Review of Benchmarking Methods Applied

2014

Power & Water Corporation

PWC Power Networks Operational Expenditure Benchmarking Review

A review of the benchmarking analysis that supports a recommendation to adjust the forecast opex of PWC Power Networks

Power and Water Corporation recently submitted its regulatory proposal for the upcoming regulatory period, including its forecast for capital and operating expenditure for its PWC Power Networks business. The Utilities Commission of the Norther Territory engaged Parsons Brinckerhoff to assess the regulatory proposal and provide a report assessing the suitability of the proposal - the report included benchmarking analysis of operating expenditure. The Utilities Commission subsequently requested that Parsons Brinckerhoff conduct a further review of its own benchmarking analysis.

The original review included a recommendation from Parsons Brinckerhoff that the Utilities Commission adjust the operating expenditure of PWC Power Networks downward by 6%. Parsons Brinckerhoff, following a review of its own benchmarking analysis, recommended a downward adjustment of 27% to the operating expenditure forecast by PWC Power Networks to achieve the average level of expenditure compared to a selected group of other DNSPs. The analysis and subsequent conclusions are documented in the report, "Review of Power and Water Corporation - further analysis of benchmarking".

Power and Water Corporation engaged Huegin Consulting Group (Huegin) to review the benchmarking analysis that forms the basis of the recommended downward 27% adjustment; this report provides the outcomes of the review.

Review In Brief

Key points arising from the review

The conclusion of this review is that:

> **The benchmarking analysis presented in support of the recommendation to reduce the operating expenditure of PWC Power Networks by 27% is neither robust nor sufficiently accurate to justify the adjustment. The limitations of partial productivity benchmarks are well documented, and the inherent levels of inaccuracy and uncertainty in the techniques are greater in aggregate than the fidelity of the recommended adjustment.**

The premises that support this conclusion are:

1. Benchmarking on partial productivity indices has well documented limitations - these are amplified when applied to a business such as Power and Water Corporation;
2. The selection of the type of regression line with the aim of achieving a higher correlation coefficient, rather than a defensible relationship between the independent and dependent variables, highlights the subjective nature of the analysis;
3. The selection of comparators in the sample has a significant influence on the fit and position of the "industry average trend line";
4. The exclusion of the PWC Power Networks data from the regression analysis illustrates the inadequacy of using the benchmarking analysis to evaluate the PWC Power Networks opex - *other businesses were excluded where they were not shown to contribute to an increased correlation coefficient on the basis that they were not considered peers, whereas the same indication for PWC Power Networks has been assessed as inefficiency;*
5. The comparison of opex over different periods renders the analysis unsuitable; and
6. The fact that respective recommendations for an opex adjustment of 6% and 27% are based on separate analyses of the same data and benchmarks by the same analysts is indicative of the degrees of freedom possible in inferring relative efficiency from what is otherwise data error, statistical noise and sampling bias and heterogeneity.

Inside

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Benchmarking Has Limitations

Benchmarking of electricity businesses is a global challenge and in Australia - like in many countries - it is a regulatory imperative. Benchmarking has been a specific focus in the electricity industry in recent years due to the price rises associated with the current regulatory periods of the various regulatory jurisdictions in Australia. The Australian Competition Consumer Commission (ACCC) and the Productivity Commission (PC) each released comprehensive reports in 2012 that outlined the limitations of benchmarking in the electricity distribution industry that are documented in literature from around the globe.

The consultant for the Utilities Commission of the Northern Territory, Parsons Brinckerhoff, has incorporated benchmarking into its review of Power and Water Corporation's regulatory proposal associated with its PWC Power Networks business. This has been considered in two phases - firstly as part of its original report to the Utilities Commission, and then further in a follow-up analysis of the specific benchmarking component of the original report. The original report references many of the limitations of benchmarking, however the further analysis - which is the basis of the recommendation for a 27% adjustment of PWC Power Networks' operating expenditure - appears to tacitly ignore the significance of those limitations.

Regression analysis is often misused in benchmarking

Regression analysis is commonly used in electricity network benchmarking in an attempt to compare businesses that have different operating conditions. A dependent variable is plotted against an independent variable, with the relationship visualised by a regression line (a trend line that seeks to minimise the distance between all points and the line). More often than not regression analysis is misused. The most common error is spurious correlation - the inference of significance associated with a regression plot based purely on coincidental positioning of data points or a third, unexplained variable. Small sample sizes increase the potential for this error. The basic principle of statistical analysis is that the changes in one variable *cause* changes in the other - correlation does not imply causation and none should be inferred.

A high R squared value can be driven by omitting outliers and selecting favourable regression variables (both of these are apparent in the benchmarking analysis as undertaken in support of the recommended reduction in operating expenditure) - this should not be mistaken for a reliable industry average cost function. Other issues with the regression analysis presented in support of the recommended 27% reduction to the opex of PWC Power Networks include:

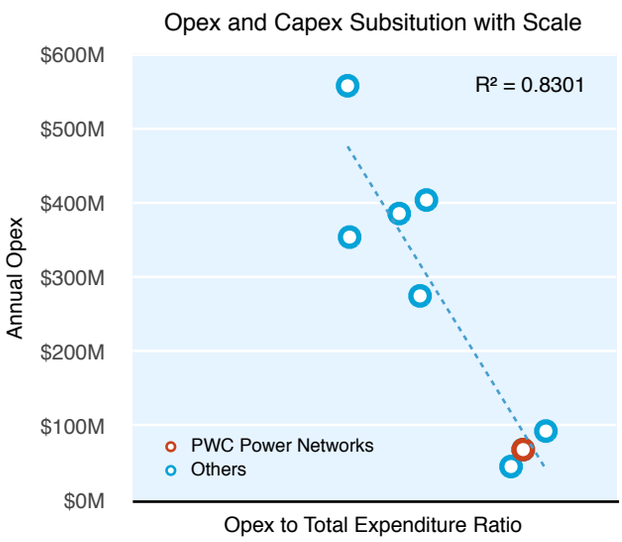
1. Omitting PWC Power Networks from the regression analysis, yet using it to measure distance to the resultant regression line is in itself a transgression of statistical analysis principles. Omitting one company completely (identified as "Company J" in the benchmarking report) and then removing PWC Power Networks from the regression analysis to drive a stronger relationship between the remaining data points is just as effective as a premise for the conclusion that the regression equation is unsuitable for comparing to PWC Power Networks as it is in inferring inefficiency.

2. There is no basis for selecting a polynomial type regression line. Polynomial trend lines will almost always achieve a higher R squared value as there are more degrees of freedom in the manner in which it can bend to fit the data sample. The selection of the regression line type should be based on sound assumptions of the nature of the relationship between the regression variables.

Partial productivity indices in isolation provide false signals

Partial productivity indices, such as opex per km, are unreliable indicators of efficiency, as noted by Cambridge Economics Policy Associates in their report associated with the 2005 regulatory review of electricity distribution businesses in the United Kingdom (see right).

Analysis shows that smaller scale businesses - such as Power and Water Corporation - generally have higher opex and lower capex than their peers - a consequence of the higher fixed costs in opex. The graph below shows the proportion of opex to total expenditure for several Australian electricity distributors and the way in which that proportion increases with the decrease in total expenditure.



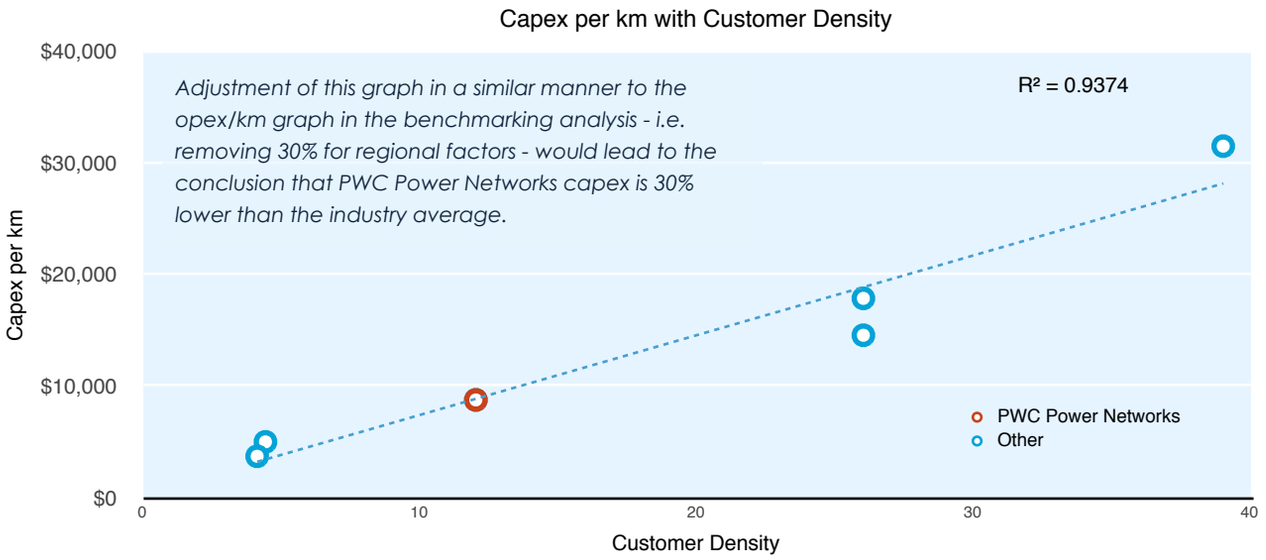
Notes:
1. Data Source: PWC and Huegin benchmarking study of 2012.
2. The sample includes many of the businesses included in the Parsons Brinckerhoff benchmarking analysis.

The graph shows that smaller businesses, such as the three which spend less than $100 million in opex per annum, have much higher opex to capex ratios. The reason for this is the "stranding" of fixed costs in opex, which are otherwise much less significant as a proportion of costs for large businesses with large capital programs and high variable opex costs.

> *Partial productivity measures can be highly misleading as they are often significantly impacted by capital substitution effects. Australian regulators have used them to examine many different aspects of the efficiency of their distribution utilities. However one cannot sum up the efficiency savings that these measures give for each function and suggest that the total efficiency saving is achievable for the company as a whole. This is to neglect the fact that companies may choose to substitute one type of expenditure for another.*

Cambridge Economic Policy Associates
Background to work on assessing efficiency for the 2005 distribution price control review

The opex/capex tradeoff and the effect on small scale electricity distributors manifests as poor performance on opex benchmarks, but favourable performance on capex benchmarks. The graph below shows the capex per km of several Australian businesses against customer density - as shown, PWC Power Networks ranks favourably using this analysis.



Notes:
1. Data Source: PWC and Huegin benchmarking study of 2012.
2. The sample includes many of the businesses included in the Parsons Brinckerhoff benchmarking analysis.

Using the same logic as that applied to arrive at a recommendation to adjust opex by 27% (taking this benchmark, and adjusting the expenditure downward to account for fixed costs and regional uplift - which is more applicable to capex than opex [1]) the argument can be made to increase the capex of PWC Power Networks. That is, if the assumptions that the opex adjustment relies upon holds true, the alternative conclusion that can be made from the analysis that PWC Power Networks opex is 27% above industry average, but its capex is 30% below - reflecting the skew of the opex/capex ratio of small scale businesses. Huegin is not concluding that this is the case, rather the analysis shows that the benchmarking that supports the opex adjustment is subjective and can be challenged through the limitations of partial productivity indices.

This point is further highlighted by the analysis in the original Parsons Brinckerhoff report where the total network expenditure is shown to be broadly in line with the industry average (Figure 4-1).

[1] Rawlinsons Construction Handbook - the source referenced for the 30% regional adjustment in the Parsons Brinckerhoff analysis - is a repository of Australian regional construction costs based on actual recorded project costs and is therefore more applicable to capital expenditure than operating.

Sample Selection Influences Results

After the limitations of partial productivity benchmarking, sample selection is the next most influential contributor to error and uncertainty in statistical analysis.

PWC Power Networks has no suitable peers in Australia

PWC Power Networks is a unique business in Australia. The combination of environmental variables and the structure of the Power and Water Corporation provide a set of circumstances unlike any other in the region. Finding peers suitable for benchmarking is therefore problematic. Only the far northern region of Ergon Energy's network has similar environmental conditions, which requires that much major maintenance cannot be done in the wet season. However Ergon Energy is not a multi-utility and is a 4000+ employee organisation with almost ten times as many customers as PWC Power Networks. ActewAGL is the closest in scale and is also a multi-utility, however its network is confined to the urban landscape of Canberra with almost half of its network underground.

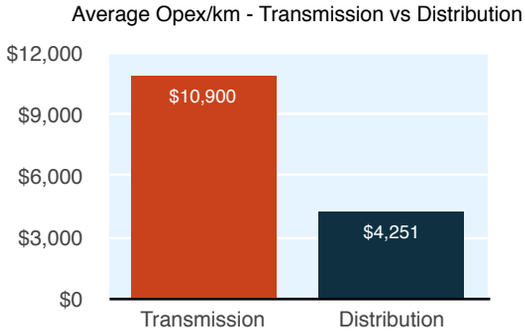
The analysis used in the benchmarking has two particular issues related to sample selection:

1. It only adjusts for scale (somewhat) and regional economic conditions - *thereby assuming that the resultant residual in the regression analysis is solely attributed to inefficiency.*
2. It uses customer density as an explanatory variable in the variation of opex - *which is a gross simplification of the differences between networks.*

Both of these issues are explored further below.

The residual - inefficiency or statistical noise?

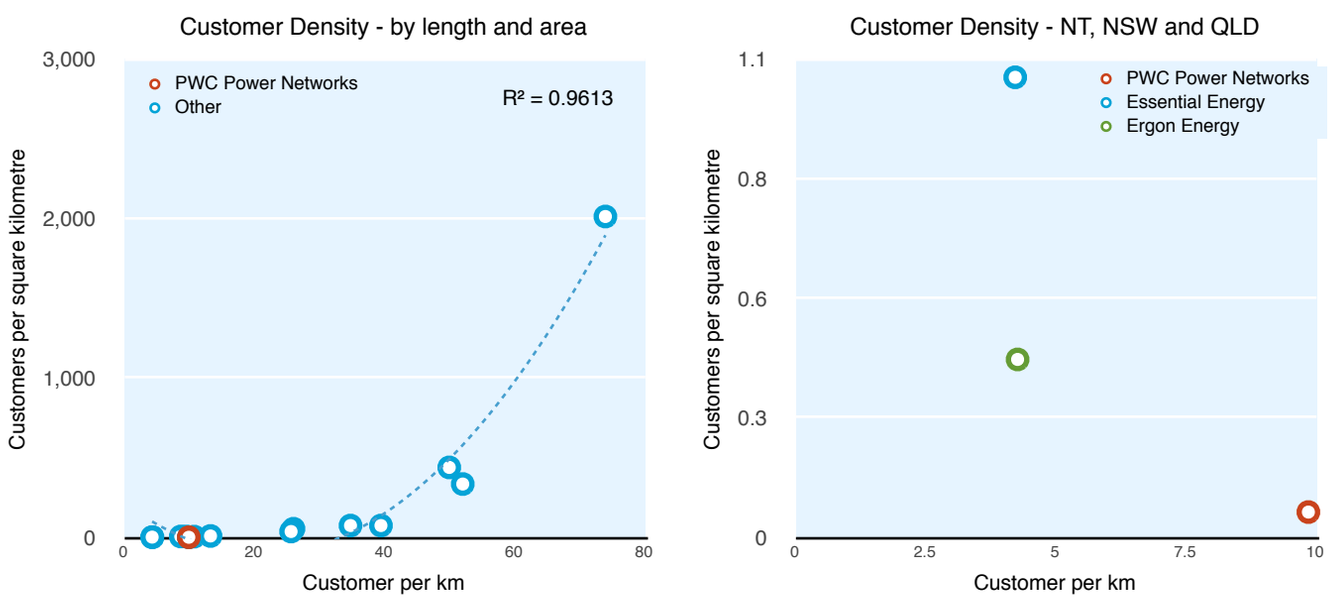
The adjustment of PWC Power Networks' opex by 27% based on the distance to the trend line (notwithstanding the arbitrary nature of that line) infers that the gap between the adjusted point and the trend line is due to inefficiency. In reality, the residual in regression analysis (the distance between a point and the regression line) is the "extent of our ignorance" - that is, it quantifies the magnitude of variation that is unexplained by the regression variables. Other influences that are unaccounted for include network design, accessibility, demographics, climate, environmental conditions, accounting policy, asset utilisation and asset age. Organisational structure and network design are two very important factors that are not considered in the benchmarking analysis. One of the most significant differences in the PWC Power Networks asset base is the existence of transmission assets. Considering that the average opex per km across all transmission networks in Australia is more than double the average opex per km for distribution networks, any distribution business with transmission assets in its network can expect to incur a cost premium in opex.



Benchmark businesses are the NEM transmission and distribution companies. Figures are taken from the financial year of 2010/11 and are sourced from Regulatory Accounts, Regulatory Information Notices and Huegin's own benchmarking source data. Figures are shown in FY2011 dollars.

Customer density is a misleading explanatory variable

Customer density is the most commonly used - mainly because it is conveniently accessible and does provide a reasonable proxy for a number of attributes, such as scale, geography, built environment, etc. When applied to PWC Power Networks, however, it is a misleading comparator. PWC Power Networks has a similar customer density to Tasmania and the eastern and western regional areas of Victoria. Unlike those small, uniformly populated areas, PWC Power Networks assets and customers are spread over a very large area. The customer density is inflated by the fact that its major network areas are not connected by long radial feeders, like in rural Queensland and NSW. The plot below shows the customer density of the distribution networks of Australia measured by both customers per km network and customers per square km of network area. As shown, the relationship is not linear - with the trend line indicating that denser networks (measured by customers per km line) are also more concentrated, providing an advantage of reach and accessibility to customers and assets. The magnified area on the right hand graph also shows that PWC Power Networks service is eight times as sparse as Ergon Energy's despite having three times the customer density.



The selection of the sample influences the suggested industry average trend line

As discussed previously, the regression line that has been referenced as an industry average is a construct that has been artificially fitted through both data filtering and assumptions. The selection of the sample participants has a significant influence on the implied strength of the regression model. The benchmarking analysis notes that "Company J" was omitted from the analysis as it was not deemed a peer of PWC Power Networks due to its high concentration of CBD network assets. This is a prudent analytical technique, as the sample participants must be as homogenous as possible. However closer analysis of the remaining data points raises similar concerns. The position of the data points on the graph clearly shows that Companies B and F are Ausgrid and Energex respectively. These networks and the businesses that operate them have very little in common with Power and Water Corporation and its network - omission of these data points can be argued and justified. This issue of sample selection is particularly significant in this case as the regression relationship used in Figure 1 of the further benchmarking analysis report is critically dependent upon the inclusion of Companies B and F. The clustering of the majority of the businesses in the bottom left as the graph effectively acts as one point in the regression analysis,

and the significant distance between this cluster and Companies B and F are favourable conditions for a strong correlation.

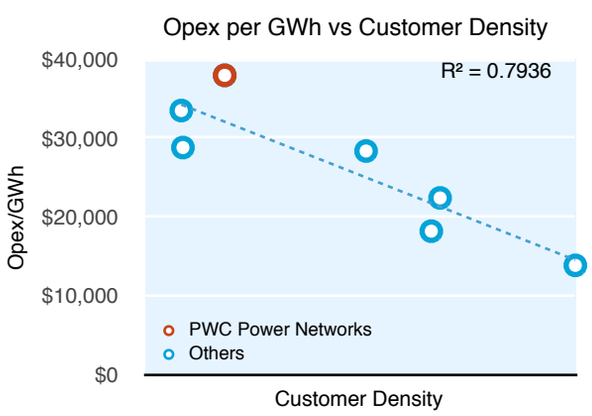
The significance of the requirement to have sufficient data of adequate comparability should not be underestimated. This is one of the inherent limitations of regression analysis in the Australian electricity industry - there are not enough networks of similar attributes to provide analysis of appropriate statistical significance. In any case, even if the differences in all networks could be accounted for, meaningful statistical analysis relies upon dozens if not hundreds of data points.

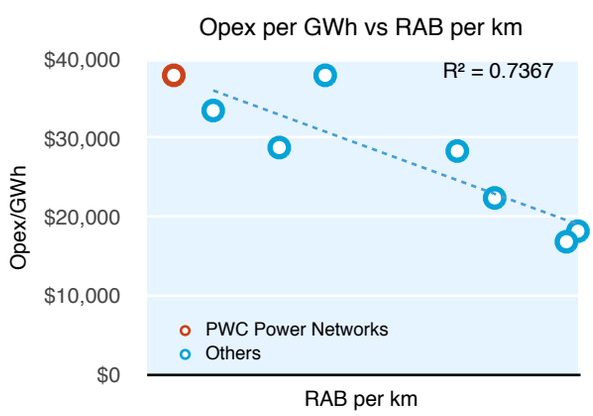
Other Treatments Compound the Errors

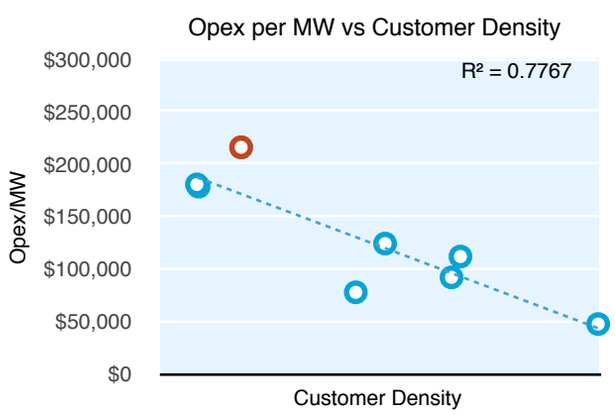
Limitations of benchmarking and regression analysis and the bias introduced through sample selection are not the only issues with using this type of analysis to adjust operating expenditure. Variable selection is highly significant and the source of the data has an impact on the accuracy (and therefore error tolerance) of the analysis.

Variable selection highlights the subjectivity

Just as sample selection influences the regression analysis, variable selection has a significant influence on the inferences made about efficiency. Changes to the variables on the x and y axes highlight the lack of reliability in using one particular plot to estimate inefficiency, as shown below.







Annual energy distributed (GWh), the Regulated Asset Base (RAB) and peak demand (MW) are all variables that have been used in benchmarking opex as alternatives to network length (km).

These plots could be used to infer a variation from the "industry average" of anywhere between 0 and 16% ***before adjustment for scale and regional factors.***

Incompatible reporting periods increase uncertainty

An observation from the benchmarking further analysis is that the level of fidelity of the recommended opex adjustment (27%) seems incongruous with the inaccurate nature of the data translations that occur to arrive at that point (e.g. the $10 million scale adjustment and 30% regional adjustments are broad estimates). Further compounding the error in the analysis is the various sources of the data. From the bibliography of data sources included in the original Parsons Brinckerhoff report, the data for benchmarked businesses is mostly sourced from each distributors most recent regulatory determination. Therefore, the data is up to four years older than the Power and Water Corporation data it is being compared to. This requires escalations to be applied, and in many cases these escalations will be applied to what was only a forecast at the time.

This issue is another of the inherent challenges in benchmarking electricity networks in Australia. The staggered nature of the regulatory determination periods across states causes benchmarking to rely upon combinations of actual and forecast data and assumptions about escalations of cost, network length, customers, RAB, etc over time. This increases the inaccuracy of the benchmarking results.

Conclusion

Huegin understands that regulators are compelled to use benchmarking as a means of testing the efficiency of an individual electricity business against its peers. However the issues associated with electricity network benchmarking - which are significantly compounded in Australia, as compared to other international jurisdictions - render it far from suitable in reliably estimating the magnitude of any potential inefficiency.

The sum of the issues with benchmarking outweigh the efficacy of the result

Benchmarking is a useful exercise to explore the differences between electricity network costs and performance. However the application of benchmarking to quantify a magnitude of inefficiency is considerably limited. Many of the general issues of benchmarking, and several specific issues with the analysis applied to Power and Water Corporation's opex, have been outlined in this report. Each is significant in isolation, and combined they are responsible for significant uncertainty in the quantitative analysis of cost - far more uncertainty than the magnitude of the adjustment recommended.

The subjective nature of benchmarking, the dependence upon assumptions with little foundation and the variability inherent in the results is perhaps best illustrated by the fact that between the two reports by the same author that contain the benchmarking analysis, the recommended adjustment has increased from 6% to 27% using the same data, but a different interpretation.

huegin

Huegin Consulting
Level 10
2 Elizabeth Plaza
North Sydney
NSW 2060
Australia

www.huegin.com.au