Review of the AER Transmission Network Benchmarking Study and its Application to Setting TransGrid's Opex Rate of Change

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Review of the AER transmission network benchmarking study & its application to setting TransGrid's opex rate of change

A report prepared for TransGrid

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1. Introduction and summary of findings

We have been asked to prepare this report by TransGrid. The context for the report is the Australian Energy Regulator's (AER's) upcoming regulatory determination for TransGrid to apply from the period commencing on 1 July 2014 to 30 June 2019.

The AER is required by the National Electricity Rules (NER) to undertake a comparison across TNSPs for the purposes of the Annual Benchmarking Report. In particular, the NER require that the AER produce a network service provider performance report that describes the relative efficiency of each transmission network services provider (TNSP). The AER published its benchmarking report in November 2014, and has subsequently drawn on this analysis in its draft determination for TransGrid, which was released on 27 November 2014.

Against this backdrop, TransGrid has asked that we provide expert advice on benchmarking of the performance and expenditure of TNSPs. In particular we have been asked to:

- describe the multilateral total factor productivity (MTFP) methodology that the AER has adopted to benchmark the TNSPs, and the principles that underpin the application of that methodology;
- examine the robustness of the AER's MTFP model, and the sensitivity of the model to changes in input assumptions; and
- provide our opinion as to the implications of our analysis for the conclusions drawn from the AER's benchmarking study in its draft determination for TransGrid.

Our report is structured as follows:

- in section 2 we provide a description of the MTFP model that the AER has applied to benchmark TNSPs;
- in section 3 we set out our assessment of the robustness of the AER's MTFP model, and present the results of testing the sensitivity of the model to changes in input assumptions; and
- in section 4 we describe the manner in which the AER has applied its benchmarking analysis to set TransGrid's operating expenditure ('opex') allowance for the draft determination, and provide our opinion as to whether the analysis supports the conclusions drawn from it.

We have attached copies of our curricula vitae as Annexure A.

1.1 Summary of findings

Our assessment of the MTFP analysis has found that the results derived from the model are not robust. Our opinion is based on the following three findings:

- the output weights derived by the model are highly uncertain, even in the model's own terms;
- the output weights are sensitive to changes in input data; and
- alternative model specifications lead to considerable changes in results

The lack of robustness of the results of the MTFP model extends to other elements of the benchmarking analysis. Specifically, both the input-output specification and output weights influence *every result* obtained from the benchmarking – ie, the TFP/PFP opex analysis; the MTFP and MPFP analysis; and the AER's resultant estimates of the rate of change in productivity and the rate of change in outputs which it has used to estimate the rate of change in opex.

We have identified three principal shortcomings with the AER's approach to forecasting the rate of change of opex, ie:

- the forecasts depend on the same output weights underpinning the MTFP analysis, and so are not robust;
- the resultant opex forecasts are themselves not robust; and
- the forecasts of the productivity growth rate do not properly account for step changes.

It follows that the AER's estimates of the rate of change of opex are compromised, and so are not appropriate as a basis for setting TransGrid's opex allowance.

Finally, we note that the AER's treatment of step-changes is predicated on the assumption that historical step changes are a sensible proxy for future step changes. In our opinion, they are not. The AER has ignored the specific information provided by TransGrid in relation to step changes and has instead relied on an estimate derived from a model that is compromised. In our opinion this approach does not represent regulatory best practice.

2. Description of the AER MTFP Model

In this section we provide a description of the MTFP model that the AER has applied to benchmark TNSPs. The AER has engaged Economic Insights to develop a benchmarking model, and to apply that model to the TNSPs based on historical data.

Economic Insights' methodology is complex and makes use of advanced statistical techniques. Arguments as to the merits of one econometric technique over another are often expressed algebraically, via proof, disproof and counterexample. We have instead focussed on explaining the concepts that underpin the methodology, since it assists in developing intuition and understanding of the model and its application.

Economic Insights' methodology comprises three steps:

1. Selection of inputs and outputs for inclusion in the model specification
2. Estimation of the weight of each output
3. Calculation of the MTFP index.

The following sections describe each of the steps in greater detail.

2.1 Selection of inputs and outputs to include in the specification

An MTFP index is a ratio of business outputs to inputs over time. The first step is therefore to select the inputs and outputs that characterise the operations of a business, hereafter referred to as the input and output specifications.

In many industries, there may be obvious input and output specifications. For example, a coffee vendor has inputs of coffee, milk, labour and rent for premises. The coffee vendor might measure output simply in terms of the number of coffees sold – a logical choice given that the single ostensible output of the business is servings of coffee (albeit, perhaps of different sizes). Such an output specification would be consistent with our intuitive understanding of the output of a coffee business, and so could be adopted to measure a business' productivity over time.

In contrast to the coffee vendor, an electricity transmission business is significantly more complex, particularly in relation to the specification of outputs. The value and cost of energy carried across the network is highly dependent on the time, location, and reliability of supply. Any specification of outputs and inputs for a TNSP must therefore consider outputs beyond the simple volume of delivered energy, eg, maximum demand and value of unserved energy.

The specification of outputs for an electricity transmission business is therefore a non-trivial process, because our ability to describe and, more importantly, to understand the interaction of different outputs with one another is limited. Put another way, there is no obvious formula for the 'output' of a TNSP.

Given that it is not possible to derive an explicit formula for a TNSP's output, an MTFP analysis of electricity transmission businesses relies on assumptions as to:

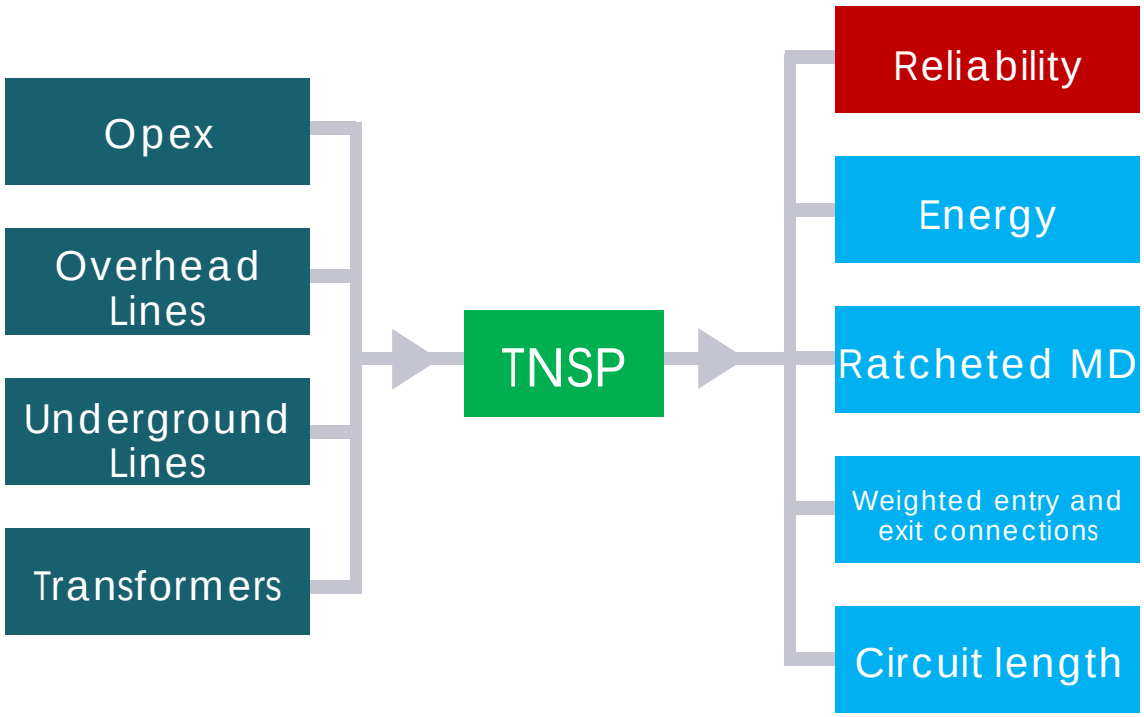
- which outputs/inputs are to be included; and
- the interactions between each output – ie, the degree to which production of one dimension of output is dependent on or correlated with the production of other dimensions of output.

The selection of outputs and inputs included in the specification is a non-trivial process. Different choices will lead to different results, and may well affect the conclusions drawn from the analysis.

2.1.1 Input and output specifications in the AER model

In developing its benchmarking model, Economic Insights considered 4 different output specifications and 3 different input specifications.[1] Economic Insights ultimately adopted input specification #1 and output specification #3, ie, inputs are opex, overhead lines, underground lines and transformers; outputs are energy throughput, ratcheted maximum demand, weighted entry and exit connections, circuit length, and reliability.

Figure 1 – Illustration of the AER's preferred input/output specification



For the remainder of the document, unless otherwise stated we have based our analysis on the AER's preferred input/output specification.

2.2 Estimation of output weights

Having determined which inputs and outputs will be used to assess productivity, the next step is to estimate the relative contribution of each to the total inputs and outputs of the TNSP.

In the AER's model specification, all inputs are already represented in dollar terms and so are comparable with one another. However, the outputs are not presented in comparable terms. For example, one megawatt of ratcheted maximum demand has no obvious relative value in terms of gigawatt hours of energy throughput. Put another way, there is no 'exchange rate' that allows us to convert ratcheted maximum demand into gigawatt hours of energy throughput.

The need for an 'exchange rate' stems from the outputs not being 'billed outputs'. In our coffee shop example, we could measure business output in terms of the revenue received for each product sold (ie, small coffees, and large coffees). However, TNSPs' tariffs are subject to price regulation and so their charges are not necessarily connected with the cost of providing a service.

[1] Denis Lawrence, Tim Coelli and John Kain, *'Memorandum – TNSP MTFP Results'*, 31 July 2014.

It is therefore necessary to determine the relative importance of each output variable to total production. Economic Insights achieves this through the estimation of a 'weight' on each of the output variables.[2] The weights determine the relative contribution of each output variable to total production.

2.2.1 Estimation of weights via regression

Economic insights has estimated the weights of the outputs by performing a regression. The functional form[3] of the model used in the regression is a follows:

$$\ln(Total\ cost) = \beta_0 + \beta_E \ln(E) + \beta_R \ln(R) + \beta_C \ln(C) + \beta_G \ln(G) + 0.5\,\beta_{EE} \ln(\mathrm{E}) \times \ln(\mathrm{E}) + 0.5\,\beta_{RR} \ln(\mathrm{R}) \times \ln(\mathrm{R}) + 0.5\,\beta_{CC} \ln(\mathrm{C}) \times \ln(\mathrm{C}) + 0.5\,\beta_{GG} \ln(\mathrm{G}) \times \ln(\mathrm{G}) + \beta_{ER} \ln(E) \times \ln(R) + \beta_{EC} \ln(E) \times \ln(C) + \beta_{EG} \ln(E) \times \ln(G) + \beta_{RC} \ln(R) \times \ln(C) + \beta_{RG} \ln(R) \times \ln(G) + \beta_{CG} \ln(C) \times \ln(G) + Y + \varepsilon$$

where E, R, C, G, and Y represent energy throughput, ratcheted maximum demand, weighted connections, circuit length, and years respectively.

This functional form is the 'translog cost function' to which Economic Insights refers in their paper. The term describes the form of the function that is assumed to describe the costs of a network business. Put another way, Economic Insights' analysis assumes that network businesses' costs can be broadly described in terms of the regression equation, which is the assumed 'cost function'. Having assumed a functional form, the regression analysis seeks to identify the coefficients on each of the key predictors.

Economic Insights has performed this regression through the use of the 'POOL' command in SHAZAM.[4] Economic Insights suggests that adopting this regression, as opposed to a typical ordinary least squares regression, is more appropriate given that the data has both cross-sectional and time series characteristics, and given that the error terms for each cross section are auto-correlated.

Having performed the regression, the weights are then estimated from the first order coefficients of each of the outputs. For example, the coefficients estimated for the AER's preferred input-output specification are set out in Table 1.

[2] In the interests of consistency, we have adopted the convention of using the term 'weight' in place of both 'output weights' and 'output cost shares'.

[3] Economic Insights refers to the estimation of weights occurring via the use of a 'translog cost function'. This describes the assumed functional form of the regression equation, ie, the assumed relationship between the outputs and total cost.

[4] SHAZAM is a proprietary statistical software package, the primary purpose of which is to estimate and test econometric models.

Table 1 – Cost function estimates using AER preferred input-output specification

Variable	Coefficient
ln(Energy)	0.279
ln(RMDemand)	0.288
ln(Connections)	0.362
ln(CircLen)	0.374
0.5 * ln(Energy)*ln(Energy)	-0.376
0.5 * ln(RMDemand)*ln(RMDemand)	-0.716
0.5 * ln(Connections)*ln(Connections)	-2.365
0.5 * ln(CircLen)*ln(CircLen)	-6.992
ln(Energy)*ln(RMDemand)	-0.732
ln(Energy)*ln(Connections)	0.102
ln(Energy)*ln(CircLen)	1.574
ln(RMDemand)*ln(Connections)	-0.509
ln(RMDemand)*ln(CircLen)	0.891
ln(Connections)*ln(CircLen)	3.826
Year	0.022
Constant	12.665

From these estimated coefficients, the weights have then been calculated as follows:

- Energy throughput – the coefficient 0.279 divided by the sum of the first order coefficients[5] (0.279+0.288+0.362+0.374=1.303) yields 21.4 per cent.
- Ratcheted maximum demand – the coefficient 0.288 divided by the sum of the first order coefficients yields 22.1 per cent.
- Weighted connections – the coefficient 0.362 divided by the sum of the first order coefficients yields 27.8 per cent.
- Circuit length – the coefficient 0.374 divided by the sum of the first order coefficients yields 28.7 per cent.

[5] Economic Insights has used the shares of the first order output coefficients only, and so excludes all interaction terms from the calculation of weights.

Reliability has been incorporated into the model as a 'negative output', and its weight has been assigned based on the value of consumer reliability (VCR). In simple terms, this means that each megawatt-hour of unserved energy in a transmission network reduces the outputs of a business by the VCR.

The regression model seeks to explain the manner in which the chosen outputs influence the businesses' total costs. That is, the model assumes that the cost of the business depends on the outputs, and that an examination of the historical relationship between costs and outputs allows us to determine how each output contributes to total cost. For example, Economic Insights' results suggest that a 1 per cent increase in energy throughput will result in a 0.21 per cent increase in total cost, assuming all other factors are held constant.

2.3 Calculation of the MTFP index

Having determined the weights, the final step is to calculate indexes of inputs and outputs, and then to derive the MTFP index. Economic Insights has formulated the index using the Fisher ideal index.[6] The MTFP index is a measure of the productivity of the business, and is simply a ratio of outputs (measured by the output index) to inputs (measured by the input index).

A crucial element of Economic Insights' methodology is that it seeks to allow comparisons between the inputs and outputs of different businesses, and so the indexing methodology has been designed with this intention in mind. In essence, this means that the objective of estimating the weights, the inputs, and the outputs is to allow comparisons of the relative productivity (or the differentials in productivity) between transmission businesses.

2.3.1 MTFP estimates

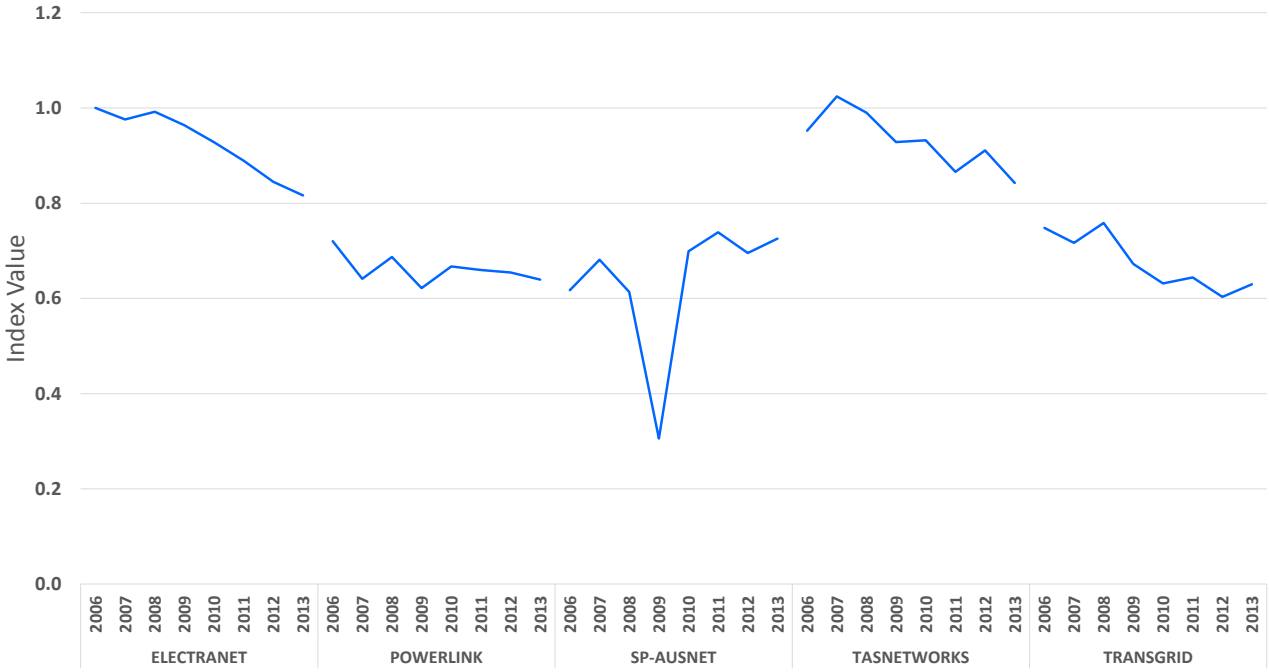
Economic Insights arrives at the estimates of MTFP set out in Table 2 and Figure 2. We note that the results have been normalised so that ElectraNet has an index value of 1 in 2006.

Table 2 – Economic Insights MTFP results

Business	2006	2007	2008	2009	2010	2011	2012	2013
ElectraNet	1	0.976	0.9921	0.9639	0.9282	0.8891	0.8449	0.8165
Powerlink	0.7201	0.6413	0.687	0.6218	0.6673	0.6597	0.6546	0.6396
AusNet	0.6173	0.6814	0.6136	0.3057	0.699	0.7389	0.6955	0.7257
TasNetworks	0.9524	1.0243	0.9899	0.9284	0.9322	0.866	0.9108	0.8425
TransGrid	0.748	0.7166	0.7585	0.6724	0.6316	0.644	0.6033	0.6298

[6] Denis Lawrence, Tim Coelli and John Kain, '*Economic Benchmarking Assessment of Operating Expenditure for NSW and Tasmanian Electricity TNSPs – Report prepared for Australian Energy Regulator* ', 10 November 2014, Appendix A.

Figure 2 – Economic Insights MTFP results



3. Assessment of the AER MTFP model

In this section, we set out our assessment of the MTFP analysis performed by Economic Insights. Our principal observation is that the results of the MTFP analysis are not robust, ie, small changes to the input assumptions, or the adoption of equally valid alternative model specifications, can effect marked changes in the results. The lack of robustness has implications for how the AER has used the results from the MTFP analysis in its draft determination for TransGrid.

Our opinion that the model is not robust is based on the following three findings:

- the output weights derived by the model are highly uncertain, even in the model's own terms;
- the output weights are sensitive to changes in input data; and
- alternative model specifications lead to considerable changes in results.

We address each of these three points of concern in the following sections.

3.1 Weights derived by the model are highly uncertain

We have explained that the estimation of the weights applied to each of the outputs is a critical element of the methodology, and that these weights are estimated via a regression. These weights represent a single point estimate. Any single estimate of the parameters in the regression equation will differ from the true values because of sampling noise, ie, the degree to which individual chance outcomes influence the results of the regression.

A relevant question is the level of certainty, or confidence, that we have in the weights estimated via the regression equation. Moreover, we are interested in the probability that the true value of the parameter differs from the estimated value by more than some defined level.

3.1.1 Confidence intervals and standard errors

This analysis is typically provided through an examination of the confidence interval that accompanies an estimate, a concept that it is helpful to describe. Suppose that there is some number, M, such that:

$$\Pr(Estimate\ of\ \beta - M \leq Actual\ value\ of\ \beta \leq Estimate\ of\ \beta + M) = 95\,\%\,.$$

The interval $(Estimate\ of\ \beta - M, Estimate\ of\ \beta + M)$ is known as a 'confidence interval', and in this case has a 5 per cent (ie, 1 – 95 per cent) level of significance.

The confidence interval associated with an estimate has a very specific interpretation. In the case of the 95 per cent confidence interval, it means that over many repetitions 95 out of every 100 intervals constructed in this way will contain the true value of parameter. Put another way, were we to *repeat the process* many, many times, 95 per cent of the confidence intervals constructed in this way would contain the true value.

For any given level of significance, it is clear that the wider the confidence interval, the less we can rely upon our estimate. In the case of the coefficients in Economic Insights' regression equation, the confidence interval is proportional to the standard error of each coefficient. The standard error is a measure of the precision of an estimate, ie, the precision with which the estimator measures the true value of the parameter. The upper and lower bounds of the 95 per cent confidence interval are (approximately) given by the value of the estimate plus or minus two times the standard error. In simple terms, the greater the standard error, the wider the confidence interval, and so the less certain our estimate.

3.1.2 Examination of confidence intervals for Economic Insights analysis

We have reviewed the analysis performed by Economic Insights, and examined the standard errors of each of the coefficients derived. We have translated the standard errors on the coefficient into an implied standard error for the weights, ie, by dividing the standard error by the sum of the first order coefficients. Based on this implied standard error, we have also calculated a 95 per cent confidence interval for each estimated weight. The results of our analysis are set out in Table 3.

Table 3 – Standard errors and confidence intervals for estimated weights

	Coefficient	Standard Error	Estimated Weight (%)	Implied standard error in terms of weights	95 % Confidence Interval
Energy	0.279	0.1238	21.4	9.5	(2,41)
Ratcheted MD	0.288	0.1521	22.1	11.7	(-2,46)
Connections	0.362	0.1930	27.8	14.8	(-3,58)
Circuit Length	0.374	0.2141	28.7	16.4	(-5,63)

The results show that the standard errors on each of the estimated coefficients translate into an implied standard error for the weights of between 9.5 and 16.4 percent. As a result, the confidence interval for each of the weights is very wide. For example, for circuit length the results suggest that our regression provides us with a 95 per cent confidence interval from -5 per cent to 63 per cent. Given that the weight must intuitively fall between 0 and 100 per cent, we would suggest that Economic Insights' estimate provides very little additional information.

We note that our analysis does not provide evidence that the weights are not equal to those estimated by Economic Insights. Instead, our analysis suggests that there is considerable uncertainty surrounding the estimates of those weights. These weights are uncertain in the model's own terms – the standard error is a key indicator of the certainty that we can ascribe to the results of the model. In this instance, our finding does not challenge Economic Insights' assumptions, but instead the strength of the conclusions that it draws from its own analysis.

As we will demonstrate, the uncertainty of the estimated coefficients manifests itself in the outputs weights being sensitive to changes in modelling assumptions.

3.2 Output weights are sensitive to changes in input data

We have explained that the output weights are uncertain. The importance of this is that the weights are then used to draw conclusions about the productivity of different businesses.

We have repeated Economic Insights' analysis with three changes to the input data, namely:

- excluding AusNet Services;
- excluding observations from 2013; and
- assuming energy throughput data decreases by 1 per cent per annum from 2009 onwards versus actual outcomes.

We would expect a robust model to be relatively unaffected by these modest changes to the input data.

Figure 3 compares the output weights derived for each scenario with those established in the AER's MTFP model.

Figure 3 – Comparison of output weights under different assumptions

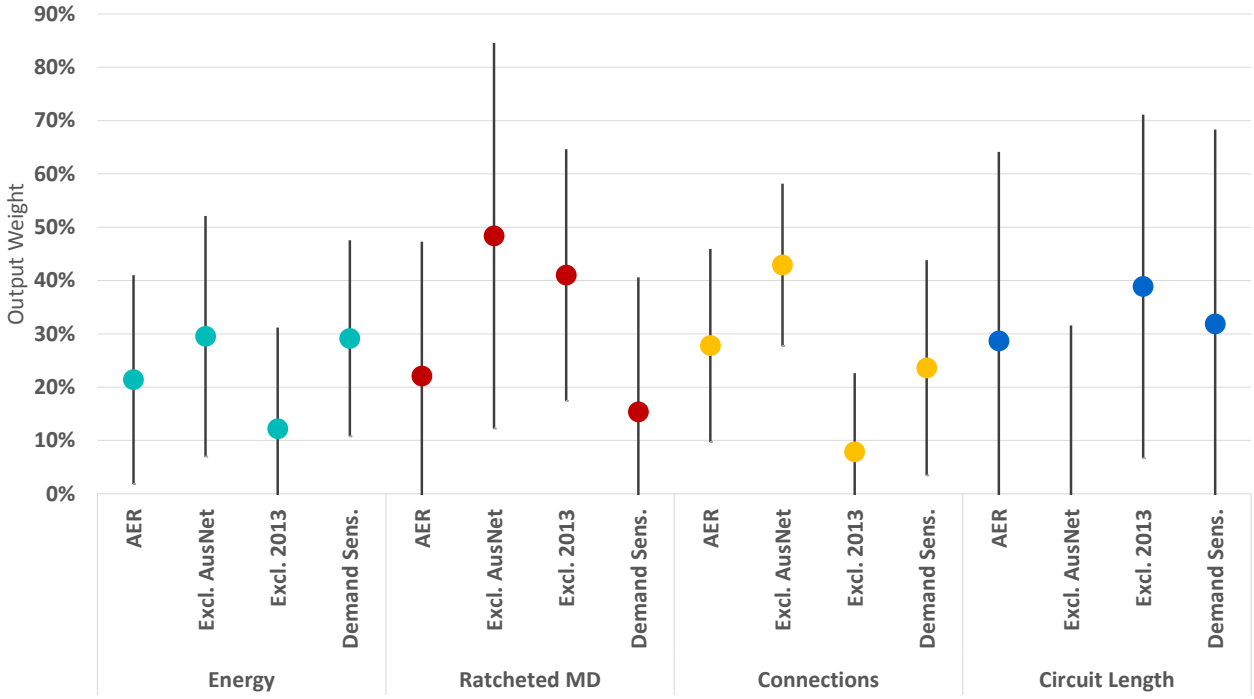


Figure 3 sets compares the output weights that arise under each of the four scenarios. The coloured circles indicate the estimate of weight, and the black lines indicate the 95 per cent confidence interval associated with that estimate. We observe the following:

- **Exclusion of AusNet Services –** the exclusion of AusNet Services from the analysis leads to a significant change in the output weights, ie:
  - the weights ascribed to energy throughput, ratcheted maximum demand, and the weighted connections increase;
  - circuit length being ascribed a negative value, implying that absent AusNet Services, other businesses tend to see total cost decrease with increases in circuit length – a nonsensical result.
- **Exclusion of 2013** – the exclusion of a single year of data also leads to a significant change in the weights, ie:
  - from 21.4 per cent to 12.2 per cent for energy throughput;
  - from 27.8 per cent to 7.9 per cent for weighted connections;
  - from 22.1 per cent to 41 per cent for ratcheted maximum demand; and
  - from 28.7 per cent to 38.9 per cent for circuit length.
- **Demand sensitivity** – the reduced level of demand leads to a less pronounced change in output weights, but nevertheless significant:
  - from 21.4 per cent to 29.1 per cent for energy throughput;
  - from 22.1 per cent to 15.4 per cent for ratcheted maximum demand;
  - from 27.8 per cent to 23.6 per cent for weighted connections; and

> from 28.7 per cent to 31.9 per cent for circuit length.

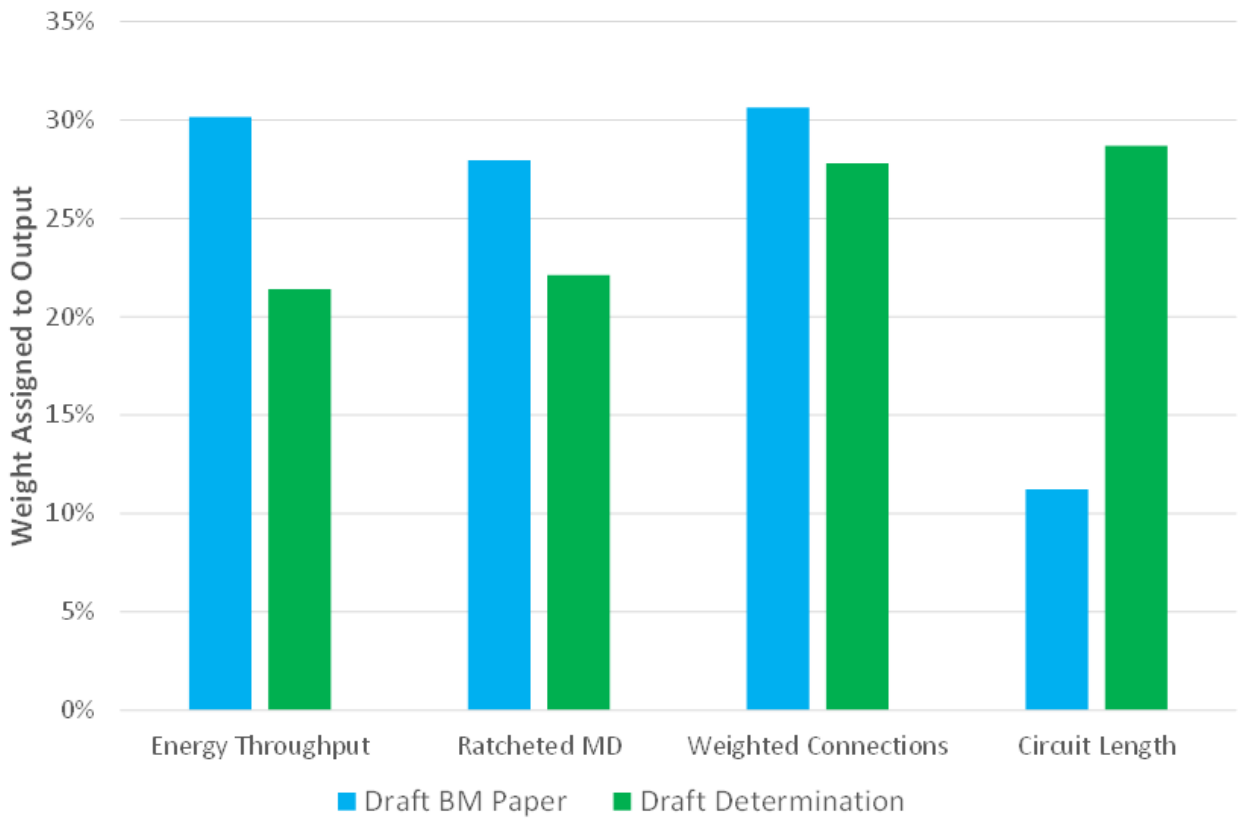
Economic Insights' model is predicated on the assumption that these weights are of pivotal importance to the business in which TNSPs are engaged – the business of delivering the four specified outputs, the relative cost of which is represented by the modelled weights. The changes in the output weights for each of the different scenarios set out above essentially suggests that this business has changed markedly (ie, the relative importance of each of the business' outputs has changed) because of the changes to the input data set. In our opinion, this outcome can only be deemed nonsensical.

In our opinion, the significant changes in weights arising from relatively small changes to the input data set suggest that the regression model is not sufficiently robust to be used as a basis for setting businesses' revenue. The sensitivity of the results implies that significant changes in the weights, and so the benchmarking results, could arise from:

- the inclusion of new information, such as new data that appears from one year to the next; and
- measurement or other errors in inputs.

To illustrate the potential implications of adopting the model, we note that the AER's own analysis changed markedly between the release of its draft benchmarking report[7] and the release of the draft determination – Figure 4.

Figure 4 – Output weights in draft benchmarking paper and draft determination



The change in results is attributable to a revised set of opex values for AusNet Services, ie, revisions to the cost outcomes for a single business have led to significant decreases in three of the weights (energy

[7] AER, *'Electricity transmission network service providers – Annual benchmarking report (Draft)'*, August 2014.

throughput, ratcheted maximum demand, and weighted connections) and a substantial increase in the weight of circuit length.

3.3 Alternative model specifications lead to considerable changes in results

We have described that the output weights arising from the AER's preferred specification are sensitive to relatively small changes in the underlying data set. Beyond this observation, an additional matter is the significance of adopting the chosen input-output specification. Economic Insights' rationale for adopting its chosen model specification was set out in a memorandum prepared in July 2014,[8] and this rationale remains unchanged in the final annual benchmarking report.[9]

We have identified two principal shortcomings with Economic Insights' analysis. In particular, the rationale set out in the memorandum and again in the draft determination does not:

- recognise the limitations inherent to the MTFP analysis; and
- identify that alternative, equally valid formulations of outputs and inputs lead to different results.

3.3.1 Limitations inherent to the MTFP analysis

We have explained that the specification of outputs for electricity transmission businesses is a non-trivial process, because our ability to describe and, more importantly, to understand the interaction of different outputs with one another is limited. Put another way, there is no obvious formula for the 'output' of a TNSP.

In our opinion, Economic Insights' has not adequately described this limitation on the MTFP analysis. Further, the memorandum contains several statements that appear to ignore this limitation, namely:

- '… output specification #2 appears to perform relatively well';
- '… the results obtained using output specification #3 did not appear to favour any particular type of TNSP'; and
- 'A potential disadvantage of the specification in this context is the multiplicative nature of the system capacity variable, which introduces a degree of non-linearity thereby potentially advantaging large NSPs'.

These statements are all predicated on an assumption that it is possible to measure the performance of a given output specification against some external benchmark. It is not.

Of particular concern is the statement that:

> '… the results from [output specification #4] were considerably more dispersed than for specifications #2 and #3 with smaller TNSPs being relatively advantaged. We consequently believe this specification is less preferred than output specification #3.' [10]

Economic Insights' report neither explicitly states the basis for its use of dispersion as a measure of an MTFP specification's performance, nor does it explain why dispersion is an undesirable trait of an MTFP index. Regardless, this statement implies that Economic Insights has adopted its own subjective system to rank input/output specifications.

In summary, Economic Insights does not acknowledge the inherent limitations of the MTFP analysis. Its analysis neither supports the chosen specification, nor detracts from any alternative.

We note that in its final benchmarking report for Transmission Network Service Providers, the AER comments that:

[8] Denis Lawrence, Tim Coelli and John Kain, *'Memorandum – TNSP MTFP Results'*, 31 July 2014.

[9] AER, *'Electricity transmission network service providers – Annual benchmarking report',* November 2014.

[10] Denis Lawrence, Tim Coelli and John Kain, *'Memorandum – TNSP MTFP Results'*, 31 July 2014, pp. 4.

> '… Economic Insights considers that the model specification presented here is currently the most appropriate and we agree.'[11]

Again, in terms of the criteria that have been applied in forming the conclusion that the proposed specification is 'the most appropriate', in our opinion there is no robust basis for the proposed model specification.

3.3.2 Alternative specifications lead to different results

We have explained that there is no objective means of assessing the appropriateness of any different input/output specification, and so alternative specifications are equally valid. Importantly, the adoption of alternative specifications would significantly affect the results.

We have replicated Economic Insights' analysis, and so have been able to examine output/input specifications other than those considered by Economic Insights. We have focussed on examining different *output* specifications, because of the importance of the output weights in determining the MTFP results.

We have considered three alternative output specifications, ie:

- **Excluding Connections** – outputs of energy, ratcheted maximum demand, circuit length and reliability.
- **Excluding Energy** – outputs of ratcheted maximum demand, weighted connections, circuit length and reliability.
- **Including System Capacity** – outputs of energy, ratcheted maximum demand, system capacity and reliability.

The output weights that arise under each of these alternative output specifications is set out in Table 4. Our first observation is that the adoption of alternative output specifications leads to significant, and sometimes counter-intuitive outcomes for output weights. For example, excluding connections leads to a reduction in the weight assigned to energy.

Table 4 – Comparison of output weights for alternative output-specifications

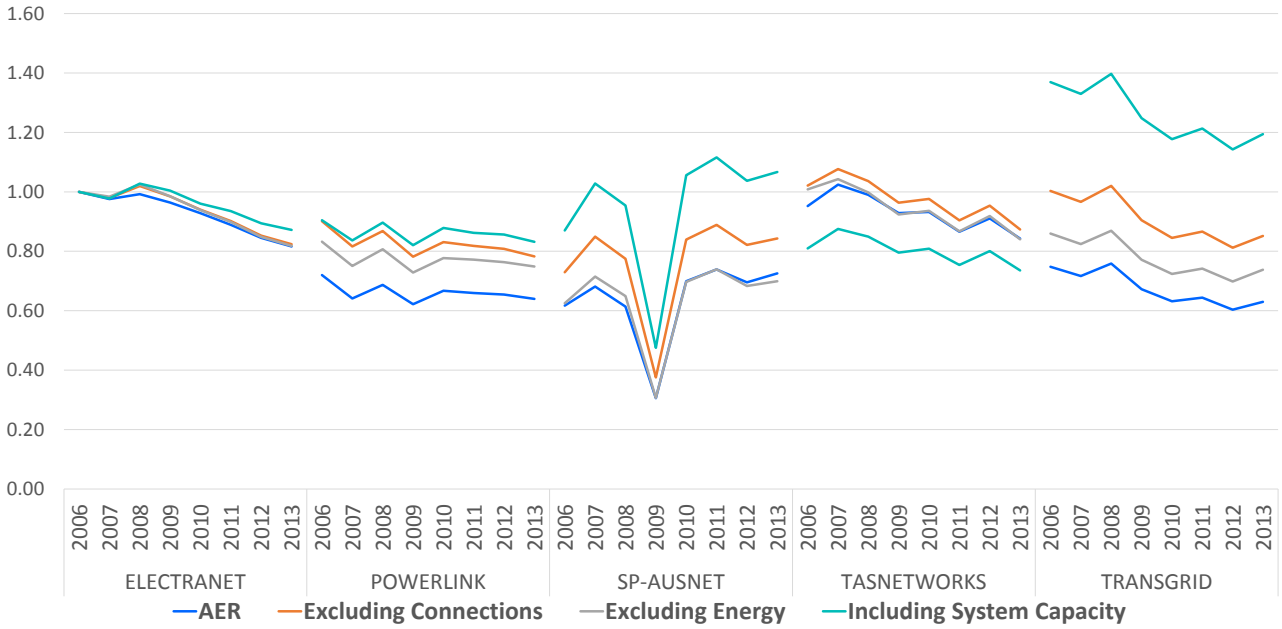
	AER	Excluding Connections	Excluding Energy	Incl. System Capacity
Energy	21.4	10.0	-	17.9
Ratcheted MD	22.1	53.9	44.5	61.5
Connections	27.8	-	-2.0	-
Circuit Length	28.7	36.1	57.5	-
System Capacity	-	-	-	20.5

Note: All values are percentages.

Figure 5 compares the resulting MTFP index values for the AER's preferred specification and our three alternative output specifications. To aid in comparison with our previous analysis, for all cases our results are normalised so that ElectraNet has an index value of 1 in 2006.

[11] AER, *'Electricity transmission network service providers – Annual benchmarking report'*, November 2014, pp 22.

Figure 5 – Comparison of MTFP index results for alternative output specifications



The four different output specifications lead to significant variations in MTFP. For example, including system capacity TransGrid's productivity is considerably higher than every other TNSP, whereas under the AER's specification it is amongst the lowest.

The variation in outcomes emphasises that the results of the analysis are heavily influenced by the decision to adopt one specification over another – a decision that we have already explained is inherently subjective.

The differing results suggest that the relative performance of TNSPs as measured by the MTFP index is highly conditional on the specification adopted. For this reason alone, we caution against drawing conclusions as to the relative productivity of any particular TNSP from this analysis.

4. Application of benchmarking to set opex

We have explained in the previous section that the MTFP model used by the AER is not robust. In this section, we describe the manner in which the AER has applied other elements of its benchmarking analysis to set TransGrid's opex allowance in the draft determination. We then explain that the lack of robustness of the results of the MTFP model extends to these other elements of the benchmarking analysis, and so compromises the AER's proposed forecast opex allowance.

4.1 Role of benchmarking in the AER's Draft Determination

The AER has made use of its benchmarking analysis to set TransGrid's opex allowance in its draft determination. The primary role of benchmarking in the AER's framework has been to assess the relative efficiency of TNSPs' opex. In this regard, the AER has stated that:

> 'We have no evidence to suggest that TransGrid's revealed base year expenditure is materially inefficient. In arriving at this conclusion we had regard to the results of various benchmarking analysis. On the whole, our benchmarking analysis for TransGrid is inconclusive.' [12]

Further, the AER stated in its annual benchmarking report for TNSPs that:

> 'We have not drawn conclusions on the relative efficiency of the transmission networks because the relative rankings observed are currently sensitive to the model specification. MTFP analysis is in its early stage of development in application to transmission networks within Australia which makes efficiency comparisons at the aggregate expenditure level difficult.'[13]

The AER's observation that the results are sensitive to the model specification is consistent with our findings in section 3.3.2.

Notwithstanding these statements, the AER has used elements of its benchmarking analysis to inform its forecasts of opex – ie, the forecasts that it has substituted for TransGrid's proposed forecasts. Specifically, the AER has used the same weights that informed its MTFP analysis to estimate two of the inputs to its rate of change calculation. The rate of change formula for opex for a given year is:

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

where:

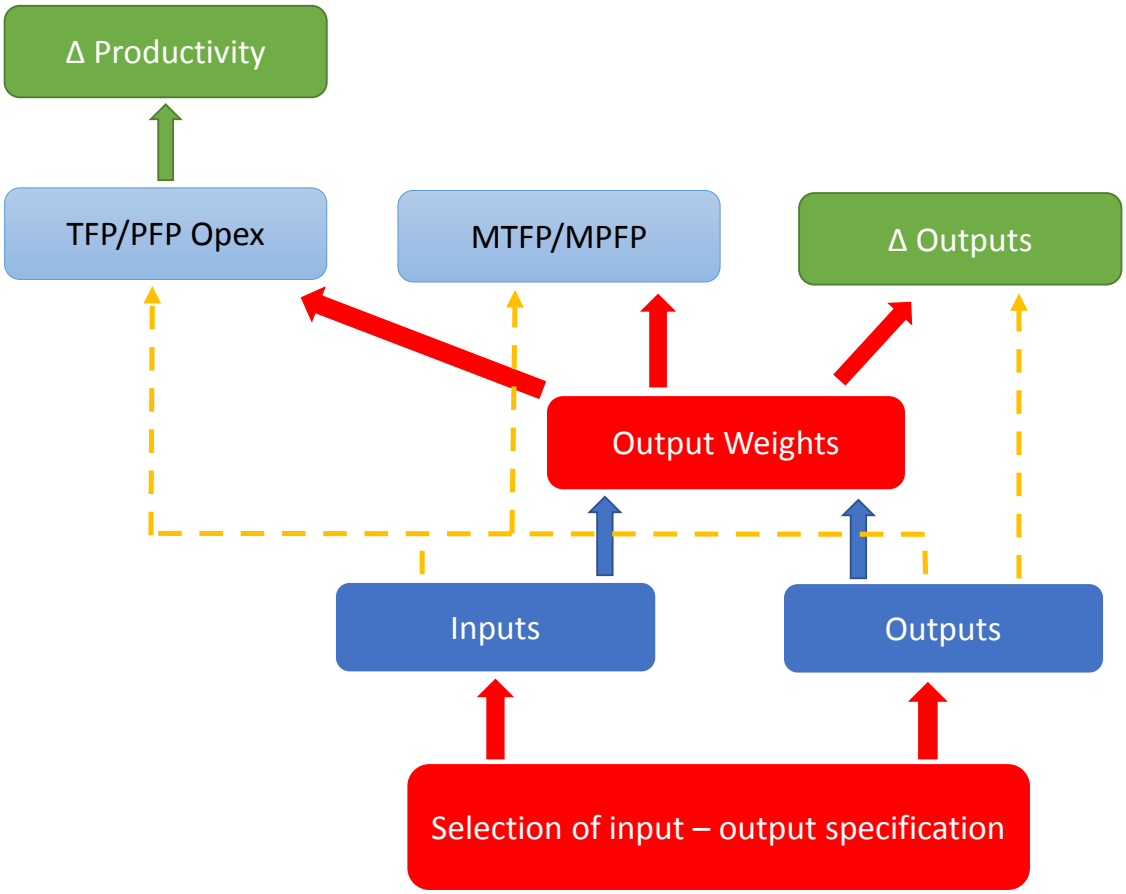
- $\Delta\, Opex$ is the proportional change in opex in that year;
- $\Delta\, Price$ is the proportional change in input prices in that year;
- $\Delta\, Output$ is the proportional change in measured outputs in that year; and
- $\Delta\, Productivity$ is the proportional change in productivity in that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

The AER has estimated the proportional change in outputs and the proportional change in productivity using results from the benchmarking analysis. Figure 6 illustrates the relationship between the different components of the benchmarking analysis.

[12] AER, *'Draft decision: TransGrid transmission determination 2015-16 to 2017-18 – Attachment 7: Operating expenditure',* November 2014, *pp. 7-33.*

[13] AER, *'Electricity transmission network service providers – Annual benchmarking report',* November 2014, *pp. 6.*

Figure 6 – Relationship between different components of the benchmarking analysis



A critical observation is that both the input-output specification and output weights (marked in red) influence *every result* obtained from the benchmarking – ie, the TFP/PFP opex analysis; the MTFP and MPFP analysis; and the AER's resultant estimates of the rate of change in productivity and the rate of change in outputs. The following sections describe the AER's process for estimating:

- the proportional change in measured outputs; and
- the productivity growth rate.

In so doing, we demonstrate the pivotal role that the input-output specification and the output weights play in estimating the inputs to the opex rate of change calculation.

4.1.1 Forecasting the proportional change in measured outputs

Within the rate of change approach, the output change parameter captures the changes in the level of outputs delivered, ie, the quantum of each of the outputs that the TNSP produces. The AER states that:

> 'To measure output change, we select a set of output measures and apply a [weight] to these measures. We have chosen the same output change measures and weightings as used in our multilateral total factor productivity (MTFP) analysis. This ensures output change is measured consistently through time and across transmission network service providers.'[14]

[14] AER, *'Draft decision: TransGrid transmission determination 2015-16 to 2017-18 – Attachment 7: Operating expenditure'*, November 2014, *pp. 7-67.*

Table 5 sets out the steps involved in the AER's calculation of the rate of change of outputs for TransGrid for each year from 2014-15 to 2017-18. The AER's forecast is therefore a weighted average of the change in each of the outputs, where the weights are those that informed Economic Insights' MTFP analysis.

Table 5 – AER's calculation of the rate of change of outputs

	2013-14	2014-15	2015-16	2016-17	2017-18
Forecast output measure					
Energy (GWh)	65900	66600	66700	67300	68000
Ratcheted MD (MVA)	19400	19400	19400	19400	19400
Weighted entry and exit connections	17203	17621	17891	17896	18226
Circuit Length (km)	13087	13280	13280	13280	13182
Growth rate [a]					
Energy	-	1.06%	0.15%	0.90%	1.03%
Ratcheted MD	-	0.00%	0.00%	0.00%	0.00%
Weighted entry and exit connections	-	2.40%	1.52%	0.03%	1.83%
Circuit Length	-	1.46%	0.00%	0.00%	-0.73%
Weight multiplied by growth rate					
	Weight	2014-15	2015-16	2016-17	2017-18
Energy	21.4%	0.23%	0.03%	0.19%	0.22%
Ratcheted MD	22.1%	0.00%	0.00%	0.00%	0.00%
Weighted entry and exit connections	27.8%	0.67%	0.42%	0.01%	0.51%
Circuit Length	28.7%	0.42%	0.00%	0.00%	-0.21%
Forecast Output Change		**1.31%**	**0.45%**	**0.20%**	**0.52%**

a: *Growth rate is calculated as $ln(x_t) - ln(x_{t-1})$ where x_t is the value the output measure x in year t.*

4.1.2 Forecasting the productivity growth rate

The AER's rate of change approach incorporates changes in productivity – ie, changes in the quantum of outputs that a business derives from its inputs. Economic Insights has drawn on the results of its opex partial factor productivity (PFP) analysis to estimate the rate of change in productivity, stating that:

> '… we present an illustrative set of MTFP results …, we caution against drawing strong inferences about TNSP efficiency levels from these results. More confidence can be placed in productivity growth rate results because they simply measure year-to-year changes without passing judgement on relative efficiency levels.'[15]

The AER has set the productivity change parameter to be the annual PFP growth rate[16] across the five TNSPs (as an industry) between 2006 and 2013, ie, 0.86 per cent per annum. Table 6 sets out the opex PFP indexes and average annual growth rates for each TNSP, and for the industry as a whole.

Table 6 – Economic Insights opex PFP indexes and average annual growth rates, 2006 to 2013

	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	Annual Growth
ElectraNet	1.000	0.943	1.056	0.997	0.960	0.891	0.830	0.880	-1.82%
Powerlink	1.000	0.924	0.939	0.977	1.023	1.071	1.053	1.066	0.92%
AusNet	1.000	1.121	1.165	0.691	1.050	1.158	1.228	1.251	3.20%
TasNetworks	1.000	1.073	0.927	0.921	0.920	0.955	0.994	1.034	0.47%
TransGrid	1.000	1.026	1.113	1.111	0.990	1.088	1.013	1.108	1.47%
Industry	1.000	1.004	1.026	0.925	0.986	1.041	1.013	1.062	0.86%

*Source: '*Economic Benchmarking Assessment of Operating Expenditure for NSW and Tasmanian Electricity TNSPs – Report prepared for Australian Energy Regulator *', Denis Lawrence, Tim Coelli and John Kain; 10 November 2014, pp15.*

In simple terms, the PFP opex index is calculated as the ratio of total outputs to opex, and is calculated separately *for each TNSP*. Of particular relevance is that the need to establish a measure of total outputs requires an 'exchange rate' to place outputs in comparable terms, and Economic Insights' analysis has once again applied the same output weights as were used in the MTFP analysis.

Treatment of step changes

In estimating the change in opex, the AER has not made any adjustment for step changes. In particular, the AER states that:

> 'Our measured productivity will include the effect of past step changes which typically increase a service provider's inputs. This will lower our measured productivity. If we include an allowance for step changes in forecast opex, there is a risk that a service provider will be compensated twice for step changes.'[17]

Put another way, the AER suggests that its PFP-derived measure of productivity incorporates the effect of historical step changes, and so there is no need for an allowance for future step changes in opex.

[15] Denis Lawrence, Tim Coelli and John Kain, '*Economic Benchmarking Assessment of Operating Expenditure for NSW and Tasmanian Electricity TNSPs – Report prepared for Australian Energy Regulator* ', 10 November 2014, pp. 6.

[16] In its draft determination, the AER states that '… our opex MPFP growth rate is an appropriate basis for forecasting the rate of change in opex going forward.' (pp 7-34). The AER is in fact in error – it has not adopted the MPFP growth rate, but instead the opex PFP growth rate. The results of the two analyses are virtually identical and so are easily confused.

[17] AER, *'Draft decision: TransGrid transmission determination 2015-16 to 2017-18 – Attachment 7: Operating expenditure'*, November 2014, *pp. 7-68.*

4.2 Analysis of the AER's forecast of opex

We have identified three principal shortcomings with the AER's approach to forecasting the rate of change of opex, ie:

- the forecasts depend on the same output weights underpinning the MTFP analysis, and so are not robust;
- the resultant opex forecasts are themselves not robust; and
- the forecasts of the productivity growth rate do not properly account for step changes.

It follows that the AER's resultant estimates of the rate of change of opex are compromised, and so are not appropriate as a basis for setting TransGrid's opex allowance.

4.2.1 AER's estimates of rate of change parameters depend on the output weights

We have demonstrated that Economic Insights' MTFP model is not robust. The AER itself acknowledges this, stating that:

> 'We have not drawn conclusions on the relative efficiency of the transmission networks because the relative rankings observed are currently sensitive to the model specification.'[18]

Nevertheless, the AER has relied upon the very elements of its MTFP model that are not robust to set TransGrid's proposed opex allowance, ie:

- the output weights estimated from the regression described in section 2.2.1; and
- the input-output specification for its MTFP model.

Figure 6 (see above) illustrates that these factors, which give rise to such instability in the MTFP analysis, also influence the opex PFP analysis and so the AER's forecasts of the rate of change of opex. Moreover, we have explained that the role of these factors is integral to the AER's approach to estimating these parameters. It follows that the AER's forecasts of the change in outputs and productivity growth are compromised, and so cannot be used as a basis for setting TransGrid's opex allowance.

4.2.2 Opex forecasts are themselves not robust

To demonstrate the potential implications of small changes in the input data for the AER's forecasts of the opex rate of change, we have repeated the analysis performed by Economic Insights' with two changes to the input data, namely:

- excluding observations from 2013; and
- including observations derived from 2014 Regulatory Information Notice (RIN) responses, as published on the AER website.

We note that at the time of writing not all of the necessary information was available from the 2014 RIN data set, and so TransGrid has instructed us to make the following assumptions:

- operational data that AusNet services was not required to provide in its RIN – we have assumed these values remain at their 2012/13 levels;
- unsupplied energy for 2013/14 was not required in the RINs – we have assumed it to be the average over 2005/06 to 2012/13, excluding the 2008-09 AusNet services observation; and
- the 2013/14 value for the capital goods price index is extrapolated from historical values.

In the absence of any other information, it is our opinion that that these assumptions are reasonable.

[18] AER, *'Electricity transmission network service providers – Annual benchmarking report'*, November 2014, *pp. 6.*

Table 7 and Table 8 set out our resultant estimates of the output rate of change for TransGrid and productivity growth rates for all five TNSPs and for the industry as a whole.

Table 7 – Comparison of output rate of change for TransGrid under different assumptions

	2014-15	2015-16	2016-17	2017-18
Draft Determination	1.31%	0.45%	0.20%	0.52%
Excluding 2013	0.89%	0.14%	0.11%	-0.02%
Including 2014	1.31%	0.50%	0.18%	0.58%

Table 8 – Comparison of productivity growth rate under different assumptions

	AER	Excluding 2013	Including 2014
ElectraNet	-1.8%	-3.1%	-1.4%
Powerlink	0.9%	0.9%	0.3%
AusNet	3.2%	3.4%	2.2%
TasNetworks	0.5%	-0.1%	1.3%
TransGrid	1.5%	0.2%	-0.9%
Industry	0.86%	0.18%	-0.07%

We observe the following:

- **Exclusion of 2013** – the exclusion of a single year of data results in:
  - a considerable reduction in forecast output growth in each year of the upcoming regulatory period; and
  - a marked reduction in the estimated industry productivity growth rate, from 0.86 per cent to 0.18 per cent; and
- **Inclusion of 2014** – the expansion of an additional year of data results in:
  - only marginal changes to the forecast output rate of change; and
  - a marked reduction in the estimated industry productivity growth rate, from 0.86 per cent to -0.07 per cent.

These two sensitivities demonstrate that small changes in output data have the potential to effect a marked change in the inputs to the AER's rate of change calculation. This finding is consistent with our earlier analysis, and demonstrates that the AER's estimates of the opex rate of change are compromised.

4.2.3 Treatment of step changes

Even if we accept Economic Insights' analysis, an additional concern arises from the AER's treatment of step changes. The AER's rationale for not providing an allowance for step changes hinges on the following four propositions:

1. The AER's measure of productivity includes the effect of step changes.
2. Step changes typically increase a service provider's inputs, and so lower the measure of productivity.
3. The reduction in the AER's measure of productivity introduced by including step changes provides an allowance for step changes.
4. It is therefore not necessary to make additional provision for step changes.

The AER's approach is essentially predicated on the assumption that historical step changes are a sensible proxy for future step changes. In our opinion, they are not.

By definition, step changes are factors that are incorporated into forecasts on a case-by-case basis. Put another way, step changes are one-off events that give rise to a discontinuity in the prevailing trend. In our opinion, the link between historical and future step changes is at best tenuous, and at worst non-existent.

Moreover, the AER has adopted its forecast in favour of information that TransGrid has provided as to future step changes. In particular, the AER has stated that:

> '.. we have applied the lower productivity forecast and have made no separate provision for step changes. This is because the step change increment already captured in our productivity forecast over the 2014-18 regulatory period is $7.5 million, which more than compensates for the $2.8 million of expenditure we assessed as justified for step changes.'[19]

The AER has therefore adopted a forecast that ignores step changes in opex, even though it deems that expenditure to be justified. We do not consider it regulatory best practice to ignore reliable information as to future expenditure in favour of a forecast derived from historical data, particularly when that forecast is so questionable.

[19] AER, *'Draft decision: TransGrid transmission determination 2015-16 to 2017-18 – Attachment 7: Operating expenditure'*, November 2014, *pp. 7-18.*

A1. Curricula Vitae

Oliver Nunn

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Overview

Oliver Nunn is one of Houston Kemp's senior economists, and is an expert in the design, development and application of mathematical models to economic problems.

On antitrust matters, Oliver has provided modelling advice to rule-makers and regulators on the potential consequences of mergers and acquisitions in the wholesale electricity sector and the steel industry.

In the regulatory area, Oliver has led projects to review the rules that govern the operation of the electricity and gas sectors. Most recently, he undertook a review of the efficiency of electricity network charges for the Australian Energy Market Commission, and an assessment of policy options to promote the trading of gas transmission pipeline capacity, for the Standing Council on Energy and Resources.

Oliver is an expert in wholesale energy markets, and his advice is regularly sought on the implications of changes to policy and macroeconomic factors for the wholesale energy sector. He has worked with generation businesses, renewable energy developers, and private equity firms, to provide expert quantitative analysis to inform bids for major gas transmission and electricity generation assets.

Oliver has had a major role in several arbitrations concerning long-term contracts for the supply and transport of natural gas, and is highly familiar with the valuation of complex contract conditions that alter the terms on which commodities are bought and sold.

Prior to the founding of HoustonKemp, Oliver worked as a senior consultant at NERA Economic Consulting and, earlier, in the advisory services team at Intelligent Energy Systems, and at the Independent Pricing and Regulatory Tribunal of New South Wales.

Oliver holds a first class honours in pure mathematics, as well as a commerce degree with majors in economics and finance, both from the University of New South Wales.

Qualifications

2009	**UNIVERSITY OF NEW SOUTH WALES** Bachelor of Science (Pure mathematics) with first class honours
2005	**UNIVERSITY OF NEW SOUTH WALES** Bachelor of Commerce (Economics and finance) with distinction

Prizes and Scholarships

2008	Szekeres Prize for Pure Mathematics, University of New South Wales

Career Details

2014 TO PRESENT	**HOUSTONKEMP ECONOMISTS** Senior Economist, Sydney, Australia
2012-2014	**NERA ECONOMIC CONSULTING** Senior Consultant, Sydney, Australia
2011-12	**INTELLIGENT ENERGY SYSTEMS, ADVISORY SERVICES** Senior Energy Market Analyst, Sydney, Australia
2010	**INDEPENDENT PRICING AND REGULATORY TRIBUNAL** Analyst, Water Pricing, Sydney

Project Experience

Energy and regulatory experience

2014 — **Western Power, Western Australia**

Estimation of long run marginal cost

Provided advice on an appropriate methodology for estimating long run marginal cost in Western Power's network, and developed models to implement that methodology.

2014 — **Infrastructure Australia, Australia**

National Infrastructure Plan

Investigated state of the electricity, gas and petroleum sectors in Australia and potential challenges for these sectors industry over the next 15 years.

2014 — **Australian Energy Market Commission, Australia**

Customer impact of efficient network pricing

Advice on the potential effect on consumers of moving to more efficient network tariffs, and in particular estimation of benefits for residential customers with high load factors and business customers that can reduce their consumption in respond to the introduction of critical peak pricing.

2014 — **ActewAGL, ACT**

Advice in relation to AER draft decision for electricity distribution

Currently advising ActewAGL in responding to the AER's draft decision for its electricity distribution network, with a particular focus on the use of benchmarking to determine ActewAGL's opex allowance.

2014 — **ActewAGL, ACT**

Opex and the Efficiency Benefit Sharing Scheme

Advice on the relationship between opex forecasts and the operation of the Efficiency Benefit Sharing Scheme, in the context of the AER's decision to set opex based the results of economic benchmarking.

2014 — **Grid Australia, Australia**

AER draft benchmarking report for transmission businesses

Assessed the AER's inaugural draft benchmarking report for transmission businesses. The report described the limitations of the analysis, and in particular the conclusions that could be drawn as to the relative efficiency of the businesses.

2014 **Gladstone Area Water Board, Queensland**

Methodology for forecasting demand

Co-authored a report assessing the appropriateness of Gladstone Area Water Board's proposed demand forecast methodology. This involved consideration of the implications of the methodology for the level and time profile of water supply prices in the context of the Queensland Competition Authority's 2015 regulatory review.

2014 **Enernoc, Australia**

Necessary conditions for an effective energy-only market

Oliver co-authored a report which explained the necessary preconditions for an energy-only market to be an efficient market design for electricity supply in Western Australia.

2014 **Territory Generation, Northern Territory**

Estimation of long run marginal cost

Oliver assisted Territory Generation to develop a pricing schedule for its wholesale electricity services in the Darwin-Katherine system. This involved a detailed assessment of the operational profile of T-Gen's power system, and the operational costs of its generation assets.

2014 **Energex, Queensland**

Estimation of long run marginal cost

Oliver led a major modelling exercise to project wholesale electricity purchase costs for all Australian jurisdictions. The results of the modelling informed the AEMC's 2013 price trends review. The project involved modelling a number of scenarios to identify potential drivers of changes in wholesale electricity prices over a three-year time horizon.

2014 **Australian Energy Market Commission, Australia**

Review of distribution network pricing principles

Oliver worked on this major review for the AEMC into the economic rationale for the distribution network pricing principles set out in the National Electricity Rules. The principal focus of this study was to ensure that the rule framework led to implementation of tariffs that promote more efficient outcomes. A central part of this exercise was to establish the principles associated with setting tariffs with reference to long-run marginal cost of network services.

2014 **Australian Energy Market Commission, Australia**

Review of efficiency of network tariffs for emerging technologies

Oliver led this major project for the AEMC that examined the efficiency or network tariffs for four existing and emerging technologies: air conditioners, solar PVs, electric vehicles, and battery storage systems. The outcomes of this review informed AEMC's rule change that addresses current distribution network pricing arrangements.

2013 **Ausgrid – Smart Grid Smart City Team, NSW**

Technical analysis to support the Smart Grid Smart Cities Project

Oliver led a project to provide advice to Ausgrid and to review the technical analysis performed as part of the Smart Grid Smart Cities Project. This involved detailed analysis of the half-hourly meter data collected from thousands of smart-meters over the course of the trial, and an in-depth review of Ausgrid's methodology for completing that analysis.

2013 **Standing Council on Energy and Resources, Australia**

Assessment of gas transmission capacity trading policy options

Oliver worked on this project for the Standing Council on Energy and Resources to assess the costs and benefits of a range of options designed to promote secondary trading of gas transmission capacity in the eastern Australian gas market.

2013 **Australian Energy Market Commission, Australia**

Electricity market modelling for the AEMC price trends review

Oliver led a major modelling exercise to project wholesale electricity purchase costs for all Australian jurisdictions. The results of the modelling informed the AEMC's 2013 price trends review. The project involved modelling a number of scenarios to identify potential drivers of changes in wholesale electricity prices over a three-year time horizon.

2013 **Australian Energy Market Commission, Australia**

Modelling to support review of best practice retail price regulation

Oliver led a project that performed detailed modelling of wholesale electricity purchase costs, using a variety of different approaches. This modelling informed the Commission's review of best-practice retail price regulation.

2013 **Confidential Client, Western Australia**

Gas Supply Agreement Arbitration

Oliver assisted in preparing an expert report for a confidential client in the context of an arbitration concerning the price payable under a long term major gas supply agreement in Western Australia. This involved a comprehensive review of numerous long term gas supply agreements, and an assessment of the relative value of non-price terms and conditions within the contract.

2013 **Confidential Client, Victoria**

Gas Supply Agreement Arbitration

Over a period of several months, Oliver assisted in preparing an expert report for a confidential client in the context of an arbitration concerning the price payable under a long term major gas supply agreement in Victoria. This involved a comprehensive assessment of supply and demand in the Victorian wholesale gas market in the decade leading up to the arbitration.

2013 **Ausgrid, NSW**

Analysis to Support the Smart Grid Smart Cities Trial

Oliver was engaged to work with Ausgrid's Smart Grid Smart Cities project team to analyse the data, and draw out any implications, from the customer applications network and retail pricing trials. This involved investigating how consumers have responded to the information tools provided to trial participants, so as to determine the relative advantages of each information tool.

2013 **Tokyo Gas, Japan**

Market study of cogeneration and tri-generation in Australia

Oliver was part of a NERA team that performed a quantitative and qualitative market study of gas-fired cogeneration and tri-generation in Australia. As part of this project, Oliver developed long-term projections of both gas and electricity prices across Australia. The report has been submitted to Tokyo Gas and will be used to inform their decision whether or not to invest in Australian cogeneration/tri-generation projects.

2013 **Australian Energy Market Commission, Australia**

Prices and Profit Margin Analysis in New South Wales

Oliver managed this project that analysed both retail market prices and retailer profit margins in the New South Wales gas and electricity sectors from 2002 to 2012. The study forms part of the AEMC's broader review of competition in the New South Wales electricity and gas retail markets. The major part of the study was to examine the components of retail costs for both gas and electricity, ie, network costs, wholesale costs, and retailers' operating costs.

2012 **Confidential Client, United States**

Outlook for generation across the National Electricity Market

Oliver undertook this project for a US-based private-equity business that was looking to make substantial investments in power-generation assets in Australia. The review involved detailed qualitative and quantitative assessments of the state-of-play for new-entrant power stations (both conventional and renewable) in the National Electricity Market. Key issues examined included the outlook for demand growth and the impact of proposed changes to the Large-scale Renewable Energy Target.

2012 **Confidential Client, Singapore**

Market Study of Vietnam

This study was undertaken for an international renewable-energy investor that was looking to purchase a number of hydro-electric power stations across Vietnam. The review centred upon the construction of a least-cost planning model for the Vietnam electricity market that was used to project electricity spot-prices. Oliver was the lead analyst on this review, and was responsible for developing and running the model, as well as drafting sections of the report to the client.

2012 **Confidential Client, Western Australia**

Analysis of residential electricity consumption

Oliver undertook this review for a major participant in the Western Australian electricity industry. The review assessed the drivers of variation in residential electricity consumption in the South-West Interconnected System in Western Australia. The review consisted of detailed analysis of historical consumption, particularly the degree to which year-to-year variation in weather had affected residential consumption.

2012 **Office of the Tasmanian Electricity Regulator, Tasmania**

Impact of the carbon pricing mechanism on the wholesale electricity price

Oliver was part of the team that examined the impact of the carbon pricing mechanism on the wholesale electricity price in Tasmania. The review made a projection of the rise in the Tasmanian wholesale electricity price that could be attributed to the introduction of the carbon price on 1 July 2012. The projected 'carbon pass-through' was then used as an input to the calculation of regulated retail prices for Tasmania's non-contestable load.

2011 **Chevron, United States**

Review of the Philippines Wholesale Electricity Spot Market

Oliver was part of the team that performed this major review of the outlook for spot prices in the Philippines Wholesale Electricity Spot Market (WESM). The review involved two components: modelling of the outlook for spot-market prices under a range of scenarios, and a qualitative comparison of WESM with electricity markets in other

countries (eg, Singapore, NordPool member countries, Australia, New Zealand).

2011 **Australian Energy Market Commission, Australia**
Assessment of inter-regional congestion in the National Electricity Market

Oliver was the lead analyst on this project that examined the level of inter-regional congestion in the NEM from 1 July 2008 to 30 June 2011. The purpose of the review was to identify whether there was substantial inter-regional congestion within the NEM that was unlikely to be addressed by existing planning arrangements. The review formed the basis of the AEMC's decision not to exercise the Last Resort Planning Power in 2011.

2011 **International renewable-energy developer, United States**
Review of the impact of the Clean Energy Future Scheme

Oliver led the analysis on this project to assess how the introduction of the Clean Energy Future Scheme would change the outlook for wind farms in the NEM. The project revolved around market modelling to project spot-prices, Large-scale Generation Certificate prices, and flows between each of the NEM regions under a range of scenarios.

2011 **Confidential Client, Australia**
Valuation of generation portfolio

Oliver was part of a team that provided a valuation of a portfolio of generation assets for a participant in the National Electricity Market. The valuation involved detailed assessment of long-term fuel costs, revenues from tolling arrangements, and future spot-market revenues. Oliver was responsible for constructing and managing the financial model that was one of the main outputs of the project.

Competition Policy, Intellectual Property and Mergers

2014 **King Wood and Mallesons, Australia**
Proposed merger

Assisted with the preparation of an expert report which addressed the key issues raised in a statement of issues published by the ACCC in response to the proposed acquisition of Wotif by Expedia. This report included an analysis of the dynamic nature of the industry and how its two-sided nature would affect market definition and the analysis of competitive effects.

2014 **Confidential client, Australia**
Market Definition and Effect of Exclusive Contracts

Prepared quantitative analysis advice on the appropriate market definition and whether exclusive contracts would substantially lessen competition for a client in Australia.

2014 **Australian Competition and Consumer Commission, Australia**
Assessment of effect of merger on market power

Oliver prepared analysis for the ACCC to assess the effect of a proposed acquisition on wholesale market outcomes. This involved detailed modelling of wholesale electricity market spot prices, contract positions, and the strategies employed by different market participants.

2013 **BlueScope Steel, Australia**

Proposed mergers

Oliver prepared a quantitative analysis of the degree of competition from imported products using statistical and econometric techniques, and assessed the incentive for the merged firm to foreclose rivals after the proposed merger.

Ann Whitfield

Partner

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Overview

Ann has twenty-one years' experience working as an economist for both private consultancies and government. Ann's particular areas of expertise include utility regulation, cost benefit analysis (particularly in relation to investment assessments) and broader issues of energy market development.

Ann has advised both regulators and utility businesses in Australia, including the COAG Energy Council, the Australian Energy Market Commission, various jurisdictional regulators and a range of utility businesses in the electricity, gas, water, rail and aviation sectors. She has also directed a number of large-scale projects in the wider South-East Asian region, including in both Singapore and Hong Kong.

Highlights of Ann's experience include:

- involved with the initial development of the National Electricity Rules covering the regulation of electricity transmission and distribution networks. Ann has subsequently advised on the application and further development of the Rules.
- particular depth of experience in relation to the arrangements for network investment (including the AER's RIT-T and its predecessor, the regulatory test). Ann has advised a number of businesses on the practical application of these tests.
- Advice on arrangements for allocating scarce capacity across a range of industries.
- a wide-ranging review of the operation of the Singapore Electricity Market, as well as a separate pre-feasibility study of the introduction of nuclear power into Singapore. Ann has also advised a number of the electricity generators in Singapore in relation to proposed changes to the market arrangements.
- In Australia Ann has been involved in assignments for the COAG Energy Council in relation to the roll-out of smart meters, harmonisation of Feed-in Tariff schemes for renewable energy and Retailer of Last Resort arrangements.

In 2013-14 Ann spent nine months on secondment to the Australian Energy Market Commission as the Senior Director in the Strategy and Economic Analysis Team.

Qualifications

1991-1992 **LONDON SCHOOL OF ECONOMICS**
M.Sc., Economics.

1987-1990 **OXFORD UNIVERSITY (JESUS COLLEGE)**
B.A.(Hons.), Philosophy, Politics and Economics (First Class).

Prizes and Scholarships

1991 ESRC Scholarship, London School of Economics

1989 Open Scholarship, Jesus College

1988	Open Exhibition, Jesus College Bahram Dequani-Tafti Scholarship, Jesus College

Career Details

June 2014 – current	**HOUSTONKEMP ECONOMISTS** Partner, Sydney, Australia
Sept 2013 – May 2014 (secondment)	**AUSTRALIAN ENERGY MARKET COMMISSION** Acting Senior Director, Strategy and Economic Analysis, Sydney Australia
Sep 1998- May 2014	**NERA ECONOMIC CONSULTING** Associate Director, Sydney, Australia Senior Consultant, Sydney, Australia
March 1998- Sep 1998	**DELOITTE CONSULTING** Senior Consultant, Perth, Australia
Feb 1996-Feb 1998	**NERA ECONOMIC CONSULTING** Consultant, London, UK
Feb 1995-Feb 1996	**LMC INTERNATIONAL** Consultant, Oxford, UK
Sept 1992-Oct 1994	**RESERVE BANK OF FIJI** Principal Research Officer, Suva, Fiji
August 1990-March 1991	**CENTRE FOR BUSINESS STRATEGY, LONDON BUSINESS SCHOOL** Research Officer, London, UK

Project Experience

Regulatory Analysis

2014-15	**ActewAGL, ACT** **Advice in relation to AER draft decision for electricity distribution** Ann is currently advising ActewAGL is responding to the AER's draft decision for its electricity distribution network, with particular focus on the AER's use of benchmarking to determine ActewAGL's opex allowance.
2014	**Department of Premier and Cabinet, NSW** **Service standards for network businesses** Ann provided an expert report summarising the reliability standards applying to the NSW transmission and distribution businesses, and describing the current framework under which these standards are set. This report was commissioned in the context of the proposed partial lease of the NSW transmission business (TransGrid) and two of the

distribution businesses (Ausgrid and Endeavour Energy), and was released publicly.

2014 **ActewAGL, ACT**
Tariff control mechanism for gas distribution network

Ann provided analysis and advice in relation to the tariff variation mechanisms available under the National Gas Rules (NGR), and the issues that ActewAGL should consider in arriving at a decision on the mechanism to be proposed in its 2016-21 gas network access arrangement.

2014 **Grid Australia, Australia**
AER draft benchmarking report for transmission businesses

Ann provided a report assessing the AER's draft of its inaugural benchmarking report for transmission businesses. The report highlighted the limitations of the conclusions that can be drawn in relation to the relative efficiency of the businesses from the analysis in the report.

2014 **South Australia Power Networks, South Australia**
Review of comparative profitability analysis

Ann provided an assessment of analysis conducted by Bruce Mountain on the relative profitability of SAPN compared to UK electricity distributors, which identified several fundamental shortcomings, which undermine the conclusions drawn.

2013-14 **ACTEW Water, ACT**
Regulatory best practice and competitive neutrality

Ann led the preparation of two reports for ACTEW Water in response to the ICRC's draft decision on regulated water and sewerage prices from 2013. One report provided a critique of the regulatory model proposed by the ICRC. Ann also provided support for a report written by Professor Lewis Evans (Victoria University of Wellington, New Zealand) on the implications for competitive neutrality of the ICRC's draft decision.

Subsequently, Ann provided strategic advice to Actew during the process of its successful appeal of the ICRC's decision.

2013 **TransGrid, NSW**
Contingent projects

Ann assisted TransGrid with the development of its proposal for a number of contingent projects as well as the business cases for its strategic land acquisition program, as part of its regulatory submission to the AER.

2013 **Grid Australia, Australia**
Expert report on use of benchmarking techniques

Ann assisted in the drafting of independent advice addressing the alignment of the AER's proposed use of economic benchmarking techniques with other parts of the regulatory framework applying to network businesses, as set out in the National Electricity Law and National Electricity Rules and the process that should be adopted in relation to the development of the Economic Benchmarking Model, from the perspective of what may be considered 'good

benchmarking practice', including the approach to substantiating the robustness of the model(s) and their degree of 'accuracy'.

2013 **Tokyo Gas, Japan**
Assessment of opportunities for cogeneration in Australia
Ann led an independent assessment and examination of the size of the market and business opportunities in Australia for distributed generation. The report covered the general policy environment, estimates of current and forecast retail electricity prices and retail natural gas prices for commercial and industrial users by state and description of a number of case studies.

2013 **ElectraNet, South Australia**
Strategic land acquisition

Ann assisted ElectraNet with the development of business cases for its planned strategic land acquisition program, as part of its regulatory submission to the AER.

2012-13 **ElectraNet, South Australia**
Nominated cost pass through events

Ann assisted ElectraNet with the development of its submission relating to proposed nominated pass through events for the 2013-2018 regulatory period. Ann also assisted in responding to the AER's comments in relation to the proposed pass through events.

2012 **ActewAGL, ACT**
Interstate regulatory models for public lighting

Ann led the development of a report which summarised the approach to economic regulation for public lighting services in the various NEM jurisdictions.

2012 **Energy Networks Association, Australia**
Analysis of key drivers of electricity network price changes
Ann was project manager for a report analysing the key drivers of changes in transmission and distribution network charges in the current regulatory period. For each of the transmission and distribution businesses in the NEM, the analysis re-calculated the price change that would have occurred had there been no change in the regulatory decision in relation to WACC, capex and opex, using the PTRM model for each business. The report was submitted to the AEMC as part of the AER Rule Change process.

2011 **Grid Australia, Australia**
Cost Pass-through

Ann assisted Grid Australia (the body representing the electricity transmission network owners in Australia) with the development of a Rule Change Proposal in relation to the cost pass-through arrangements in the National Electricity Rules.

2011 **Western Power, Western Australia**
Revenue Deferral

Ann provided an expert report for Western Power (together with Brendan Quach) addressing the question of the appropriate recovery period for revenue deferred in a previous access arrangement period.

2011 **AusGrid, NSW**
Regulatory Framework for Public Lighting

Ann provided a short analysis of the desirable features of a regulatory regime for public lighting, and suggested alternatives to the current arrangements which may better reflect these features.

2010 **ActewAGL, ACT**

Long-Run Marginal Cost (LRMC) Study

Ann led an analysis to estimate ActewAGL's LRMC, stand alone cost and avoidable cost of supplying electricity distribution services, for the purpose of compliance with the pricing principles in the National Electricity Rules. The study was submitted to the AER.

2009 **EnergyAustralia, NSW**

Appeal of AER Determination on Public Lighting

Ann assisted EnergyAustralia in relation to its appeal of the AER's determination in relation to public lighting. As part of this advice, Ann provided a report which set out the economic principles underlying the roll-forward approach to asset valuation, and applied these principles in rolling-forward the value previously assigned by IPART to EnergyAustralia's public lighting assets.

2009 **Western Power, Western Australia**

Revenue Deferral

Ann provided an expert report for Western Power addressing issues arising in relation to the ERA's Draft Decision to require Western Power to defer some of its revenue requirement from the second access arrangement period. The report was submitted to the ERA.

2009 **Western Power, Western Australia**

Application of the New Facilities Investment Test

Ann undertook an assignment for Western Power in relation to the application of the New Facilities Investment Test under the Access Code, and its link with customer contributions (together with Wedgewood White). The assignment includes developing a theoretical framework to assess the merits of the current arrangements and recommend potential changes, and the provision of practical advice in relation to the way in which Western Power applies the provisions.

2008- 2009 **ActewAGL, ACT**

Electricity and Gas Distribution Price Reviews

Ann provided advice to ActewAGL in relation to its electricity distribution price review and gas access arrangement review. For the electricity review Ann provided advice in relation to the appropriate negotiation framework and cost pass-through arrangements, as well as undertaking a 'reviewer' role for ActewAGL's submission more generally.

2008-09 **EnergyAustralia, NSW**

Distribution Price Review

Ann provided advice to EnergyAustralia during its electricity distribution price review and subsequent appeal process. Ann drafted a report (together with Greg Houston) on the economic interpretation of clauses 6.5.6 and 6.5.7 of the National Electricity Rules, in relation to the assessment of a regulated business' expenditure forecasts. Ann subsequently provided a separate report critiquing the AER and Wilson Cook's assessment of the prudence and efficiency of step changes in opex, which was also submitted to the AER.

2004-2005 **Essential Services Commission (ESC), Victoria**
Electricity Distribution Price Review 2006-2010

Ann advised the ESC in Victoria in relation to the electricity distribution price review for 2006-2010. Ann's role focused on advice in relation to the review of capital and operating expenditure, as well as general strategic and editorial advice in relation to the ESC's various publications issued as part of the review process.

2003-2004 **ActewAGL, ACT**
Electricity Distribution and Water Regulatory Reviews

Ann provided regulatory and strategic advice to ActewAGL as part of the 2004-2009 pricing reviews for its electricity distribution and water and wastewater businesses. Ann also provided 'hands-on' support in managing the preparation of the regulatory submissions.

2003-2004 **TransGrid, NSW**
Transmission Regulatory Review

Ann was part of a team advising TransGrid in relation to its 2005-2010 regulatory review. Ann's input focused on asset valuation issues, cost pass-through proposals and the appropriate use of the regulatory test in assessing the prudency of past investment.

2003 **EnergyAustralia, NSW**
Cost Pass-Through Mechanism

Ann prepared a report for EnergyAustralia which examined the rationale for incorporating a cost pass-through mechanism in the regulatory arrangements applying to the NSW distribution businesses.

2002-03 **Essential Services Commission of South Australia (ESCOSA)**
Efficiency Carryover Mechanism

Ann advised ESCOSA in relation to the mechanisms which could be put in place to carryover the efficiency gains made by ETSA Utilities from the current regulatory period into the next regulatory period. The advice included providing input into the Discussion Paper released by ESCOSA and commenting on the submissions received.

2002 **SPI PowerNet, Victoria**
Efficiency Carryover Mechanism

Ann authored a report for SPI PowerNet (submitted to the ACCC) which set out an appropriate efficiency carryover arrangement to apply to SPI PowerNet's electricity transmission business.

2002 **Essential Services Commission (ESC), Victoria**
Review of Gas Access Arrangements 2002-2007

Ann advised the ESC as part of its review of the Gas Access Arrangements to apply to the three Victorian gas distributors for the period 2002-2007. Specific areas of advice included the form of price control which should be incorporated into the distributors' Access Arrangements and the mechanism for the carry-over of efficiency gains from one access arrangement period to the next.

2001 **Essential Services Commission (ESC), Victoria**
Review of Standing Offer Tariffs For Electricity Retailers

Ann advised on options for the review of electricity retailers' 'standing offer' tariffs, in the context of the introduction of full retail competition. She assisted in drafting an Issues Paper for the ESC which set out options for assessing the key components of retail tariffs, including energy costs and the retail margin. Ann provided advice to the ESC in its subsequent assessment of retailers' standing offer tariff proposals.

1998-2000 **Essential Services Commission (ESC), Victoria**
Electricity Distribution Price Review 2001-2005

Ann provided assistance to the Victorian regulator in relation to the 2001-2005 electricity distribution price review. She worked with ESC staff to analyse the incentives under both the existing form of price control and alternative forms, and to formulate detailed proposals for the tariff basket price control to apply to the distribution businesses from 2001, and drafted two consultation papers on these issues. As part of the distribution review, Ann also advised on the appropriate mechanism for the carry-over of efficiency gains between regulatory periods and on incentive payments for the achievement of service targets.

2000 **Australian Competition and Consumer Commission, Australia**
Regulation of Competing Gas Pipelines

Ann drafted a report on the implications of five alternative regulatory approaches for the regulation of the tariffs charged by an incumbent gas pipeline following the entry of a new, potentially competing pipeline. The report considered the implications of each option in relation to the incentives pipeline service providers and pipeline users would face, in a situation in which there is excess pipeline capacity.

1999 **Australian Competition and Consumer Commission, Australia**
Treatment of Taxation in Estimating the Cost of Capital

Provided advice on the approach taken by regulators overseas in relation to the treatment of taxation in estimating the WACC. This included commentary and analysis of nominal versus real approaches to the WACC (and associated frameworks for revenue determination); pre-tax versus post-tax WACC formulations; and the use of short versus long-term estimates of the effective tax rate.

1998 **Great Southern Networks, NSW**
Gas access arrangements

Advised Great Southern Networks (GSN) on their response to IPART's draft and then final decision on GSN's proposed gas access arrangements for Wagga Wagga. This work involved strategic advice, the drafting of GSN's responding submission to IPART, and providing expert evidence on cost of capital issues at IPART's public hearing.

Reviews of Regulatory Arrangements

2014 **Australian Energy Market Commission, Australia**
Competition in metering rule change

Ann provided strategic advice and project leadership in relation to the AEMC's rule change relating to the introduction of competition into the provision of metering services.

2013 **Australian Energy Market Commission, Australia**
Differences between actual and forecast demand in network regulation

Ann provided analysis and drafting assistance to the AEMC as part of a review requested by the Standing Council of Energy and Resources on the implications of differences between actual and forecast demand on energy network regulation. The review considered the impact on efficient expenditure and pricing structures.

2011-12 **Energy Networks Association, Australia**
Advice on AER Rule Change Proposal (Chapter 6 and 6A)

Ann advised the ENA (the body representing electricity and gas distribution and transmission network owners in Australia) in relation to the AER's Rule Change Proposal, covering various aspects of the regulatory arrangements for electricity distribution and transmission. Ann's particular focus was in relation to the proposed changes to the Rules in relation to determining capital and operating expenditure allowances.

2011 **Ministerial Council of Energy (MCE), Australia**
Harmonisation of Feed-in Tariff Schemes

Ann was project manager for a report which updated earlier advice to MCE in relation to the COAG national principles for Feed-in Tariff (FiT) schemes. The report (which was undertaken jointly with law firm Allens) assessed the consistency of the current premium and non-premium FiT schemes with the National Principles, and put forward possible options for determining a 'fair and reasonable' tariff, how a national arrangement could best be implemented and the potential impact of the options on micro renewable technology penetration.

2010 **Grid Australia, Australia**
Scale Efficient Network Extensions

Ann advised Grid Australia throughout the AEMC's Rule Change Process for Scale Efficient Network Extensions.

2009 – 2010 **Australian Energy Market Commission (AEMC), Australia**
Cost Recovery Arrangements for Smart Metering

Ann advised the AEMC during its review of the appropriateness of the Chapter 6 cost recovery arrangements in the context of a Ministerial Determination relating to smart meters.

2009 **Ministerial Council of Energy (MCE), Australia**
Harmonisation of Feed-in Tariff Schemes

Ann advised MCE in relation to giving effect to the COAG national principles for Feed-in Tariff (FiT) schemes and the specific tasks that COAG has allocated to the MCE in relation to these schemes. This assignment (which was undertaken jointly with law firm Allens) included consideration of what constitutes 'fair value' for small customers with renewable generation, as well as areas in which it may be possible to achieve greater harmonisation amongst jurisdictions in relation to their 'premium' FiT schemes.

2008 – 2009 **Grid Australia, Australia**
AEMC Climate Change Review

Ann advised Grid Australia throughout to the AEMC's review of Energy Market Frameworks in Light of Climate Change Policies.

2006 **Ministerial Council on Energy (MCE) Standing Committee of Officials, Australia**
Development of Chapter 6 Rules – Distribution Networks

Ann was involved with preparing a report for the Network Policy Working Group of the MCE in relation to the initial Rules which should apply for the determination of revenue and prices for electricity distribution businesses. The report answered specific questions focused on the scope of regulation and treatment of excluded services, cost pass-through, service standard incentive mechanisms and criteria for reviewing expenditure forecasts.

2005-2006 **Australian Energy Market Commission (AEMC), Australia**
Development of Chapter 6A Rules – Transmission Networks

Ann advised the AEMC on its Chapter 6A review of the Electricity Rules relating to transmission revenue determination and pricing. Ann was regularly involved in providing briefings to the Commission and assisted with the drafting of the public papers released as part of the review process and the development of the Rules Proposal and Draft Rules.

2005 **Ministerial Council of Energy (MCE) Standing Committee of Officials, Australia**
National Framework for Distribution Regulation

Ann had a lead role in the preparation for the MCE of a proposal for a national framework for energy distribution and retail regulation (prepared by NERA and Gilbert+Tobin). This assignment involved reviewing the existing regulatory obligations applying to retail and distribution businesses across all states and territories in Australia and proposing a substantial simplification and harmonisation of those obligations, based on 'best practice' principles.

Capacity Allocation

2012-13 **Aurizon Networks, Queensland**
Capacity allocation

Ann provided internal advice to Aurizon Networks in relation to alternative models for the allocation of scare rail network capacity, in the context of the queuing policy provisions in Aurizon Network's Access Undertaking for the Central Queensland Coal Network.

2012 **APA Group, Australia**
Advice on optimal auction design for RBP

Ann co-authored a report addressing the question of what form of auction design is likely to lead to outcomes consistent with the National Gas Objective in the case of the auction of scarce capacity on the Roma to Brisbane Pipeline. This report was submitted to the AER.

2011 **APA Group, Australia**
Advice on alternative queuing policies

Ann provided an expert report addressing the question of whether queuing requirements based on a first-come-first-served approach or a

publicly notified auction is most likely to lead to economically efficient outcomes in the context of the Roma to Brisbane Pipeline. This report was submitted to the AER.

Network Planning

2012-13 **Australian Energy Market Commission, Australia**
Transmission Frameworks Review

Ann acted as an expert advisor to the AEMC in relation to the implications for network planning arrangements of the AEMC's proposed Optional Firm Access (OFA) model.

2012 **Grid Australia, Australia**
US network planning arrangements

Ann co-authored a report on the arrangements for the competitive procurement of transmission investment in the US, including developments in response to FERC Order 1000. The report also discussed the context in which the ISO/RTO planning model in the US was developed. The report was submitted to the Productivity Commission as part of its review of the electricity network regulation.

2012 **Australian Energy Market Commission (AEMC)**
Development of an alternative transmission planning framework

Ann led a joint assignment with law firm Allens to develop an alternative transmission planning framework for the National Electricity Market (NEM), as part of the AEMC's Transmission Frameworks Review. The focus of the alternative framework was on ensuring national coordination of planning across the NEM.

2012 **Australian Energy Market Commission (AEMC)**
International review of transmission planning arrangements

Ann was project manager for a review of transmission planning arrangements in other electricity markets, to inform further development and consideration of planning options in the Australian NEM. This review was conducted as part of the AEMC's Transmission Frameworks Review.

2008 **Origin Energy, Australia**
Impact of the Renewable Energy Target on Network Investment

Ann drafted a report for Origin Energy that focused on the implications for transmission investment of the expanded Renewable Energy Target scheme. The report canvassed both changes to the regulatory frameworks for transmission investment that may be required and provided an indicative quantification of the potential extent of investment needed.

2007-09 **Grid Australia, Australia**
Review of National Transmission Planning Arrangements

Ann worked for Grid Australia throughout the AEMC's review of the National Transmission Planning Arrangements and the Reliability Panel's review of National Reliability Standards. In this role Ann drafted submissions for Grid Australia. Ann subsequently advised in relation to the AEMC's Rule proposal implementing the new RIT-T.

Application of RIT-T (and earlier Regulatory Test) for Network Augmentation

2013-14	**TransGrid** **Application of the RIT-T to QNI** Ann advised TransGrid during its application of the RIT-T to the expansion of the capacity of the QNI interconnector. In this role Ann provided advice in relation to the required analysis and assisted with the drafting of the PADR and the PACR.
2014	**South Australia Power Networks, South Australia** **Review of RIT-D Manual** Ann undertook a review of the RIT-D Manual prepared by SAPN to guide its staff in applying the RIT-D.
2013	**Grid Australia** **Advice in relation to development of the RIT-D** Ann provided advice and drafted submissions on behalf of Grid Australia during the AER's development of the RIT-D.
2012-13	**ElectraNet** **Application of the RIT-T** Ann has provided ad hoc advice and peer review to ElectraNet in the context of several, small-scale RIT-T applications.
2012	**ElectraNet** **Application of the RIT-T to the Eyre Peninsula** Ann assisted ElectraNet with the application of the RIT-T to the expansion of the network in the Eyre Peninsula. In this role Ann led the RIT-T modelling as well as the drafting of the PADR.
2012	**ElectraNet** **Expansion of the Heywood Interconnector** Ann assisted ElectraNet as part of the RIT-T application (jointly with AEMO) on the expansion of the capacity of the Heywood interconnector. In this role Ann led the drafting of the PADR and PACR, and provided advice in relation to regulatory compliance issues.
2010-11	**Grid Australia** **RIT-T Working Group** Ann participated in the RIT-T Working Group set up by Grid Australia in order to clarify and discuss approaches to the RIT-T analysis. In this role she facilitated discussions between network planners from each of the businesses and led the preparation of the RIT-T Cost Benefit Handbook to guide Grid Australia members. This Handbook is publicly available.
2010-11	**ElectraNet, South Australia** **Assistance with RIT-T Implementation Process** Ann provided assistance to ElectraNet with its internal RIT-T implementation process. In this capacity Ann conducted several training workshops for relevant ElectraNet staff in relation to the cost-benefit analysis required under the RIT-T, the documentation that needs to be produced, and approaches to the initial quantification of potential market benefits.
2010	**South Australia Power Networks, South Australia** **Application of the Regulatory Test to the Fleurieu Peninsula**

Ann provided advice to SAPN (then ETSA Utilities) in relation to the application of the regulatory test to a proposed distribution network augmentation in the Fleurieu Peninsula. The advice covered the appropriate test to be adopted and guidance on the calculation of the cost and benefit categories, including for potential non-network alternatives.

2010 **TransGrid, NSW**
Development of RIT-T Process Guideline and RIT-T Cost Benefit Analysis Guideline

Ann led the development for TransGrid of a detailed process guideline for applying the RIT-T as well as a guideline and spreadsheet templates relating to the RIT-T cost benefit analysis. This included guidance on the calculation of market benefits, as well as on the mechanics of the evaluation itself (eg, use of terminal values, appropriate discount rates). Ann also led a workshop for relevant TransGrid staff.

2010 **Grid Australia, Australia**
Advice in relation to the AER's Development of the RIT-T

Ann advised Grid Australia in relation to the AER's development of the Regulatory Test for Transmission (RIT-T) and associated Application Guidelines, including in relation to the calculation of option value in the context of an electricity network investment.

2007 **Electricity Network Owners Forum (ETNOF), Australia**
Submission to the AER in relation to the Regulatory Test version 3

Ann assisted ETNOF in drafting its submission to the AER in response to Version 3 of the regulatory test.

2006 **TransGrid, NSW**
Application of the Regulatory Test to the 500kV Upgrade

Project Director in applying the regulatory test to TransGrid's proposed 500kV upgrade. The application of the regulatory test considered alternative generation scenarios and non-network alternatives to the proposed network augmentation.

2003 **TransGrid, NSW**
Submission to the ACCC's Review of the Regulatory Test

Advised TransGrid in response to the ACCC's Discussion Paper on the review of the regulatory test. Ann prepared a report which commented both on the ACCC's proposal to amend the regulatory test to improve clarity and to ensure consistency with the provisions in the National Electricity Code, and also on the ACCC's proposed options for incorporating 'competition benefits' in the regulatory test.

2003 **Clayton Utz, TransGrid, NSW**
Murraylink's Application for Regulated Status

Ann advised TransGrid and Clayton Utz in responding to Murraylink's Application to the ACCC for regulated status, and, in particular, Murraylink's use of the regulatory test to derive a regulatory asset value. Ann drafted a report which was submitted to the ACCC as part of the latter's consultation process. Ann also advised TransGrid in responding to the ACCC's Preliminary View on Murraylink's Application, and drafted a further report commenting on aspects of the ACCC's approach.

2002 **Clayton Utz, TransGrid, NSW**
National Electricity Tribunal Hearing of Appeal against NEMMCO's Determination in relation to the SNI Interconnector

Project manager for the preparation of expert economic testimony in relation to the appeal of NEMMCO's Determination that SNI passed the regulatory test. Ann's role included assistance with the preparation of testimony, liaising with the modelling firm carrying out the re-application of the regulatory test, providing background briefings in relation to the regulatory test and NEMMCO's determination and all aspects of managing NERA's role in the litigation process.

2001-03 **TransGrid, NSW**
Application of the Regulatory Test to Network Augmentation in the Western Area

Project director for undertaking an application of the regulatory test on behalf TransGrid, for intra-regional network augmentation planned for the Western Area of NSW. The application highlighted issues in applying the regulatory test in a situation where an agreed reliability standard is not currently met.

2000-01 **TransGrid, NSW**
Methodological Issues Arising from the Application of the Regulatory Test for Network Augmentation

Provided a commentary in relation to a number of methodological issues arising in the application of the regulatory test for network augmentation, including the extent to which demand side management measures should be included within the options considered for network planning.

2000 **TransGrid, NSW**
Application of the Regulatory Test to the SNI Interconnector

Provided a summary of the methodology implied under the regulatory test for network augmentation, in the context of TransGrid's proposal for an interconnector between NSW and South Australia (SNI). This summary included a critique of the draft methodology proposed by the Inter-Regional Planning Committee.

1999-2000 **TransGrid and EnergyAustralia, NSW**
Final Cost Effectiveness Study of Supply Augmentation

Joint Project Manager of the team conducting the final cost effectiveness analysis of alternative options for augmenting supply to Sydney CBD area. The final analysis reflected significant changes in both the required regulatory test and the options considered. Also provided detailed advice to TransGrid on early drafts of the regulatory test released by the ACCC.

1998-99 **TransGrid and EnergyAustralia, NSW**
Initial Cost Effectiveness Study of Supply Augmentation

Development of a methodology consistent with the National Electricity Code for evaluating alternatives for intra-regional network augmentation. Ann was joint Project Manager of a small team conducting an initial cost effectiveness analysis of alternative options for augmenting supply to the Sydney CBD area, including identification and

evaluation of generation and demand management options. The report was published in January 1999 as part of the public consultation process. Ann presented the report to a public forum.

Market Development and Market Design

2012 **Tuas Power, YTL Power Seraya, Senoko Power Ltd, GMR Energy PTE Ltd, Singapore**
EMA proposal to introduce a demand response mechanism

Ann critiqued a proposal by EMA to introduce a demand response program in the Singapore Electricity Market, for a number of Singapore generators. The report considered whether the proposed mechanism would be likely to incentivise the efficient level of demand response, and identified several potentially problematic features.

2012 **Tuas Power and YTL Power Seraya, Singapore**
EMA proposal for a secondary price cap

Ann critiqued a proposal by EMA to introduce a secondary price cap in the Singapore Electricity Market, for two Singapore generators. The report considered how well the proposal would meet the objectives set out by the EMA, as well as comparing it with similar mechanisms adopted in other electricity markets.

2010-11 **Energy Market Authority, Singapore**
Pre-feasibility study for introduction of nuclear power

In 2010, the Singapore government embarked on a pre-feasibility study of nuclear energy. The pre-feasibility study was led by the Ministry of Trade and Industry (MTI). NERA was one of the consultancies appointed to assist with this study. Ann led the NERA team, which worked closely with MTI and a wide range of relevant Singapore ministries and agencies. NERA's role focused on examining the viability of nuclear energy as a potential long-term fuel source, in the context of Singapore's electricity market structure, projected electricity demand, and lack of indigenous generation fuel resources.

2009 – 2010 **Ministry of Trade and Industry (MTI), Singapore**
Appeal of the Vesting Relief Scheme

Ann provided advice to MTI in the context of an appeal by some of the Singapore generating companies of a decision taken by the EMA to introduce a Vesting Relief Scheme to address market power concerns.

2008 **Ministry of Trade and Industry (MTI), Singapore**
Review of Aspects of the Singapore Electricity Market

Ann was project director for a wide-ranging review of the Singapore electricity market. The project involved six workstreams, focused on both quantitative analysis of market outcomes and the development of robust regulatory strategies to address specific issues identified by MTI. Ann co-ordinated the project team involving staff from Sydney, London and New York and lead all discussions and presentations with the client, at senior government level.

2000-2005 **Energy Market Authority, Singapore**
Restructuring of the Singapore Gas Market

Ann was part of an international, multi-disciplinary team undertaking the design of a competitive natural gas market in Singapore. Ann was

involved in the design of the new market framework, and had lead responsibility in developing the Network Code, which sets out the detailed rules governing the interaction of parties in the new gas market. In this role Ann was involved in presentations of the new market arrangements to industry players and in consultation and negotiations on the final Network Code. Ann also liased with the IT consultants in translating the Network Code provisions into the IT systems which will be used to support the new market.

As part of this project, Ann was also involved in designing recommendations governing the future operation of the gas retail market in Singapore.

2003 **Commission for Energy Regulation, Ireland**
Development of new Market Rules for the Irish Gas Market

Ann acted in an expert reviewer role for changes proposed to the Network Code for Ireland, to facilitate the move from a point-to-point to entry-exit capacity regime.

1999 **Electricity Businesses, New Zealand**
Reform of Arrangements for Ancillary Services

Preparation of a report for an industry group in New Zealand comprising electricity lines businesses, generators and retailers, on pragmatic measures to improve the efficiency of the provision of ancillary services in the electricity market in New Zealand. The report was publicly released.

1999 **Water Reform Unit, Department of Treasury and Finance, Victoria**
Tradeable Water Entitlements

Part of a team involved in designing a system of tradeable water entitlements for metropolitan Melbourne. Prepared step-by-step examples of how the proposed dispatch and settlement system would operate, under arrangements which encompassed financial transmission rights. Developed a detailed specification of a simple model to illustrate how all of the aspects of the proposed arrangements would operate in practice.

Institutional and Regulatory Reform

2008 **Ministerial Council on Energy (MCE), Australia**
Development of a National Framework for Retailer of Last Resort

Ann led NERA's involvement in an assignment for the MCE to develop a national framework for the Retailer of Last Resort (RoLR). This project was conducted together with Allens Arthur Robinson. NERA set out the principles that should underpin the RoLR scheme and provided a base set of arrangements consistent with those principles. The project involved extensive consultation with stakeholders, both via bilateral meetings as well as a public forum and a written submission process.

2006 **Essential Services Commission (ESCV), Victoria**
Role of Licences

Ann prepared a report for the ESCV on the role of licences for energy distribution and retail businesses in Victoria. The report considered the

typical role of licences within a legal and regulatory framework and evaluated the effectiveness of the current regime.

2001-02 **Independent Pricing and Regulatory Tribunal (IPART), NSW**
Review of Energy Licensing Regime

Ann was project manager for a review of the electricity and gas licensing regime in NSW. The review fell into three parts: (i) to provide advice on the most effective model for the NSW electricity and gas licensing regimes, given the current institutional arrangements; (ii) to develop a compliance monitoring and reporting framework which IPART can implement; and (iii) to assess the need for minimum performance standards for licensed electricity and gas businesses. Ann had lead responsibility for all aspects of the review, including consultation with and presentations to government ministries and licensees.

1999 **Government of Vanuatu, World Bank**
Utility Sector Regulation

Part of a small World Bank team organising and facilitating a workshop on introducing utility sector regulation in Vanuatu. The workshop participants included government officials and representatives from the private sector utility concessionaries. The outcome of the workshop was an agreed policy statement for each of the utility sectors, which was submitted to the Council of Ministers.

Competition Policy

2005 **Hong Kong Government**
Competition Analysis of Hong Kong Autofuel Market

Ann led NERA's involvement in a multi-disciplinary team advising the Hong Kong government on the competitiveness of the Hong Kong retail autofuel market. Ann's role included both on-the-ground interviews as well as analysis and presentations to the government Steering Committee. This was the first competition policy investigation undertaken in Hong Kong.

2002 **Singapore Power International (SPI)**
Impact of Acquisition of a Victorian Distributor on Competition

Advised SPI on the competition policy implications of its proposed acquisition of a Victorian electricity distribution/retail business, given its existing ownership of the Victorian electricity transmission business, SPI PowerNet. The advice included the preparation of a paper submitted to the ACCC as part of the application for Section 50 clearance, which examined the impact of the acquisition on the transmission, distribution, retail and generation markets, and attendance at meetings with the ACCC.

2000 **Baker & MacKenzie, Victoria**
Impact of Consolidation on Competition

Provided a first principles analysis of the extent to which the acquisition of Powercor (a Victorian electricity distribution/retail business) by an entity with interests in the national electricity market may lead to a 'substantial lessening of competition' in a relevant energy market. This analysis was submitted to the ACCC and the Office of the Regulator-

General by Baker & MacKenzie, who are acting for Powercor as part of the latter's sale process.

Cost Benefit Analysis

2008 **Ministry of Trade and Industry (MTI), Singapore**
Cost Benefit Analysis of Deregulation

Ann was project director for a cost benefit analysis of the deregulation of the electricity market in Singapore. The cost benefit analysis involved consultations with stakeholders in Singapore, preparation of detailed Requests for Information and the use of a dispatch model of the Singapore electricity market.

2007 – 2008 **Ministerial Council on Energy (MCE), Australia**
Cost Benefit Study of a National Smart Meter Rollout

Ann was part of the consulting team conducting a cost benefit analysis of a rollout of smart meters and direct load control. Ann's prime responsibility was the drafting of the overview reports that brought together the costs and benefits identified by the different consulting workstreams, and the development of the recommendations resulting from that analysis. Ann was also involved in estimating the customer benefits associated with smart meters.

1998-2000 **TransGrid/Energy Australia, NSW**
Cost Effectiveness Study for Network Augmentation

Ann conducted both an initial and a final cost effectiveness study of options for addressing future electricity transmission constraints in the Sydney CBD and Inner Suburbs. Analysis involves the identification of alternative options (network, generation and demand side options) and undertaking cost-benefit analysis to arrive at a preferred recommendation.

Acquisitions and Privatisation

2005 **Investment Bank (Confidential)**
Risk Analysis

Project director for a review of the risks associated with the purchase of a generator in Queensland, on behalf of the investment bank acting for a potential acquirer. The report considered pricing risks, institutional risk and input cost risk.

2002 **Singapore Power International (SPI)**
Regulatory Due Diligence

Carried out regulatory due diligence for SPI in relation to its bid to acquire a Victorian electricity distribution/retail business. The advice included the preparation of a report covering detailed aspects of the regulatory framework and ad-hoc advice in relation to how aspects of the framework should be represented in the financial modelling.

1998 **US Utility, Queensland**
Asset sale, Due Diligence

Part of the due diligence team acting on behalf of a large US utility in the purchase of a gas pipeline in Queensland, Australia. Provided advice on

the regulatory implications of the purchase and analysed the business's transportation and gas sale contracts as part of the financial modelling and due diligence procedures.

1996-7 **European Bank for Reconstruction and Development (EBRD)**
Government of Armenia, Armenia, Privatisation

Conducted an assessment of the possibility of attracting private investment in a thermal generating plant in Armenia. Identification of the risks which would be perceived by potential private investors and outlining the steps which could be taken to mitigate those risks. The main deliverables of the project were a "pre-prospectus" document to be shown to potential private investors, a timetable outlining the process to privatisation, and a financial model of the project. A follow up study provided a more detailed "Roadmap", setting out the necessary milestones to be met for privatisation to be achieved.

1992 **Centre for Business Strategy, London Business School, UK**
Transport Market Deregulation, Contestability

Analysis of the impact of the deregulation of the UK express coaching market on competition and pricing, and the importance of incumbent advantage. Identified the implications for successful business strategy.

Intellectual Property

2006 **Crown Solicitor's Office (CSO), NSW**
Payments for Digital Copyright

Ann was part of a team advising CSO on the likely range of reasonable licence payments for government use of digital copyright materials, and the approach that should be taken in valuing digital copyright. The advice was in the context of negotiations between government and the Copyright Licensing Agency, and took account of rates payable in equivalent agreements (including for print media) and in previous decisions of the relevant Copyright Tribunals, both in Australia and overseas.

2003 **Phillips Fox, Attorney General's Department, Australia**
Digital Agenda Act Review

Ann advised Phillips Fox as part of the review conducted on behalf of the Attorney-General's Department of the impact of the Copyright Amendment (Digital Agenda) Act 2000. Specifically, Ann provided initial analysis of publicly available data in relation to music sales and cinema attendance and provided responses to the economic issues raised by interested parties as part of the review process.

Economic Development

1997 **Department for International Development (DfID), UK**
Enterprise Restructuring, Evaluation, Economic Development

Preparation of guidance notes for the international development department of the UK government on assessing the impact of enterprise restructuring projects in developing and transition economies. Joint project with London Business School.

1992-1994 **Reserve Bank of Fiji, Fiji**
Exchange Rates, International Trade

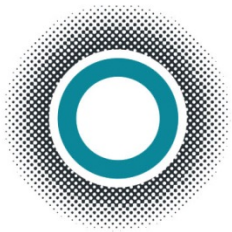
Head of the External Section of the Research department with responsibility for four junior members of staff. Main areas of work: exchange rate policy; foreign reserves projections; analysis of balance of payments developments; and monitoring external debt. Secretariat to the Macroeconomic Committee, the primary policy advisory body to Government.

Speeches, Presentations and Testimony

2012	APTPPL Industry Queuing Workshop on Roma to Brisbane Pipeline Presentation, Brisbane, 17 May 2012.
2008	MCE Public Workshop on Retailer of Last Resort Arrangements Presentation, Sydney, 9 July 2008.
2008	MCE Public workshop on Cost Benefit Analysis of National Smart Meter Roll-out: Demand Response Benefits Presentation, Sydney, 28 March 2008.
2002	IPART Public Workshop Review of Electricity and Gas Licensing Regimes in NSW Presentation, Sydney, 19 March 2002.
1999	World Bank Workshop on Regulation and Competition Draft Policy Statement: Power Sector Presentation, Vanuatu, 2 November 1999.
1999	TransGrid public hearing Supply to the CBD and Inner Suburbs: Initial Cost Effectiveness Study Presentation, Sydney, 5 February 1999.
1998	Expert Witness on behalf of Great Southern Networks in the access determination by IPART Sydney, 12 November 1998.

Publications

2008	The Future of Smart Metering in Australia Co-Author with Adrian Kemp, Metering International, 2008
1995	"Express Coaching: Deregulation, Incumbent Advantage and the Competitive Process" in The Regulatory Challenge Co-Author with Thompson, ed. Bishop, Kay and Mayer, Oxford University Press 1995.



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