

We agree with CitiPower, Powercor and SA Power Networks and the ENA that the EBSS provides a strong continuous efficiency incentive and therefore base year opex should be an efficient starting point for forecasting opex.

Of course, the AER does not accept NSPs' revealed base year opex in all circumstances. If the AER's benchmarking analysis suggests that an NSP's revealed base year opex is materially inefficient, the AER's usual practice is to adjust revealed opex down towards its estimate of efficient opex in the base year.

Unlike when determining the base year level of opex, the AER does not accept the revealed input mix of *any* NSP under *any* circumstance. Instead, the AER applies an estimate of industry average input weights on *all* NSPs. An NSP's actual input mix will correspond to the input weights adopted by the AER only if the NSP happens to have an input mix that resembles the average across the industry.

It is unclear why the AER adopts fundamentally different approaches to assessing base year opex and input weights. Why, for example, does the AER not accept NSPs' revealed input mix unless there is compelling evidence that the revealed input mix is materially inefficient? After all, the same mechanism that the AER agrees "provides a strong continuous efficiency incentive" to achieve an efficient level of base year opex also operates to incentivise the adoption of an efficient input mix.

In our view, the AER should adopt the actual input mix of individual NSPs unless it is satisfied, through proper analysis and evidence, that the revealed input mix is materially inefficient. Such an approach would be more likely than the AER's current approach to ensure that opex forecasts are efficient, prudent and realistic.

2.3 The AER's benchmarking analysis is not as sensitive to the use of actual input weights as claimed by the AER

2.3.1 The AER's argument

The AER uses a composite labour/non-labour input price index to conduct benchmarking of historical opex (for example, to assess the efficiency of the revealed level of base year opex). The AER also uses a composite labour/non-labour input price index to forecast future opex allowances via the trend component of the base-step-trend formula. The AER contends that it is necessary to:[24]

[23] AER, Expenditure forecast assessment guideline – Explanatory statement, November 2013, p. 62.

[24] CitiPower final decision, Attachment 7, May 2016, p. 87.

> *…use a consistent price index in the efficiency assessment and the opex real price growth component of the rate of change when applying the base–step–trend method.*

In order to justify this position, the AER noted in its 2016-20 final decision for CitiPower that its benchmarking analysis makes use of an opex price index, weighted between labour and non-labour inputs, where the weights reflect the average input weights for the whole industry. The AER argued that had it applied the actual input weights of the DNSPs being benchmarked, then some of the DNSPs it had found to be efficient may instead be found to be inefficient:[25]

> *…as pointed out by Economic Insights, Frontier Economics ignored the fact that the efficiency assessment used an opex price index that had a 62 per cent weight applied to the EGWWS WPI. It is technically possible that a DNSP could in fact have used a higher share of an opex input whose price increased less rapidly than, say, the WPI. If Economic Insights had used these weights in its efficiency assessment then the DNSP's estimated opex quantity would increase relative to the current assessment and Economic Insights could have found the DNSP to be inefficient. Economic Insights admitted this scenario was unlikely to occur in practice but it was technically possible.*

2.3.2 Assessment of AER's argument

The AER's argument is flawed because:

- The AER's existing approach does not in fact ensure consistency in the price indices used in its benchmarking analysis and in the setting of the real price growth allowance; and
- The AER's conjecture that benchmarking outcomes may be sensitive to the input weights used is not supported empirically.

The AER's existing approach does not ensure consistency in the price indices used in its benchmarking analysis and in the setting of the real price growth allowance

Whilst the AER argues for a consistent price index for the purposes of conducting opex benchmarking and for setting the trend component of the opex allowance for the next regulatory control period, in practice, the AER does not actually maintain consistency in the price index for these two tasks. When determining input price growth in the trend term, the AER uses the Wage Price Index (WPI) to forecast the growth in the price of labour inputs, and the Consumer Price Index (CPI) to forecast the growth in the price of non-labour inputs. In its benchmarking analysis, the AER uses the WPI to measure the growth in the price of labour inputs, but uses five distinct Producer Price Indices rather than the CPI to measure the growth in non-labour inputs.[26] Hence, it is misleading for the AER to imply that its current approach ensures perfect internal consistency in the price indices used in its benchmarking analysis and in the setting of the real price growth allowance.

[25] CitiPower final decision, Attachment 7, May 2016, pp. 86-87.

[26] See, for example, the file *DNSP opex index.xlsx* prepared for the AER by Economic Insights for the purposes of the 2017 Annual Benchmarking Report.

The AER's conjecture that benchmarking outcomes may be sensitive to the input weights used is not supported empirically

The AER has simply asserted that using actual input weights might result in some DNSPs that it finds to be efficient when using industry average input weights in its benchmarking analysis might be found to be inefficient if actual input weights were applied. The AER's advisers, Economic Insights, acknowledged that this was unlikely to occur in practice, but considered that it was "technically possible." The AER performed no empirical analysis to verify whether its concern was real. On the basis of mere speculation about what might be "technically possible", the AER rejected the use of actual input weights to determine the trend component of the opex allowance.

We have tested the AER's assertion empirically and find no compelling evidence to support it. In order to test the AER's claim, we estimated the AER's econometric benchmarking models presented in the latest (2018) annual benchmarking report under two alternative scenarios:

- Under the first scenario, we retained the AER's industry average input weights when calculating the price index used to deflate the opex that is benchmarked.
- Under the second scenario, we replaced the AER's industry average weights with actual (firm-specific) input weights.

Using the estimated efficiency scores from the AER's benchmarking models, we calculated the rolled forward efficient base year opex of each DNSP under the two scenarios and investigated whether any of the DNSPs identified by the AER's models as not materially inefficient using industry average input weights are found to be materially inefficient using actual input weights. Details of our approach and modelling results are presented in Appendix A.

The AER's general approach when assessing the efficiency of revealed base year opex is to estimate, using its benchmarking models, an efficient level of base year opex for each DNSP, and to compare this to the DNSP's actual, revealed base year opex. If the revealed level of opex is materially higher the AER's estimate of efficient base year opex, then the AER would judge the DNSP to be materially inefficient. Under these circumstances, the AER would, for the purposes of forecasting efficient opex over the next regulatory control period, adjust the DNSP's revealed opex down to the estimated efficient level in the base year.

Having applied the AER's econometric benchmarking models to the 2018 annual benchmarking report dataset published by the AER, we searched for examples of DNSPs whose revealed base year opex would require no adjustment using industry average weights but would require a downward adjustment using actual input weights. We find no such instances when the AER's full benchmarking dataset, covering the period 2006 to 2017 is used. Every DNSP found to be efficient using industry average input weights is also found to be efficient using actual input weights.[27]

We conclude from this analysis that there is no evidence that the benchmarking results are, in practice, as sensitive to the input weights used as the AER has speculated. Our findings corroborate the advice provided by Economic Insights' to the AER that using actual input weights rather than industry average weights would be "unlikely" in practice to alter the AER's efficiency assessment. Our findings show that the AER's concerns over the sensitivity of the efficiency assessment to the choice of input weights are overstated, and are therefore not a sound reason to reject the use of actual input weights.

[27] If the benchmarking period is shortened from 12 years (i.e., 2006 to 2017, inclusive) to six years (i.e., 2012 to 2017, inclusive), then we identify just two examples of DNSPs found to be efficient using industry average input weights appearing inefficient using actual input weights: EvoEnergy and United Energy. In United Energy's case, the implied adjustment to revealed base year opex implied by the AER's models using actual input weights is very small—just 1.2%. In our view, this would not be evidence of material inefficiency. If the full benchmarking period is used, no evidence of United Energy or EvoEnergy being materially inefficient is found, regardless of whether actual or industry average input weights are used.

2.4 The AER does not consider cost efficiency as opposed to productive efficiency when implementing every aspect of base-step-trend

2.4.1 The AER's argument

In a report to CitiPower and Powercor in December 2015, we noted that the AER's benchmarking analysis had found CitiPower and Powercor to be the two most efficient DNSPs of the 13 it had assessed, and that the AER had described these two companies as "frontier performers." We argued that since the AER has assessed the efficiency of revealed base year opex and has judged those expenditures to be efficient, there would be no sound basis to then argue that the input mix that gave rise to that base year opex is inefficient.[28]

In response to our report, the AER argued that we had only considered productive efficiency and not overall cost efficiency. The AER noted that:[29]

> *Productive efficiency means that the firm is producing the most output it can produce with a given combination of inputs. It does not mean that the firm is producing a given level of output at the lowest cost.*

2.4.2 Assessment of AER's argument

The AER's argument is flawed because:

- The AER focuses on productive efficiency alone when assessing the efficient level of base year opex. Hence, the AER seems to apply a double-standard when it criticises us for arguing for actual input weights based on the outcomes of its benchmarking analysis;
- The AER has not established that the use of industry average input weights ensures cost efficient outcomes; and
- The AER has not established that industry average input weights represent "the best estimate" of input weights that would achieve the NER's operating expenditure objectives.

The AER focuses on productive efficiency alone when assessing the efficient level of base year opex

The AER seems to argue that a productively efficient firm is not necessarily a cost efficient one, and it is cost efficiency that it ought to have regard to when forecasting an NSP's opex allowance. We agree that the NER requires the AER to have regard to efficient costs when deciding whether to accept an NSP's opex forecasts.

However, we note that the AER considers productive efficiency rather than cost efficiency when implementing some aspects of its base-step-trend approach. For example, the AER's first step when forecasting opex allowances is to determine whether an NSP's revealed base year opex is efficient. When doing so, the AER focusses exclusively on productive efficiency, rather than cost efficiency. This is because its benchmarking analysis considers only the extent to which NSPs are productively efficient. Therefore, whilst the AER has rejected the use of actual input weights due to lack of consideration of

[28] Frontier Economics, Review of AER's Preliminary Decision on opex input weights, December 2015, p. vii.

[29] CitiPower final decision, Attachment 7, May 2016, p. 87.

cost efficiency, there are circumstances in which the AER itself does not explicitly consider cost efficiency.

The AER has not established that the use of industry average input weights ensures cost efficient outcomes

Even if cost efficiency ought to be the overriding consideration when determining input weights, the AER has not established that using a uniform, industry average input mix would produce greater cost efficiency than using actual input weights. For example, in its 2016 final decision for CitiPower the AER asserts that:[30]

> *Using an industry benchmark instead would provide an incentive to adopt the most efficient input mix.*

The AER simply assumes that the industry average input weights represents an efficient benchmark without providing any evidence or justification for this claim.

The AER has not established that industry average input weights represent "the best estimate" of input weights that would achieve the NER's operating expenditure objectives

The AER also assumes that industry average input weights are "the best estimate" of the appropriate weights of labour and non-labour components of opex:[31]

> *As noted by Economic Insights, using the best estimate available of the appropriate weights of labour and non–labour components of opex and applying these to all DNSPs, removes the incentive to skew either actual, or reported, opex composition towards components with faster growing prices.*

The AER does not define what constitutes "the best estimate" of the appropriate weights of labour and non-labour components of opex. In our view, the best estimate of the input weights that should be used to set opex allowances should be input weights that satisfy the operating expenditure criteria expressed in the NER. That is, the input weights used should be commensurate with the efficient, prudent and realistic cost inputs of an NSP required to achieve the operating expenditure objectives in the NER.

The AER should not focus on cost efficiency to the exclusion of the prudency and realism of the input mix required to achieve the operating expenditure objectives. The AER does not address the possibility that the actual input mix adopted by at least some NSPs is the "best estimate" of an appropriate mix (in terms of being the most efficient, prudent and realistic input mix required to achieve the operating expenditure objectives) for those NSPs. Nor does the AER explain why industry average input weights represent the best estimate of an appropriate input mix for *all* NSPs, irrespective of their particular circumstances and cost requirements. Such an approach presumes that the efficient, prudent and realistic input requirements for all NSPs are the same, without providing any supporting evidence.

[30] CitiPower final decision, Attachment 7, May 2016, p. 88.

[31] CitiPower final decision, Attachment 7, May 2016, pp. 87-88.

2.5 Conclusion

For the reasons set out above, we consider that the AER has not established that it is reasonable for it to apply industry average input weights for all NSPs, regardless of their circumstances, when setting opex allowances. To the extent that NSPs' actual input weights reflect the efficient, prudent and realistic opex required to delivery standard control services, the imposition of allowances based on industry average input weights on all NSPs is likely to undercompensate some networks and incentivise them to spend inefficiently. This would, in our view, be inconsistent with the opex objectives and criteria in the NER.

3 RELIABILITY OF AER'S OPEX INPUT WEIGHT ESTIMATES

In its most recent decisions for DNSPs (since 2017), the AER has used a labour share of 59.7% and a non-labour share of 40.3% as opex input weights for all DNSPs.[32] These input weights were calculated by the AER using data collected from the DNSPs in 2017 on the composition of their opex.

The appropriateness of using industry average input weights relies in part on the robustness of the data and methods used to develop those weights. We have assessed the opex input weight calculations performed by the AER and have concluded the input weights used by the AER in recent decisions are not reliable. Significant further investigation and testing is warranted before the input weights estimated by the AER are used to set opex allowances for DNSPs.

This section describes the methodology adopted by the AER to estimate these opex input weights; assesses the quality of the data used by the AER; identifies potential methodological problems with the AER's methodology; identifies potential errors in calculations in the AER's methodology.

3.1 Overview of the AER's approach to estimating input weights

In 2017, the AER sought data from the DNSPs on the composition of their opex in order to update the input weights computed by Pacific Economics Group in 2004 and previously used by the AER in a number of past decisions. The data submitted by the DNSPs, and the calculations performed by the AER to derive the updated input weights, can be found in the AER's Excel workbook 'Opex labour and non-labour costs – Consolidated data.xlsx', published on the AER's website as an ancillary file to the 2017 annual benchmarking report.[33]

Data on the composition of opex were collected for the majority of the DNSPs, for the three-year period 2014 to 2016. The exceptions are United Energy, on whom no data are available within the dataset published by the AER, and Jemena, which provided data for 2016 only.

For each year, the DNSPs provided data on operating expenditure for six cost categories:

- Vegetation management;
- Maintenance (routine and non-routine);
- Emergency response;
- Non-network expenditure;
- Network overheads; and
- Corporate overheads.

Within each category, the data were disaggregated further into the following four sub-categories:

[32] See, for example, Ausgrid draft decision, November 2018, Attachment 6, p. 37.

[33] See 'Opex labour and non-labour costs – Consolidated data.xlsx' in the zip folder 'Economic Insights DNSP – Economic Benchmarking Results for the AER – 31 October 2017' on the AER's website for the 2017 annual benchmarking report, https://www.aer.gov.au/networks-pipelines/guidelines-schemes-models-reviews/annual-benchmarking-report-2017/initiation (accessed on 17 January 2018, 2.30pm).

- In-house labour expenditure;
- Contracted expenditure (labour proportion);
- Contracted expenditure (non-labour proportion); and
- Other non-labour and non-contracted expenditure.

Hence, for each year the DNSPs provided costs allocated across a total of 24 categories. The DNSP also reported total operating expenditure as a separate line item.

The AER used these data to calculate updated opex input weights. The methodology adopted by the AER essentially followed four stages:

- **Stage 1 – Classify labour costs and non-labour costs and aggregate data.** The first stage of the AER's methodology involved classifying each of the 24 categories provided by the DNSPs as either labour or non-labour costs, and within each of these two groups into a further three sub-groups, and then aggregating costs across these six categories for each DNSP. The six groups are indicated below:
    - **Labour costs:**
        - In-house labour expenditure;
        - Contracted field services expenditures (labour proportion); and
        - Contracted non-field services expenditures (labour proportion).
    - **Non-labour costs:**
        - Contracted field services expenditure (non-labour proportion);
        - Contracted non-field services expenditure (non-labour proportion); and
        - Other non-labour and non-contracted expenditure.

  The AER classification is based on the distinction between field services expenditures (also referred to as direct costs), namely vegetation management, maintenance, and emergency response, and non-field services expenditures (also referred to as indirect costs), namely non-network expenditure, network overhead, and corporate overheads. **Table 3** shows the classification that the AER has adopted to categorise costs provided by the DNSPs into these six groups.

- **Stage 2 – Estimate DNSP-specific labour and non-labour cost shares for contracted field services and non-contracted field services.** In Stage 2, the AER derived the share of labour and non-labour costs within the two groups of contracted field-services and non-contracted field services. **Table 4** presents the labour and non-labour cost shares derived by the AER.

  The Table shows that there is significant variation in the allocation of costs between labour and non-labour costs for these two groups. For example, ActewAGL classifies all field services expenditures as non-labour costs; Endeavour classifies all these expenditures as labour costs; and AusNet classifies 76% to labour costs and 24% to non-labour costs. Essential Energy seems to have split costs equally both for field and non-field services expenditures.

Table 3: AER's classification of costs provided by the DNSPs into six groups

GROUP	SUB-GROUP	COST CATEGORY	COST SUB-CATEGORY
Labour costs	In-house labour expenditure	All six categories	In-house labour expenditure
	Contracted field services expenditure (labour proportion)	Vegetation management, maintenance (routine and non-routine), emergency response	Contracted expenditure (labour proportion)
	Contracted non-field services expenditure (labour proportion)	Non-network expenditure, network overheads, corporate overheads	Contracted expenditure (labour proportion)
Non-labour costs	Contracted field services expenditure (non-labour proportion)	Vegetation management, maintenance (routine and non-routine), emergency response	Contracted expenditure (non-labour proportion)
	Contracted non-field services expenditure (non-labour proportion)	Non-network expenditure, network overheads, corporate overheads	Contracted expenditure (non-labour proportion)
	Other non-labour and non-contracted expenditure	All six categories	Other non-labour and non-contracted expenditure

Source: Frontier Economics' summary of AER's methodology

Table 4: Labour and non-labour cost shares for contracted field and non-field services expenditure by DNSP

	CONTRACTED FIELD SERVICES EXPENDITURE		CONTRACTED NON-FIELD SERVICES EXPENDITURE	
	Labour	Non-labour	Labour	Non-labour
ActewAGL	0%	100%	39%	61%
Ausgrid	0%	100%	23%	77%
AusNet	**76%**	**24%**	**49%**	**51%**
Citipower	**50%**	**50%**	**34%**	**66%**
Endeavour	100%	0%	0%	100%
Energex	100%	0%	100%	0%
Ergon	100%	0%	100%	0%
Essential	**50%**	**50%**	**50%**	**50%**
Jemena	**70%**	**30%**	**91%**	**9%**
Powercor	**86%**	**14%**	**30%**	**70%**
SA Power Networks	100%	0%	80%	20%
TasNetworks	100%	0%	100%	0%

Source: AER's calculations.

Note: We have used bold font to highlight those DNSPs that originally reported non-zero costs across the four groups above.

- **Stage 3 – Re-allocate costs of contracted field services and contracted non-field services between labour and non-labour.** In Stage 3 the AER adjusted the costs allocated to labour and non-labour contracted field (non-field) services for those seven DNSPs that do not allocate any costs to either labour or non-labour.[34] For contracted field services, the adjustment consists in re-allocating total expenditures to labour and non-labour costs using a labour share of 65%. For contracted non-field service, the adjustment consists in re-allocating total expenditures using a labour share of 42%. For example, as ActewAGL does not report any contracted field services labour expenditures, the AER allocates 65% of ActewAGL's total contracted field services expenditures to labour costs and the remaining 35% to non-labour costs. The same labour shares are used across all DNSPs that did not report any costs in these categories. **Table 5** shows the implied shares after the AER's re-allocation of costs.

  The estimates of the labour share for contracted field and non-field services of 65% and 42%, respectively, are derived by aggregating the data of those five DNSPs that allocate non-zero costs to each of the four categories.[35]

Table 5: Adjusted labour and non-labour cost shares for contracted field and non-field services expenditure by DNSP

	CONTRACTED FIELD SERVICES EXPENDITURE		CONTRACTED NON-FIELD SERVICES EXPENDITURE	
	Labour	Non-labour	Labour	Non-labour
ActewAGL	65%	35%	39%	61%
Ausgrid	65%	35%	23%	77%
AusNet	**76%**	**24%**	**49%**	**51%**
CitiPower	**50%**	**50%**	**34%**	**66%**
Endeavour	65%	35%	42%	58%
Energex	65%	35%	42%	58%
Ergon	65%	35%	42%	58%
Essential	**50%**	**50%**	**50%**	**50%**
Jemena	**70%**	**30%**	**91%**	**9%**
Powercor	**86%**	**14%**	**30%**	**70%**
SA Power Networks	65%	35%	80%	20%
TasNetworks	65%	35%	42%	58%

Source: AER's calculations.

Note: We have used a bold font to highlight those DNSPs that originally reported non-zero costs across the four groups above.

- **Stage 4 – Estimate industry average labour and non-labour costs shares.** The last stage of the AER's methodology involved aggregating labour and non-labour costs across all DNSPs and years and then deriving industry average labour and non-labour cost shares of 59.7% and 40.3%, respectively. The labour costs aggregated by the AER are the following: in-house labour

[34] The seven DNSPs for which the AER adjusts costs were ActewAGL, Ausgrid, Endeavour Energy, Energex, Ergon, SA Power Networks and TasNetworks.

[35] These five DNSPs were AusNet, CitiPower, Essential Energy, Jemena and Powercor.

expenditures from Stage 1 and adjusted contracted field and non-field services labour expenditures from Stage 3. The non-labour costs aggregated by the AER are the following: other non-labour and non-contracted expenditure from Stage 1 and adjusted contracted field and non-field services non-labour expenditures from Stage 3.

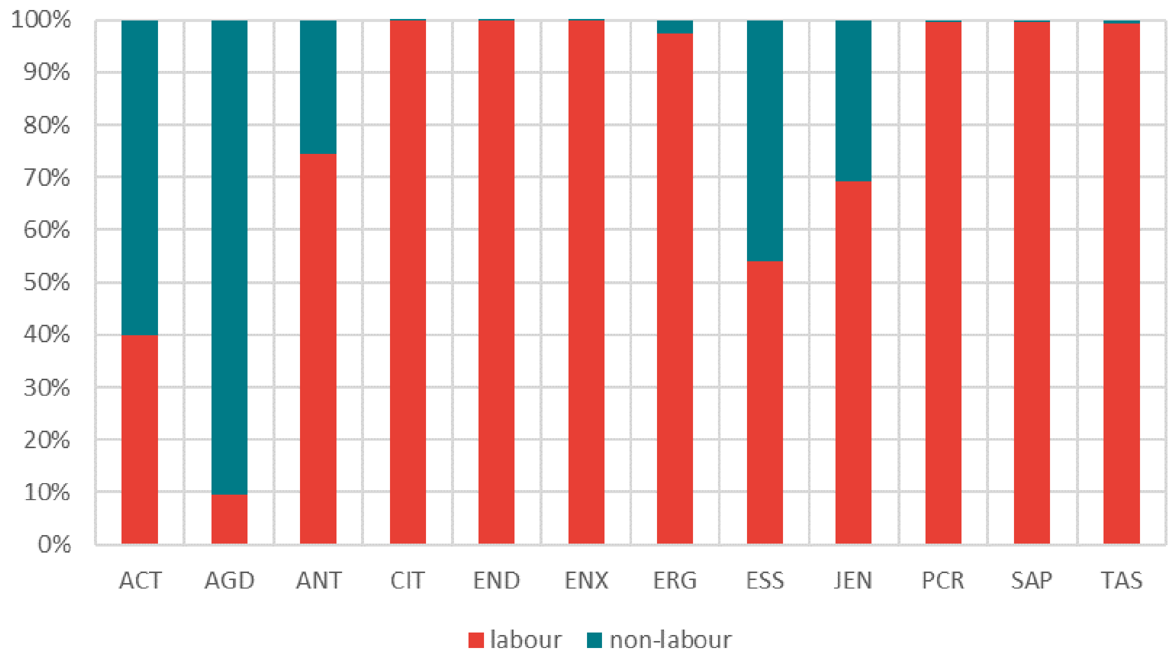
3.2 Potential concerns over data quality

The AER does not appear to have undertaken any due diligence of the data to ensure that they are fit for purpose to compute reliable input weights. If the data submitted by DNSPs to the AER have been reported on different bases, or if there are reporting errors that have not been identified through a due diligence process, then the resulting estimates of input weights (both the industry average and for specific DNSPs) will be unreliable.

Our assessment of the quality of the data suggests that the data have not been reported consistently within and between DNSPs. Further, it appears that the AER has made no attempt to adjust for differences in capitalisation policies or to deal properly with unreported (i.e., missing) data. We describe below some of the concerns we hold over the quality of the data used by the AER.

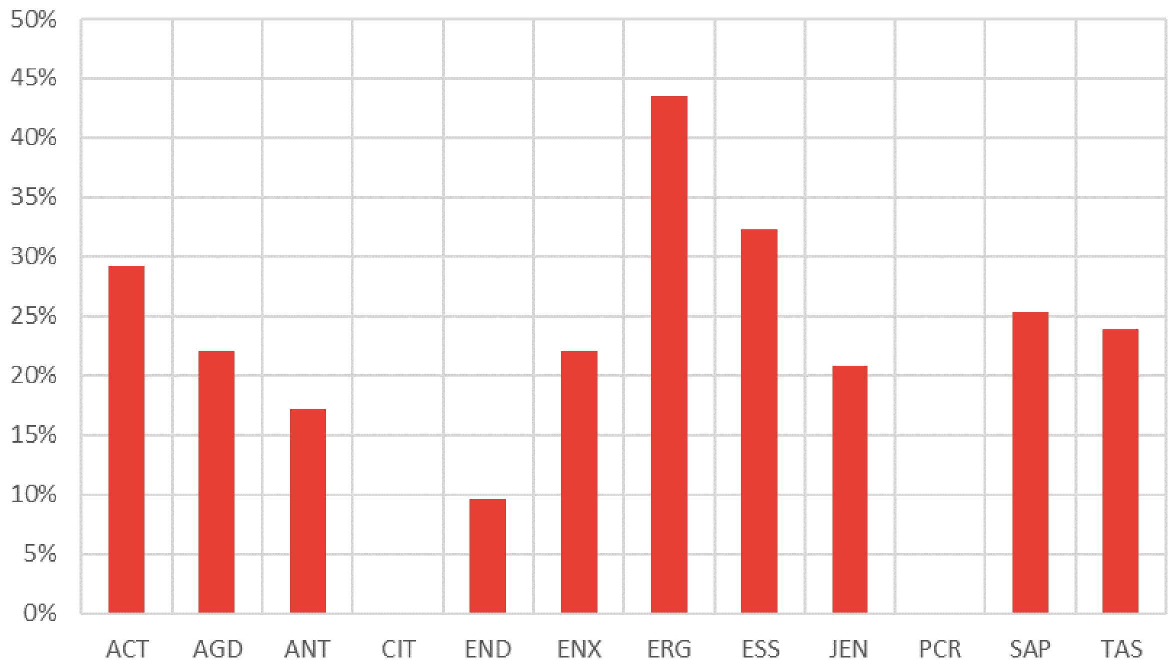
- **The data do not appear to have been reported in a consistent way within DNSPs**. For example, Energex's total operating expenditure does not match the sum of costs across the 24 cost items: in 2014 total costs are lower than the sum of its components by 19% or $132m, in 2015 total costs are lower than the sum of its components by 17% or $120m, and in 2016 total costs are higher than the sum of its components by 10% or $44m.
- **The data do not appear to have been reported in a consistent way across DNSPs.** It is apparent that the allocation of opex across the cost categories varies widely by DNSP. For example:
  - **Table 4** above shows that the share of labour costs for both contracted field services expenditures and contracted non-field services expenditures varies from 0% to 100%.
  - **Figure 1** below shows the proportion of vegetation management costs reported as labour and non-labour costs. The Figure shows that there are significant differences in allocation across DNSPs. For example, Ausgrid reports that 90% of its vegetation management costs are non-labour costs, while Endeavour reports that (almost) 100% of its vegetation management costs are labour costs. Both of these extremes are surprising as we would expect vegetation management activities to involve mostly labour inputs, but we would also expect some non-labour costs (e.g., costs associated with lifts, other machinery and equipment). It is unclear whether the differences represented in the data are genuine or due to reporting errors or differences in cost allocation rules across DNSPs.
  - **Figure 2** below shows the proportion of total opex reported as 'Other non-labour and non-contracted expenditure' across DNSPs. The Figure shows that there are significant differences in allocations across DNSPs, with all of the VPN businesses reporting no opex at all in this category and Ergon reporting nearly 44% of opex in this category.

Figure 1: Proportion of labour and non-labour vegetation management costs in 2016 by DNSP



Source: Frontier Economics' analysis of cost data submitted by the DNSPs to the AER

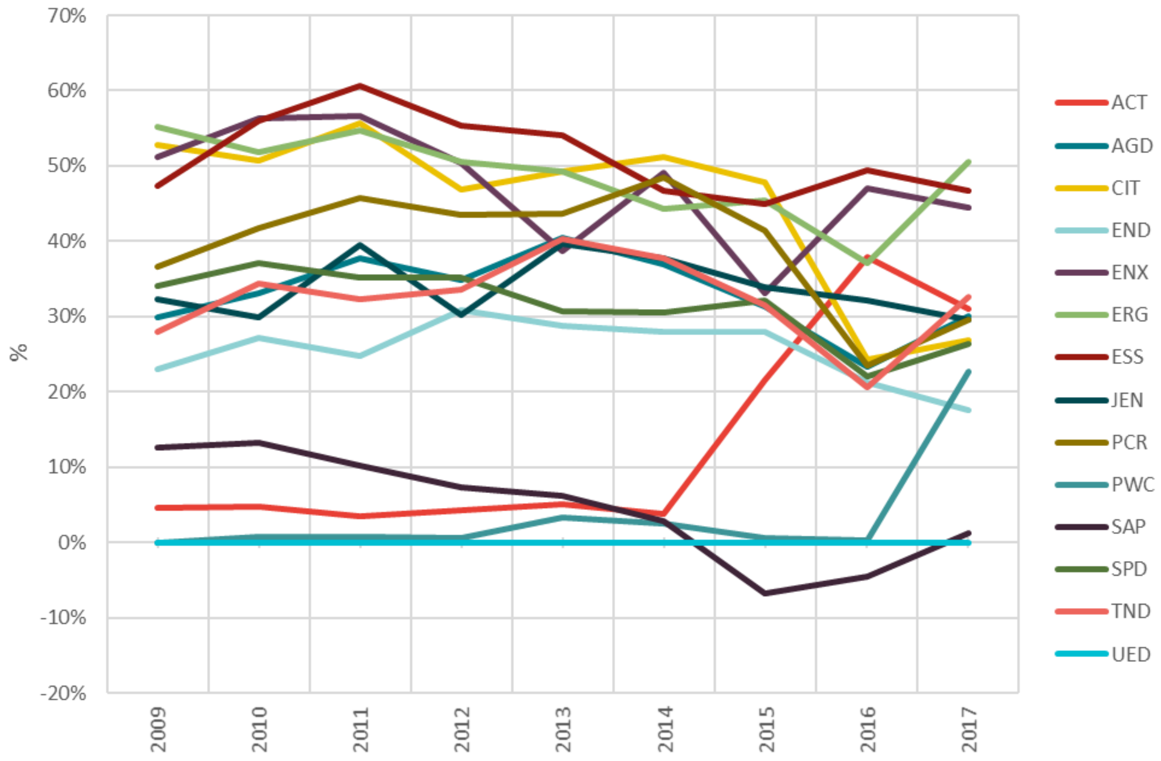
Figure 2: Proportion of total opex reported as 'Other non-labour and non-contracted expenditure' in 2016 by DNSP



Source: Frontier Economics' analysis of cost data submitted by the DNSPs to the AER

- **It is unclear whether the data have been adjusted appropriately for differences in capitalisation policies.** DNSPs appear to expense or capitalise costs at different rates, as can be seen from **Figure 3**, which shows the proportion of network and corporate overheads which are capitalised for all DNSPs over 2009-2017. The Figure shows that the capitalisation rates across DNSPs range from 0% to more than 50%. For example, in 2017 United Energy did not capitalise any network or corporate overheads, while Ergon capitalises more than 50% of these costs. The chart also shows that the DNSPs' capitalisation practices seem to change over time. For instance, ActewAGL capitalised as little as 3% of overheads in 2011 and as much as 38% of overheads in 2016. The capitalisation policies adopted by DNSPs will affect the total quantum of opex available to allocate between labour and non-labour. This, in turn, could lead to differences in the allocation between labour and non-labour.

Figure 3: Proportion of network and corporate overheads which are capitalised



Source: Frontier Economics' analysis of Category Analysis RIN data, Table 2.1.1 – Standard control services capex and Table 2.1.2 – Standard control services opex.

Note: The years reported on the x-axis represent the reporting years of the different DNSPs. Therefore, it is to be interpreted as calendar year for the Victorian DNSPs, and as financial year (year-end) for the non-Victorian DNSPs.

The proportion of capitalised costs is less than zero for SA Power Networks as capitalised costs are reported as negative numbers in the Category Analysis RIN data.

- **The AER does not seem to have addressed unreported data adequately.** As discussed in the previous section, a number of DNSPs appear not to have reported data to the AER in some or all categories of costs. For example, **Table 5** shows that two DNSPs did not allocate any costs to contracted field services labour expenditure. Another example is Powercor, which did not report any costs for non-network expenditures for any of the years 2014-2016. It is unclear whether these DNSPs either did not incur any costs in that category or did not report the information. Rather than revert to those DNSPs and determine whether the DNSPs incurred that cost or not, and if so attempt to collect the missing data, the AER has applied a rule-of-thumb approach, which may have distorted its estimates of DNSP-specific and industry-average input weights. We investigate the appropriateness of this rule-of-thumb approach in Section 3.3.

3.3 Potential methodological problems

We have reviewed each of the stages of the AER's methodology for deriving opex input weights and we have identified several potential methodological problems as well as errors in the calculations that call into question the reliability of the input weights estimated by the AER. The purpose of this section is to list the potential methodological problems that we have identified. Errors in the calculations are reported in the following section.

3.3.1 Appropriateness of time period

The AER estimates an average cost share over the 2014-2016 period. As shown in **Table 6**, this period was characterised by high variability in the proportion of labour costs for some DNSPs, reflecting significant business transformation programmes. For example, ActewAGL's proportion of labour costs decreased by 9 percentage points from 2014 to 2015 and increased by 17 percentage points from 2015 to 2016. The years captured in the AER's dataset represent a particularly anomalous period for the industry, but the AER has not consulted on the appropriateness of using data that relates to such a period for the purposes of determining input weights that would ultimately determine opex forecasts.

Table 6: Proportion of labour costs in total opex over time by DNSP

DNSP	2014	2015	2016
ActewAGL	53%	44%	61%
Ausgrid	56%	59%	63%
AusNet	73%	68%	61%
CitiPower	73%	72%	73%
Endeavour	88%	85%	86%
Energex	62%	63%	78%
Ergon	50%	54%	56%
Essential	55%	56%	57%
Jemena			77%
Powercor	81%	80%	79%
SA Power Networks	69%	73%	72%
TasNetworks	78%	76%	76%

Source: Frontier Economics' analysis of cost data submitted by the DNSPs to the AER.

3.3.2 Appropriateness of allocation of costs for DNSPs that do not report across all categories

For those seven DNSPs that do not report costs for at least one of the four categories of contracted expenditures,[36] the AER has re-allocated their total opex to the missing categories. As explained in

[36] The four categories are: contracted field services labour expenditures, contracted field services non-labour expenditures, contracted non-field services labour expenditures, and contracted non-field services non-labour expenditures.

section 3.1, Stage 3, the AER's re-allocation uses the cost shares derived by aggregating costs for those DNSPs that report non-zero costs across all categories. This approach suffers from three shortcomings:

- The AER does not appear to have verified whether some DNSPs might genuinely incur no costs for some of these categories. That is, it is unclear whether the relevant data are simply missing (i.e., not reported), or whether the DNSPs did not in fact incur any costs in those categories.
- The AER did not verify whether the data collected from those DNSPs that report costs across all categories are reliable. For example, it is unclear why the cost allocation of Essential Energy of 50% costs across each of the four contracted expenditures categories presented in **Table 5** is treated as being more reliable than the cost allocation of SA Power Networks of 100%, 0%, 80%, 20%.
- The derivation of the cost shares used for the re-allocation of costs is biased towards the larger DNSPs and against those DNSPs that report data only in one year. For example, Jemena's weight in the aggregated cost is small as it reports costs only for 2016, while all other DNSPs report costs for all years. As noted above, some of the large DNSPs above have allocated opex in certain categories (e.g., Ausgrid for vegetation management) that would warrant further investigation but appear not to have been investigated by the AER.

3.3.3 The average cost shares are biased towards those DNSPs that allocate costs across all categories

As the average cost shares are derived by using costs adjusted for the cost shares of those DNSPs that report costs across all categories (see Stage 3), the estimated average cost shares are biased towards the cost shares of those DNSPs. However, there is no explanation of why these DNSPs' cost shares should be reflective of the cost shares of the DNSPs that did not allocate costs or of a benchmark business.

3.3.4 The average cost shares are skewed towards larger DNSPs

As the average cost shares are derived from costs aggregated across all DNSPs, the estimated average cost shares are skewed towards (i.e., influenced heavily by) the cost shares of the larger DNSPs in the sample and against small DNSPs. However, there is no explanation of why the larger DNSPs' cost shares should be more reflective of the cost shares of a benchmark business compared to the smaller DNSPs' cost shares.

The share of labour/non-labour in vegetation management is an example where a large DNSP (i.e. Ausgrid) is skewing the industry average input weights with a very low and unexplained share of labour.

3.4 Potential errors in calculations

There appear to be errors in the way the AER aggregated total costs for Ausgrid at Stage 1 for the following categories:

- The category 'Other non-labour and non-contracted expenditure' is derived by aggregating only indirect costs,[37] while for all the other DNSPs it includes both direct costs[38] and indirect costs.
- The category 'Contracted field services expenditures (non-labour proportion)' is defined as the sum of 'Other non-labour and non-contracted expenditure' for direct costs, while for all the other DNSPs it is defined as the sum of 'Contracted expenditures (non-labour proportion)' for direct costs.

37 Indirect costs include non-network expenditures, network overheads, and corporate overheads.

38 Direct costs include vegetation management, maintenance, and emergency response.

- The category ‘Contracted non-field services expenditures (non-labour proportion)’ is defined as the sum of ‘Contracted expenditures (non-labour proportion)’ for both direct and indirect costs, while for all the other DNSPs it is defined as the sum of ‘Contracted expenditures (non-labour proportion)’ for indirect costs.

3.5 Conclusions

There are number of reasons (relating to data quality and consistency, and calculation methodology) to suggest that the AER’s estimate of input weights requires significant further investigation and testing before those input weights can be used to set opex allowances for DNSPs.

In our view, the AER should not rely on the existing dataset and calculation of industry average input weights to estimate benchmark input weights for DNSPs.

We recommend that the AER do a number of things to improve the reliability of its input weight estimates:

- The AER should investigate the data for consistency of reporting within and between DNSPs, issue clear reporting guidance, and follow up with DNSPs to ensure that data are reported in a consistent manner;
- Data that appear to be anomalous when compared across DNSPs should be investigated closely to ensure that these do not represent errors. If errors are uncovered, they should be corrected by the reporting DNSP;
- The AER should engage with the industry to determine the appropriate reporting period that should be used to estimate forward-looking input weights;
- If the AER intends to use industry average weights rather than actual weights, the AER should ensure that the input weights should not be skewed to be more reflective of large DNSPs;
- The AER should clarify through further investigation whether any ‘gaps’ in its existing data, in particular categories, for individual DNSPs represent unreported information that can be collected via further engagement with DNSPs or are genuine instances in which DNSPs incurred no costs. Any data gaps should be filled through further information collection, rather than through the use of rules-of-thumb; and
- The AER’s calculations should be audited and peer reviewed to identify and correct any inconsistencies or errors.

A SENSITIVITY OF THE BENCHMARKING RESULTS TO INPUT WEIGHTS USED

As described in section 2.3.2, the AER has claimed that some of the DNSPs it identifies as efficient in its benchmarking analysis using industry average input weights may be found to be inefficient if its benchmarking analysis were conducted using actual input weights. The AER noted that this is “technically possible” but did not test empirically how sensitive its benchmarking results in fact are to the input weights used in the analysis. We have tested the AER’s assertion empirically and find no compelling evidence to support it.

Approach

In order to test the AER’s claim, we have estimated the AER’s econometric benchmarking models presented in the latest (2018) annual benchmarking report under two alternative scenarios:

- Under the first scenario, we retained the AER’s industry average input weights when calculating the price index used to deflate the opex that is benchmarked.
- Under the second scenario, we replaced the AER’s industry average weights with actual (firm-specific) input weights.

In total, we estimated (for each scenario):

- The four models considered by the AER in its annual benchmarking report:
  - Stochastic Frontier Analysis (SFA) Cobb-Douglas (SFA CD);
  - SFA translog (SFA TL);[39]
  - Least Squares Econometric (LSE) Cobb-Douglas (LSE CD); and
  - LSE translog (LSE TL).
- Covering two historical time periods:
  - 2006 to 2017; and
  - 2012 to 2017.

This resulted in eight distinct models being estimated under each scenario.

For each of the estimated models we then examined the impact on the estimated efficiency scores for each DNSP, of switching from industry average to actual input weights. In doing so, we followed the approach adopted by the AER in its 2018 draft decisions for the NSW distribution businesses:[40]

- Comparing each DNSP’s estimated efficiency score to a benchmark score of 75%; and
- Adjusting the benchmark comparison score for potential operating environment factors (OEFs). As in the AER’s 2018 draft decisions for the NSW distribution businesses, we have applied the OEF adjustments adopted by the AER in its last round of regulatory determinations for DNSPs made in 2015 and 2016.

[39] We note that the AER does not present results for the SFA TL model estimated over the 2006-2017 period.

[40] Ausgrid draft decision, Attachment 6, November 2018, p. 32.

Results

Estimated efficiency scores

Table 7 below shows the impact on efficiency scores of switching from industry average to actual input weights, when applying the AER's benchmarking models.

Table 7: Impact of switching from industry average to actual input weights on estimated efficiency scores

	Industry average input weights							
	SFA CD - 2006_2017	SFA TL - 2006_2017	LSE CD - 2006_2017	LSE TL - 2006_2017	SFA CD - 2012_2017	SFA TL - 2012_2017	LSE CD - 2012_2017	LSE TL - 2012_2017
ActewAGL	-18.7%	-18.5%	-17.9%	-21.4%	-17.7%	-16.5%	-20.7%	-21.9%
AusNet	-4.5%	-3.9%	-1.3%	-4.8%	-7.7%	-10.9%	-7.9%	-13.0%
Ausgrid	-25.6%	-12.2%	-25.3%	-21.0%	-24.2%	-17.9%	-26.3%	-22.8%
Citipower	9.2%	19.3%	13.6%	9.6%	3.8%	16.6%	2.9%	4.7%
Endeavour	-12.6%	-5.9%	-12.0%	-8.4%	-9.7%	-5.4%	-12.4%	-7.2%
Energex	-5.9%	6.3%	-4.9%	-0.5%	-5.3%	-0.9%	-8.0%	-4.3%
Ergon	-8.4%	-1.2%	-7.0%	-6.5%	-5.0%	3.6%	-4.9%	1.2%
Essential	-10.1%	-5.3%	-5.7%	-1.9%	-8.3%	1.4%	-7.6%	-0.7%
Jemena	-11.9%	-6.3%	-12.2%	-21.6%	-14.2%	-14.1%	-16.7%	-24.4%
Powercor	20.3%	21.6%	25.0%	25.0%	20.1%	19.7%	25.0%	25.0%
SA Power Networks	0.7%	7.5%	0.7%	4.3%	-3.1%	1.8%	-6.9%	-1.5%
TasNetworks	-4.6%	-7.2%	-3.5%	-8.5%	-1.3%	-2.4%	-4.4%	-5.3%
United	1.9%	15.0%	3.2%	-5.6%	0.5%	2.0%	0.1%	-8.7%

	Actual (DNSP-specific) input weights							
	SFA CD - 2006_2017	SFA TL - 2006_2017	LSE CD - 2006_2017	LSE TL - 2006_2017	SFA CD - 2012_2017	SFA TL - 2012_2017	LSE CD - 2012_2017	LSE TL - 2012_2017
ActewAGL	-20.1%	-19.1%	-18.9%	-22.3%	-20.3%	-17.7%	-22.1%	-23.3%
AusNet	-5.9%	-4.6%	-2.1%	-5.6%	-10.1%	-11.9%	-9.0%	-14.1%
Ausgrid	-26.4%	-13.1%	-25.7%	-21.5%	-25.8%	-18.7%	-26.9%	-23.4%
Citipower	7.6%	19.2%	13.0%	9.1%	0.8%	16.2%	2.2%	3.9%
Endeavour	-13.1%	-5.9%	-11.9%	-8.3%	-10.9%	-5.1%	-12.3%	-7.1%
Energex	-8.1%	4.1%	-6.5%	-2.3%	-9.1%	-3.5%	-10.4%	-6.9%
Ergon	-10.1%	-2.5%	-8.5%	-8.0%	-8.1%	1.6%	-7.4%	-1.6%
Essential	-11.6%	-6.4%	-7.0%	-3.3%	-10.8%	0.0%	-9.5%	-2.8%
Jemena	-12.8%	-6.1%	-12.4%	-21.8%	-16.1%	-14.2%	-16.9%	-24.6%
Powercor	19.8%	21.6%	25.0%	25.0%	18.9%	19.9%	25.0%	25.0%
SA Power Networks	-0.9%	6.5%	-0.3%	3.2%	-5.8%	0.9%	-8.3%	-3.0%
TasNetworks	-6.3%	-7.9%	-4.7%	-9.6%	-4.5%	-3.9%	-6.3%	-7.1%
United	-0.3%	13.5%	1.8%	-6.9%	-3.4%	-0.1%	-2.0%	-10.5%

Source: Frontier Economics estimates using data and models published by the AER

The top panel in **Table 7** presents the difference between the benchmark score (adjusted for OEFs) and each DNSP's estimated efficiency score, when the AER's industry-average input weights are used. A positive number (also denoted by green shading) indicates that the DNSP's estimated efficiency score was above the OEF-adjusted benchmark score, while a negative number (unshaded cells) indicates that the efficiency score was below the OEF-adjusted benchmark. The second panel presents the difference between the benchmark score (adjusted for OEFs) and the each DNSP's estimated efficiency score, when actual input weights are used.

In a small number of cases, switching from industry average weights to actual weights caused a DNSP's efficiency score to move from lying above the OEF-adjusted benchmark to lying below the benchmark. Any such instances are highlighted in the lower panel in **Table 7** using red font. We note that in almost all cases, any move below the benchmark score is very small, with the largest reduction below the benchmark score being just 3.4%.[41]

[41] That is, the case of United Energy under SFA CD model estimated using data over the period 2012 to 2017.

Rolled forward efficient opex

Under the AER's approach, a DNSP is not necessarily considered to be materially inefficient simply because its estimated efficiency score falls below the benchmark score. In order to make such an assessment, the AER derives an estimate of the efficient level of base year opex for each DNSP for comparison against the DNSP's revealed base year opex. Only if the latter is found to be materially higher than the former is the DNSP judged to be materially inefficient.

The AER derives an estimate of efficient base year opex using two steps:

- First, if a DNSP's estimated efficiency score lies below the benchmark score, the AER adjusts the average opex of the DNSP over the benchmarking period by the difference between the two efficiency scores. This results in an estimate of period average opex that the AER considers is not materially inefficient at the midpoint of the benchmarking period.
- Then, the AER rolls forward this period-average opex to a base year to obtain an estimate of efficient base year opex.

We apply this procedure for each of the DNSPs, under each model estimated and for each scenario, taking 2017 (the final year of the benchmarking period) as a proxy base year for all DNSPs. Per the AER's approach in the 2018 NSW draft decisions, we compare the average efficient base year opex (estimated using the four econometric model specifications) to the DNSP's revealed opex to determine the required reduction in base year opex. **Table 8** presents the estimated required reduction in base year opex when industry average and actual input weights are used, for each of the two benchmarking periods considered in our analysis. A positive number (indicated by yellow shaded cells) means that the estimated efficient base year opex lies below the revealed base year opex. A negative number (unshaded cells) indicates that the revealed based year opex lies below the estimated efficient opex.

Table 8: Estimated reduction in revealed base year (2017) opex to meet the estimated efficient level

	Industry average input weights		Actual (DNSP-specific) input weights	
	Avg 2006-2017	Avg 2012-2017	Avg 2006-2017	Avg 2012-2017
ActewAGL	0.2%	0.0%	3.1%	4.3%
AusNet	-3.1%	1.5%	-2.2%	3.6%
Ausgrid	20.9%	30.3%	21.8%	32.7%
Citipower	-25.7%	-22.9%	-25.8%	-22.0%
Endeavour	6.6%	9.3%	5.1%	9.0%
Energex	-11.1%	-5.9%	-7.3%	-0.7%
Ergon	-4.1%	-6.7%	-0.1%	-1.9%
Essential	-16.8%	-18.0%	-14.8%	-15.3%
Jemena	25.4%	32.8%	24.6%	33.7%
Powercor	-37.8%	-37.1%	-38.5%	-37.2%
SA Power Networks	1.9%	2.5%	3.2%	4.8%
TasNetworks	15.9%	17.3%	18.1%	21.0%
United	-9.8%	-2.3%	-7.8%	1.2%

Source: Frontier Economics estimates using data and models published by the AER

The AER's contention is that adopting actual input weights in place of industry average input weights could result in some DNSPs it currently considers to be efficient being found to be inefficient. If that contention is correct, then that would be apparent from **Table 8**. Specifically, we would find examples of DNSPs whose revealed base year opex would require no adjustment using industry average weights but requiring a downward adjustment using actual input weights (i.e., a 'switch' from an unshaded cell in one of the first two columns to a yellow shaded cell in one of the last two columns). We find only two such instances—that of ActewAGL (EvoEnergy) and United Energy—which are highlighted using red font.

We note that in the case of United Energy, the modelling suggests that revealed opex in 2017 is only slightly higher than estimated efficient opex (i.e., only a 1.2% adjustment implied). We doubt that this constitutes compelling evidence of material inefficiency. Further, both these cases arise only when the benchmarking period is shortened.

Conclusion

We conclude from this analysis that there is no evidence that the benchmarking results are, in practice, as sensitive to the input weights used as the AER has speculated. Our findings corroborate the advice provided by Economic Insights' to the AER that using actual input weights rather than industry average weights would be "unlikely" in practice to alter the AER's efficiency assessment.

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