TASMAN ASIA PACIFIC

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PACIFIC ECONOMICS GROUP

OPERATIONS AND MAINTENANCE COST BENCHAMARKS FOR QUEENSLAND ELECTRICITY DISTRIBUTION BUSINESSES — OVERVIEW OF FINDINGS

PREPARED FOR THE QUEENSLAND COMPETITION AUTHORITY

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1. SCOPE OF WORK

The Queensland Competition Authority (QCA) will shortly assume responsibility for regulating Queensland's two electricity distribution businesses (DBs), ENERGEX Ltd and Ergon Energy. As part of this process and as an input to the setting of price controls, the QCA engaged Tasman Asia Pacific (Tasman) in association with the Pacific Economics Group (PEG) to benchmark the DBs' operations and maintenance expenditure against expenditure incurred by similar utilities in Australia and comparable overseas utilities. An analysis of the reliability of supply has also been undertaken. This overview is based on the findings of the detailed analyses which are documented in four reports comprising:

- *Benchmarking Comparison of ENERGEX Ltd and 9 other Australian Electricity Distributors*, Consultancy report prepared for the Queensland Competition Authority, Tasman Asia Pacific, 22 November 2000;
- *Benchmarking Comparison of Ergon Energy and 9 other Australian Electricity Distributors,* Consultancy report prepared for the Queensland Competition Authority, Tasman Asia Pacific, 22 November 2000;
- *ENERGEX Operating and Maintenance Cost Performance: Results from International Benchmarking*, report prepared for the Queensland Competition Authority, Pacific Economics Group, November 2000; and
- *Ergon Energy Operating and Maintenance Cost Performance: Results from International Benchmarking*, report prepared for the Queensland Competition Authority, Pacific Economics Group, November 2000.

The following section summarises the findings of the studies. The implications of the findings are outlined in section 3. This is followed by a discussion of the time that should be allowed for the business to adjust to best practice. Section 5 lists the recommendations.

2. FINDINGS

2.1 Unit operating and maintenance costs

To complete the assignment two streams of work were undertaken. The first stream of work benchmarked the DBs' operations and maintenance expenditure in 1999 against the expenditure incurred by nine other Australian DBs.

A comparison of the benchmarking data indicated that one of the Queensland DBs has a significantly different operating environment to the other nine Australian distributors. Ergon Energy has a network consisting of over 138,000 circuit kilometres in a service area of over one million square kilometres. These characteristics resulted in Ergon having a network density of less than half that of the next least dense distributor and less than ten per cent that of its fellow Queensland distributor, ENERGEX.

To make reliable cost comparisons between the DBs and the other nine Australian distributors we needed to develop a methodology that adjusted measured cost for the operating environment the DBs encounter. Thus, in the first stream of work a comprehensive measure of the output generated by each DB — or an output quantity index — was developed. Four outputs were specified for the output quantity index: throughput (measured by gigawatt hours of energy delivered), network length (measured by MVA kilometres), the number of customers served and reliability (measured by SAIDI).

The four outputs were aggregated into a comprehensive output index in the following manner. The reliability output measure was treated as a negative output because a higher number of minutes off supply equates to a less reliable system. It was allocated a value based on the retail price of forgone energy multiplied by a penalty value of 100. The remaining three outputs were weighted together using a system of weights derived from a simple econometric cost function that was estimated using our Australian DB sample data. The weight that applied to any given output was equal to its coefficient in this cost function divided by the sum of the coefficients for all three outputs in the cost function. Using this approach, the weights were around 50 per cent for throughput, 23 per cent for network length and 27 per cent for the number of customers.

Dividing operations and maintenance (O&M) cost by this output quantity index yields a partial factor productivity (PFP) index. This PFP measure for O&M produces much more stable and reliable comparisons among the DBs' O&M cost performance. As shown in Table 1, if the PFP for O&M is used, the Queensland DBs are amongst

Australia's best performers in terms of unit O&M expenditure. In contrast, the DBs appear to be less efficient if more traditional measures of distribution output are used to normalise O&M costs, eg operations and maintenance expenditure per GWh. ENERGEX does relatively well on the customer based measure while Ergon does well on the network length based measure.

Table 1: **Four measures of unit operations and maintenance costs**

	Ergon		*ENERGEX*		*Average*
	Measure	*Rank*	*Measure*	*Rank*	
Operations and maintenance expenditure per network kilometre	$1,092	2	$3,635	6	$3,712
Operations and maintenance expenditure per Gwh	$13,232	8	$9,929	4	$11,406
Operations and maintenance expenditure per customer	$278	10	$149	2	176
Operations and maintenance expenditure per unit output index (Ergon = 1.0)	1.00	5	0.85	2	1.18

The more comprehensive measure of distribution output used in this study provides an objective and scientific way of combining the different dimensions of a DB's output into one measure while going as far as is possible towards adjusting for operating environment differences using Australian data. The comprehensive output index is judged to be the most robust measure of output and it is recommended that this measure be adopted for the calculation of unit operations and maintenance expenditures.

Using this measure it can be seen from Table 1 that ENERGEX had the second lowest measured unit operations and maintenance expenditure and Ergon Energy ranked fifth on this measure. However, the DB with the lowest observed unit O&M cost has a different structure to the other nine DBs and has had to make many assumptions to present data on a similar basis to the other DBs. Consequently, we adopt the conservative policy of taking the second lowest score as a reasonable estimate of Australian best practice. This makes ENERGEX Australian best practice on unit O&M costs. It is the least dense of the urban distributors while the third and fourth placed DBs are the two rural DBs with the lowest densities (in terms of customers per network kilometre) after Ergon. Consequently, achieving a unit O&M cost similar to the second placed DB is a reasonable target for Ergon to meet Australian best practice. This would involve a reduction in Ergon's unit O&M costs of 15 per cent. It should be noted that the reduction in unit O&M costs could be achieved by output remaining unchanged and O&M costs being reduced by 15 per cent, by O&M costs remaining unchanged and output increasing by 17.5 per cent or by improving reliability performance.

However, it is important to recognise that best practice in the use of one input can be achieved through greater use of other inputs such as capital leading, in some cases, to a worsening of overall productivity. Combining a comprehensive output measure with a comprehensive input measure also allows us to calculate total factor productivity (TFP) — a key measure of overall efficiency comparing total outputs per unit of total inputs. Excluding the top performer on this measure which has quite different characteristics to the rest of the sample and taking an average of the second and third ranked DBs as Australian best practice (one of which has a substantial element of remote supply and the other of which is predominantly urban), ENERGEX is around 7.5 per cent behind Australian best practice and Ergon Energy is around 22 per cent behind Australian best practice.

This result may suggest that some of the superior operations and maintenance cost performance achieved by the DBs may have been achieved through the use of above average levels of capital. However, such a conclusion could not be justified on the basis of the analysis so far conducted. In addition we note that the QCA has also undertaken a separate analysis of the capital requirements of the DBs. Thus, from a rate setting perspective, there is insufficient information to adjust the measured differences in the PFP for operations and maintenance to reflect differences in the DB's TFP.

We therefore conclude that ENERGEX would require no adjustment of its operations and maintenance costs to reflect best practice in Australia and that Ergon Energy would need to lower unit operations and maintenance costs by 15 per cent to achieve Australian best practice.

Australian best practice may, however, be below international best practice. To examine this issue PEG undertook a statistical benchmarking exercise. Such an exercise was made possible by the extensive databases on the electricity industry in the United States. These databases are available as a result of the requirement for electric utilities to complete the Federal Energy Regulatory Commission (FERC) form.

PEG has developed a high quality database based on the FERC data. Of 187 companies that filed their FERC forms electronically, 103 were judged to have robust data. Data for the period 1996 to 1998 inclusive were employed to estimate an electricity distribution cost function and equations which explain the share in total cost of each input. The model included three inputs: capital, labour, and other operations and maintenance costs. Only two of the three share equations need to be estimated as the structure of the omitted equation can be derived from the results for the included equations and the cost function. Prior to estimating the cost function, the data for Ergon, ENERGEX and the United States companies were made as comparable as possible with regard to the definition of O&M cost.

The major determinants of cost were found to be the amount of work performed by the company, input prices paid by the companies, the amount of distribution line miles and the percentage of sales to non-industrial customers. The statistical properties of the estimated cost function were judged to be sound. The parameter estimates were in general statistically significant and plausible in size and magnitude.

The estimated cost function was used to evaluate the DBs' O&M costs given the input prices that they face and the environment they operate in. This was done through a three-step procedure. First, data on the prices paid by the DBs for their inputs and data on customer numbers, delivery volumes, distribution line miles and the per cent of deliveries to non–industrial customers were fed into the cost model and a point estimate for the DBs' total costs was derived. Next, relevant data for the DB was inputted into the estimated cost share equations and the optimal share of each input in total costs was derived for the DB. The predicted total cost for power distribution was then multiplied by the optimal cost shares to calculate the predicted cost of each input used by the businesses. These costs for O&M inputs were then compared to the actual O&M costs incurred by the businesses.

When these calculations were undertaken, Ergon's predicted operations and maintenance cost was 8.71 per cent below its actual cost. In the case of ENERGEX, the predicted cost was 1.97 per cent above its actual operations and maintenance cost. Interpreted simply, these results imply that ENERGEX's operations and maintenance costs are two per cent below the operations and maintenance costs observed for the average utility in the United States operating under the same business conditions. Ergon's operations and maintenance costs are 8.71 per cent above the average utility in the United States operating under the same business conditions. These differences were not found to be significantly different from zero. It is noteworthy, however, that the O&M cost performance of Ergon and Energex was well below the performance levels exhibited by the top quartile of performers in the US sample.

After taking account of differences in operating environments, PEG's results imply that the estimated difference in O&M cost performance between Ergon and ENERGEX is around 11 per cent (*i.e.* with ENERGEX at 2 per cent below predicted cost and Ergon at 8.7 per cent above predicted cost, the performance gap between the companies is estimated to be 10.7 per cent). This is similar to the figure of 15 per cent obtained in the Tasman study, and the common picture emerging from the different methodologies and databases provides substantial confidence in the results. The slightly larger gap in the Tasman study is likely to be explained by the inclusion of reliability as a negative output in the Tasman model. As Ergon has relatively worse reliability than ENERGEX, this will tend to reduce its comprehensive output and increase its unit O&M costs relative to the PEG study. The PEG study also adjusts for more operating environment differences than the Tasman study, and this may further reduce the estimated gap.

2.2 Reliability

Tasman assessed the reliability of the Queensland DBs against the other 8 Australian DBs in the Tasman database. This assessment showed that Ergon had the worst overall reliability performance using the SAIFI (average number of interruptions per customer) and SAIDI (average number of minutes of interruptions per customer) measures and the fourth worst reliability using the CAIDI (average duration of interruption) measure. ENERGEX had midfield reliability performance overall ranking fifth out of 10 on each of SAIFI, SAIDI and CAIDI. However, ENERGEX was generally the worst reliability performer of the five predominantly urban DBs.

PEG assessed the DB's reliability relative to the US sample and relative to a selected group of utilities which were assessed to operate in broadly similar circumstances. The SAIFI and SAIDI reliability measures were used.

The analysis is summarised in Table 2.

Table 2: **The relative reliability performance of Ergon Energy and ENERGEX.**

	Full sample	*Ergon* **a**	*US companies most similar to Ergon*	*ENERGEX* **a**	*US companies most similar to ENERGEX*
SAIFI	1.3	3.36	1.99	1.99	1.27
SAIDI	125.1	307.10	152.83	169.4	92.71

a Average of 1998 and 1999.

PEG concluded that, based on the comparison, Ergon and ENERGEX exhibit relatively poor reliability. PEG, however, recognised the limitations of its analysis and in particular a need to incorporate service reliability into the statistical benchmarking methodology. PEG did, however, conclude that there was scope for the DB's to improve reliability.

One way for ENERGEX and Ergon to improve their reliability performance is through a formal service quality incentive mechanism. Under this approach, each company's SAIFI and SAIDI performance would be compared annually to a benchmark performance level. A reasonable benchmark in the initial price control could be each company's historical performance on that indicator. Deadbands could also be established around this benchmark. A deadband refers to a zone around the benchmark where a company is neither penalized nor rewarded depending on its reliability performance.

When performance is outside of the deadband, each company would be automatically penalized or rewarded. Rewards would result when either SAIFI or SAIDI is below the lower band. Penalties would occur if SAIFI or SAIDI is above the upper band.

The amount of penalties or rewards for a given change in performance should be linked to customer value. This issue deserves further research in Queensland. However, there are a number of studies of customer outage costs from power interruptions which can be used as the basis for these penalty/reward rates. PEG has done a considerable amount of work in developing service quality incentive plans that use published outage cost research as the basis for service reliability penalty and rewards in North America. Further research is required to derive the appropriate size of incentive payments given Australian conditions.

3. IMPLICATIONS

Our results imply that both Ergon and ENERGEX would need to make significant productivity improvements to achieve an operations and maintenance performance that puts them into the top quartile of the PEG analysis.

Such an increase in performance can be thought of as consisting of two principal components:

- Movement to Australian “best practice”; and
- Movement from Australian “best practice” to United States “best practice.”

We assume, based on the Tasman analysis of Australian PFP measures for operations and maintenance inputs, that ENERGEX has already achieved Australian best practice but that Ergon would need to lower per unit operations and maintenance costs by up to 15 per cent to achieve Australian best practice operations and maintenance costs. Adopting a conservative approach again, we assume that this reduction is around 11 per cent as estimated in the PEG analysis.

A move to United States best practice, as indicated by the largest (negative) difference between actual and predicted O&M costs observed in the PEG analysis, would involve a further substantial reduction in operations and maintenance costs compared to Australian best practice O&M costs. However, even in the best benchmarking studies, there are considerable uncertainties about what constitutes an achievable efficiency “frontier”. We therefore recommend that efficiency targets be relatively conservative and not attempt to move utility costs all the way towards what is believed to be a “frontier” standard.

Given the observed US O&M performance levels, we believe that an efficiency target at the lower end of the top quartile of US performers is reasonable and achievable. The PEG analysis indicates that the top quartile O&M performance level for the US sample begins at about 19 below predicted costs. That is, within the US sample, the O&M costs for the top quartile of performers are all 19% or more below their predicted O&M costs given the business conditions that they face. A utility that attains an O&M performance level at the lower end of the top quartile would therefore have O&M costs 19% below its predicted costs.

This figure can be used to determine how much ENERGEX and Ergon would have to reduce O&M costs to attain this performance level. As Ergon’s actual O&M costs are currently 8.7 above their predicted value, its total improvement would be 27.7 per cent (8.7 +19.0). Similarly, ENERGEX's total improvement would be 17 per cent (-1.97 +19).

Efficiency targets could incorporate factors that reflect anticipated improvements in unit O&M costs over the period of price regulation. Such gains could flow from at least two other sources. One is the achievement of further economies of scale as the DB expands its output. A second is additional technological advances.

At this stage there is very little data available to assess either the scope for achieving further economies of scale or improvements in best practice over time. We are currently surveying industry experts to provide insights into the scope for technological advance in electricity distribution. Only one survey had been returned at the time of drafting. However, discussions with industry experts suggested that while there is much scope still to implement current best practice (ie move towards the current frontier), changes in best practice (ie movements in the frontier itself) are likely to be quite modest over the next 5 years. At this point in time there is inadequate information available to form reasonable quantitative estimates of the magnitude of these effects. Further research on these factors should be a high priority during the first regulatory period.

In light of the current lack of information on other factors that may influence the trend growth in unit O&M costs in Queensland, we therefore recommend that the operations and maintenance targets for the DBs not include any additional factors. Once the current regulatory structure in Queensland has become more mature and the availability of key data has improved, the QCA should consider including a factor for improvements in best practice and achieving economies of scale. These factors can be incorporated in price controls to take effect in the second regulatory period. The current review should concentrate on moving towards the elimination of existing static efficiency gaps.

4. A TIME FRAME FOR ADJUSTMENT

It is recommended that a period of ten years be set for the DBs to achieve the required improvements in efficiency. It is further recommended that yearly targets equal to one tenth of the total target be set. That is, that ENERGEX be required to reduce unit operations and maintenance costs by 1.7 per cent per year (in real terms) over the regulatory period and Ergon be required to reduce unit operations and maintenance costs by 2.77 per cent per year (in real terms) over the regulatory period.

Our recommended time frame for achieving the O&M cost targets is based largely on judgment. The rationale is that, in the first regulatory period, the DBs can begin on a path that moves them towards achieving the efficiency goals. The first regulatory review can evaluate progress towards achieving these goals, as well as industry changes that have affected unit O&M costs.

5. RECOMMENDATIONS

The following recommendations are made:

- ENGERGEX be required to reduce real per unit operating and maintenance expenditure by 1.7 per cent per year over the regulatory period;
- Ergon Energy be required to reduce real per unit operating and maintenance expenditure by 2.77 per cent per year over the regulatory period;
- Unit operations and maintenance costs be calculated by dividing real operations and maintenance expenditure by a measure of output formed by weighting together throughput, customer numbers and circuit kilometres where the weights are 0.5, 0.27 and 0.23 respectively; and
- Consideration be given to the introduction of a mechanism to encourage the DBs to improve reliability of service delivery (see section 2.2).