

Distribution Benchmarking Study

Endeavour Energy

Endeavour Energy Distribution Business Benchmarking Study

An updated analysis of comparative cost performance for Endeavour Energy

In 2012 Huegin completed a benchmarking study for several Australian and one New Zealand distribution business showing comparative performance in costs and outcomes for selected cost categories and functions. Since then, there has been two significant developments:

- 1. Networks NSW was formed, merging some of the functions of the three NSW distribution businesses; and
- 2. The Australian Energy Regulator (AER) has released its expenditure forecast assessment guidelines, describing how it intends to use economic and category benchmarking to evaluate the expenditure forecasts of electricity businesses.

The objective of this report is therefore two-fold - to provide an update to the data presented in the previous benchmarking report (which included data up to the 2010/11 financial year) and to investigate the potential outcomes of the application of economic benchmarking to the NSW businesses.

What To Expect

Key points arising from this study

The following salient points are included in the analysis and narrative of this report:

- 1. Whilst there remains uncertainty in the way the AER will apply benchmarking in the upcoming regulatory determination, it will be a significant factor.
- 2. As the first businesses to be exposed to techniques that have been abandoned in other jurisdictions due to inherent limitations in application, the NSW distributors face greater uncertainty than those later in the regulatory cycle.
- 3. Endeavour Energy benchmark reasonably favourably against many of its peers, using both economic benchmarking and category benchmarking techniques.
- 4. There has been a small shift away from the benchmarking frontier in the most recent years primarily due to an increase in capex between FY10 and FY13.
- 5. The forecast reduction in opex and capex are likely to improve the position of Endeavour Energy in the benchmarking context for the future period.
- 6. Endeavour Energy's forecast augmentation capex will push its performance in this category towards the lowest cost per km of network achieved in the current period equivalent to that of the long, radial networks of rural businesses Ergon Energy and Essential Energy.
- 7. Replacement capex ratios are forecast to overtake the current period group average (i.e. increasing expenditure per km), however this forecast increase will simply align Endeavour Energy with the replacement expenditure rate of its closest peer networks.
- 8. Non-system capex, maintenance opex and operations opex are forecast to remain close to, or improve on the current ratio performance which will maintain Endeavour's favourable benchmark position in these categories.

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About the Report

This report represents an analysis of Endeavour Energy's historical costs in the context of its peers in the Australian electricity distribution industry. Where possible, forecast data has been included.

The predominate sources of data in this report for the businesses other than the Networks NSW businesses includes:

- Public sources, such as Regulatory Determinations and Performance Reports, for the other electricity businesses; and
- Huegin's own database of historical data.

Any other information sourced from published literature is referenced within the report.

Current Status

This report is currently in final version status, released on 14th May 2014.

Benchmarking Electricity Businesses

Benchmarking of electricity businesses is a global challenge and in Australia - like in many countries - it is a regulatory requirement incorporated into the National Electricity Rules (NER). The Australian Energy Regulator (AER) is responsible for applying those rules to distribution businesses each five years. The distribution businesses also conduct their own benchmarking analysis, with a view to understanding differences in their cost performance to their peers.

Huegin has been involved in benchmarking electricity distribution and transmission businesses for many years in multiple jurisdictions and therefore has an understanding of the inherent challenges and limitations of the techniques and their application. In our experience, there has been a shift in the benchmarking efforts of the industry from a position of undertaking the exercise to support a regulatory proposal to its current purpose of providing visibility of the cost position of peers in order to inform a business' own cost and performance improvement initiatives. The widespread industry reforms affecting all electricity businesses after recent price rises has catalysed that shift. At the same time, the regulator has strengthened its position on benchmarking, augmenting its resources and producing a new framework and approach for expenditure assessment that has benchmarking as a central tenet.

How the benchmarking approaches of the businesses and the regulator co-exist will evolve in the upcoming determination cycle. The benchmarking approaches and methods adopted by industry and the regulator respectively may seem to have converged over time, however their remains a subtle, but significant, difference in the intent. One is to push businesses towards a theoretical frontier of industry efficiency by modeling industry cost functions. Of course the two approaches may ultimately achieve the same purpose, but one clearly has more potential for the unintended consequences of sharp, immediate cost-cutting, rather than targeted productivity improvements in the areas within management control. The diverse nature of operating conditions in the Australian electricity supply industry means that some businesses will experience regulatory shock simply by being the outlier of a cost model that attempts to normalise every difference between a small, heterogeneous group of businesses.

Economic benchmarking has been adopted by the AER

The first cycle of electricity distribution regulatory determinations (starting with NSW/ACT and finishing with Tasmania) under the national framework of the AER has demonstrated the evolving approach of the AER to the challenge of incorporating benchmarking into the determination of an efficient and prudent level of expenditure in the absence of natural competition. During a cycle of increasing electricity prices, bookended by a resource boom and global financial crisis, a myriad of reviews of the electricity industry from bodies such as the Productivity Commission and Australian Competition and Consumer Commission (ACCC) have examined the need for changes to the Rules and the regulatory framework, including the role of benchmarking. Literature reviews, solicitation of expert advice and broad industry and consumer consultation have led to the AER's release of its Expenditure Forecast Assessment Guideline which outlines its intended approach to benchmarking during a regulatory determination. The guideline sets out a multiple technique approach that includes some new and some existing techniques.

New Techniques

In an effort to reduce information asymmetry between the AER and individual businesses the AER will now use more sophisticated economic benchmarking techniques when evaluating expenditure, these include;

- Tornqvist Multilateral Total Factor Productivity (MTFP)
- Data Envelopment Analysis (DEA)
- Econometric analysis
- Category level benchmarking¹

A brief description of each of these techniques is provided below.

Technique	Description				
Tornqvist Multilateral Total Factor	When benchmarking businesses that have more than one output and/or more than one input the challenge is including these different values into a common comparable index.				
Productivity (MTFP)	MTFP uses revenue and cost shares as weights to overcome this problem and create a value for a firm's output and a value for a firm's input; the productivity of the benchmarked firm is then the difference between these output and input figures.				
	In the context of Australian NSPs this means that a businesses efficiency will be affected by its outputs compared to the industry average and the share of expenditure that these outputs account for.				
Data Envelopment Anglysis (DEA)	DEA is a linear programming technique that looks at all the inputs used by a firm and all the outputs it produces and then measures how efficient the firm is compared to others in its industry.				
	The efficiency comparison is based on the output/input ratio, which is difficult to define when multiple variables exist and weightings are unknown. DEA tries to solve this problem by using linear programming, which does not require the production function to be known. DEA incorporates all input and output data and finds a weighting that maximizes the ratio of output/input for each firm.				
Econometric Analysis	Econometric analysis is the statistical modelling of economic systems using assumed relationships between quantities of certain variables. Econometric analysis requires the development of formulae that describe the dependency of output variables on input variables, so that changes in the latter can be used to predict changes in the former.				
Category Benchmarking	Category benchmarking is the simple comparison of costs for specific categories of expenditure, often expressed as a ratio of variables assumed to drive changes in the level of expenditure.				

Existing Techniques

The AER will continue to utilise techniques used in previous revenue determinations, these include;

- Economic justification for expenditure
- Reviewing expenditure governance and policies

¹ High level category benchmarking has been used in previous determinations (ratios such as opex/km and capex/load density) however the guidelines suggest that category benchmarking will now be conducted in much greater detail than previously

- Trend analysis
- o Category analysis
- Targeted review of projects and programs
- Sample review of projects and programs

This report will focus on the techniques to be used by the AER when benchmarking DNSPs.

Multiple approaches produce multiple results to choose from

The AER has signalled its intent to use benchmarking as a means of predicting appropriate future expenditure levels for individual businesses - shifting the focus from comparison to forecasting. The context of how each of the benchmarking techniques will be applied in the evaluation of total, capital and operating expenditure is outlined below.

Category	Technique	Outcomes Sought		
Total Expenditure	MTFP	Overall efficiency and rate of change in efficiency		
		Growth of inputs and outputs		
		Forecast future totex		
	DEA	Cross check of MTFP results		
Capital Expenditure	Category Benchmarking	Adjust, as required:		
		 Augmentation capex 		
		 Replacement capex 		
		 Non-network capex 		
		 Customer initiated capex 		
Operating Expenditure	MTFP	High level indication of opex efficiency		
	Econometric Analysis	Base year efficiency evaluation		
		Annual rate of change		
	Category Benchmarking	Adjust, as required:		
		• Maintenance and emergency response opex		
		 Vegetation management opex 		
		 Overheads 		

MTFP, DEA and econometric analysis all have specific limitations and flaws when applied in the Australian electricity distribution environment. Some of the most pertinent of these are discussed in Appendix I.

The AER has consulted widely on its approach; throughout that consultation period a number of assumptions regarding the approach have endured through to the final release of the guideline. These include:

- 1. That multiple approaches are complementary and can validate each others results;
- 2. That a model specification can be found that is appropriate for the entire industry and its individual participants;
- 3. That exogenous variables can be accounted for through regression analysis; and
- 4. That the results of the models will be robust enough to provide a substitute forecast representative of the appropriate level of expenditure given a distributors individual circumstances.

The extent to which these hold true depends on both the model specification and the ability to normalise for differences between the businesses; these two outcomes are often in tension. Finding a model specification that fits all distribution businesses requires a very simple, high level model, particularly in such a small sample where economic benchmarking principles dictate that small sample sizes necessitate very few input and output variables. So, striving for a robust economic model pushes more costs into the residual (the sum of all variables, including inefficiency, that are not explained by the model cost function) whereas pushing more costs out of the residual into the model variables dilutes the efficacy of the model. For these reasons the adopted approach attempts to eradicate anomalies through the application of multiple techniques. However in our benchmarking experience, two significant challenges remain:

- 1. The more refined and specific a benchmark measure is, the more unreliable the data becomes; and
- 2. The more generic and accessible a benchmark model is, the less applicable it becomes to individual businesses in the diverse Australian environment.

The theory that high level economic benchmarking and lower level category benchmarking can complement each other in determining the existence and extent of efficiency improvement opportunities is sound in principle, however there are inherent issues that are amplified by the respective approaches and are not resolved through multiple techniques.

Any economic model specification introduces bias

Errors and bias are natural outcomes when striving to fit an academic construct such as an economic model to the real world. An economic model is a simple abstract of a very complex reality and is thus limited in its ability to describe complex, non-linear relationships between variables that are often hard to measure. This is inherent in the economic modelling of any industry or system, not just electricity distribution. Application for electricity distribution benchmarking does, however, compound the issue. Economic benchmarking techniques work best in large pools of homogenous firms producing products and services for a market through transactions of commerce. The application of the techniques has highlighted issues in both the sample size and variation in network attributes in the United Kingdom and Norway - both jurisdictions of much less variability of geography, network size and climate than Australia. Normalisation is difficult because it relies on measuring environmental variables at a level that does not necessarily reflect the impact on costs. For example, the number of heating days in Queensland can be used as a measure of the relative influence of climate on Ergon Energy's operations, but with a network area of almost 2 million square kilometres, the relevance of the measure is difficult to define.

Model errors and bias are always present in economic analysis, which is not an issue in itself, but the diversity of conditions in Australia and in the inherent network designs means that a particular model specification will provide advantage for some businesses and disadvantages for others. Consider the preferred and alternative specifications of the AER's economic benchmarking models:

	Preferred model	Alternative model
Inputs	Opex, overhead line length (MVA-kms), underground line length (MVA-kms), transformer capacity (MVA)	Opex, overhead line length (MVA-kms), underground line length (MVA-kms), transformer capacity (MVA)
Outputs	Customer connections, distribution capacity (kVA-kms), reliability	Customer connections, peak demand, reliability

Academically and in practice, there is little consensus as to what constitutes a DNSP output. This point was highlighted by the AER itself in its Better Regulation Issues Paper released in December 2012. The outputs identified by the AER are shown above in the preferred model, however other common outputs include peak demand, energy delivered, service area and network length. Below are benchmarking rankings using 2008/9² data and replacing distribution capacity with peak demand as a variable in an MTFP model - that is, the rankings using the AER preferred model are on the left, and the alternative model rankings are on the right (a position towards the top of the graphic indicates a higher relative productivity ranking).



Output Choice and MTFP Rankings

This representation of alternative model specification results not only shows the significant sensitivity of the results to the specification, but also highlights the inherent bias discussed previously. Closer examination shows that the only networks that are favoured in the alternative model are the small, high density, urban networks in Melbourne (Citipower, Jemena and United Energy) and Canberra (ActewAGL). These networks are condensed and meshed

² 2008/9 data has been used as it is the last date from which publicly available data for most Australian DNSPs could be found. Given the relative consistency in the size of inputs and outputs such as capacity, line length, peak demand and customer connections we believe results from using 2008/9 data are likely to be analogous with results using more recent data. Furthermore, the graph highlights the sensitivity of benchmarking results to model specification - this sensitivity is inherent within the approach adopted by the AER regardless of which years data is used.

(the Melbourne networks benefit from the city's flat, grid layout and ActewAGL's subtransmission substations are in a ring pattern) in a small area so their distribution capacity measured in kVA-kms (an output of the preferred model) is small relative to transformer capacity measured in MVA (an input of both models). On the other hand, these businesses also have higher utilisation due to the absence of long radial feeders and therefore peak demand (an output of the alternative model) is higher relative to transformer capacity.

Also of interest is the sharp, opposing direction of businesses with the same management structure and service providers, such as CitiPower and Powercor - indicating the significant influence of network characteristics when compared to any potential systemic managerial inefficiency.

As shown for Endeavour Energy, the preferred model is slightly more beneficial than the alternative model. However, note that the model construction and data format used by the regulator will differ to that applied by Huegin and whilst the general results may not vary considerably between one analyst and another, it does highlight a further uncertainty in the veracity of results.

The economic benchmarking outcomes may reinforce recent and existing DNSP efforts

Depending on which side of the line of inherent bias each business falls after model specification, the outcomes of the regulatory benchmarking may or may not be favourable. As mentioned earlier, the outcomes of both the regulatory benchmarking efforts in shifting the industry toward a hypothetical efficiency frontier may align with the reform programs most businesses are undertaking themselves. The AER's benchmarking methodology applies economic benchmarking to examine relative efficiency and then more detailed techniques to determine the location in the business where inefficiency resides and the magnitude of adjustment required. If the model specification and particular category benchmarks produce the same signals as the businesses themselves have observed and acted upon, the forecast expenditure arrived at through the AER's analysis may not differ materially from that of the businesses, despite the ranking on the first pass MTFP analysis.

The risk for businesses resides in circumstances where the drivers of their costs are not captured by the modelling techniques. In this case, the businesses will need to provide evidence to justify any deviation from the costs modelled by the economic benchmarking techniques. Thus it is a useful exercise to conduct similar modelling even if it only appears to serve the purpose of validating cost saving programs already under way. The risk of not knowing this information is that an immediate efficiency adjustment based on an unexplained model residual is forced upon a expenditure path that has already had management intervention.

Signals for Endeavour Energy

To the extent possible by the available data and without confirmation of the exact specification of the AER's economic benchmarking models, Huegin has developed its own economic benchmarking models to present analysis of likely outcomes for electricity distributors. Focusing on Endeavour Energy, the following sections provide an insight into likely outcomes from an industry-wide economic benchmarking approach. Whilst limited in the ability to inform the existence or magnitude of actual inefficiency, the exercise does at least highlight possible signals that an analyst conducting economic benchmarking observes.

Economic benchmarking is unlikely to show NSW businesses on the efficient frontier

As shown in the earlier plot of MTFP rankings using the preferred and alternative model specifications of the AER, Endeavour Energy is unlikely to be the most efficient through an MTFP ranking. Using the model specification and data from our model, Endeavour Energy can expect to land somewhere between third most efficient to midrange of the sample.

The selection of variables is not the only degree of freedom absorbed in the construct of the economic models used by the AER. The relative weighting of the variables will also influence relative rankings. The graph below shows the MTFP rankings based on a model built to the preferred AER specification, but with a variation in the weightings of the two output variables, distribution capacity and customer connections. The far left axis of the plot shows the rankings using a 100%:0% split of the weightings on Distribution Capacity and Customer Connections respectively, continuing through varying the split all the way to a 0%:100% split of weightings.



Sensitivity to Output Weightings - Change in Ranking

Output Weightings (100 represents 100% weighting on Distribution Capacity, 0% on Customer Connections)

Naturally, urban distributors are favoured by a higher weighting on customer connections. Assuming that the weightings are unlikely to be positioned close to either end of the range, Endeavour can expect to be placed between third and fifth in terms of its efficiency ranking.

Again, the analysis will change with the release of the AER's exact model specification and industry data, however these ranges are not unexpected for Endeavour Energy based on previous studies and our experience with the application of economic benchmarking in Australia.

Analysis can identify potential outcomes for individual businesses within the industry

Understanding where a business stands in the rankings of productivity of industry participants is interesting, but perhaps not useful. An understanding of the difference between modelled future costs and an individual business' own forecast expenditure is useful. The AER will predict augmentation and replacement capital expenditure requirements through their augex and repex models respectively. Augmentation and replacement capital expenditure constitute the majority of an electricity distributor's capital program and businesses are encouraged to compare their bottom-up forecasts with the results of the augex and repex models. This analysis is beyond the scope of this report, however category benchmarks for many capital expenditure categories are included later in this report.

Operating expenditure, however, can be modelled using the AER's intended technique - that of econometric analysis. The AER intend to use econometric models to assess base year efficiency and to predict an efficient level of operating expenditure. More information on econometric models is included in Appendix I, but for the purposes of illustrating the application of this statistical technique to a distributor's historical and forecast opex, Huegin have constructed a model based on the information in the regulatory guidelines. Below is a plot of the predicted opex for Endeavour Energy, compared to actual and forecast opex. Endeavour's opex in the current period was steadily increasing until the most recent year. The forecast shows that opex is expected to remain at around the current (FY13) level out to the end of the next period, which is well below the extrapolated trend of historical expenditure and the econometric prediction.





Notes: 1. All dollar figures converted to FY13/14 dollars.

2. No adjustments made to actual figures for non-recurrent costs

3. Modelled opex is based on extrapolated values from the Huegin econometric model - the AER analysis will differ.

There are more simple means of testing performance

Much of the economic analysis is dependent upon incremental changes in the inputs and outputs defined in the models compared to the industry changes in inputs and outputs. Given the inherent inaccuracy of models, often simple comparisons of rates of change can provide just as much information as detailed calculations of productivity change. This is particularly true of electricity businesses where most of the recurrent costs in the business are fixed in nature and changes in outputs have very little effect on total costs. For example, increased replacement activities due to the network asset age and condition have a much more significant impact on *change* in costs than incremental additions of customer connections. However network age and condition are the result of legacy decisions stretching back decades and are not accounted for in economic benchmarking (other than in an increase in cost).

Comparisons of simple cost trends can therefore provide insight into likely performance in industry economic benchmarking models. How those cost changes have occurred will determine the level of justification required of a business in explaining any variation from the regulatory modelled forecasts that is not accounted for in the model specification. Below and on the following pages are comparisons of trends and annual rates of change for expenditure, showing Endeavour compared to the benchmarking group average in the period 2008 to 2013 and current and forecast (where available) trends for each individual business.

Aggregate Trend Analysis - Endeavour and the Benchmark Group



Endeavour's expenditure has fallen in the most recent complete financial year after two years of increases in both opex and capex.

Total Expenditure - Endeavour vs Group Total



Amongst the benchmark group, Endeavour's "share" of total group expenditure has risen from **12%** in FY08 to **13%** in FY13, with a low point of **10%** in FY10.

DNSP Opex Trends - Actual and Forecast





DNSP D Opex

FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19



FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19



FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19

Notes:

- 1. All figures in FY2013 dollars.
- 2. Data sources are the RINs and directly supplied data from DNSPs.







FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19

DNSP C Opex



FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19

DNSP Capex Trends - Actual and Forecast











FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19

Notes:

- 1. All figures in FY2013 dollars.
- 2. Data sources are the RINs and directly supplied data from DNSPs.



DNSP M Capex





FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19

Measuring Reform Progress

It is useful to understand the current benchmark position of the NSW businesses relative to peers given the considerable change in the past two years. The previous Huegin benchmarking report compared costs across many categories for nine distribution businesses. The report highlighted some differences in cost outcomes and also identified many drivers of those costs. However, the report was based on data up until the 2011 financial year. Given that many of the businesses have also reformed or restructured since then, a more current comparison of cost benchmarks is valuable - particularly given that due to the relativity inherent in economic benchmarking models, the extent to which individual distributor cost savings influence industry rankings depend on the savings made by the rest of the industry.

This section provides an update of some of the significant benchmarks from the previous study based on 2011/12 financial year data and 2012/13 financial year data where available. Whilst the relative positioning of the businesses in many of the categories may be expected, an updated understanding of the magnitude of any differences and, perhaps more significantly the direction of trends, sheds light on the success of cost management relative to peers. At a high level, the movement in the most common benchmark ratios over the past three years is shown below and on the next page. Whilst there is only minor "re-positioning" of businesses amongst the rankings, these incremental changes over time will be important in economic benchmarking techniques as the assessment of individual efficiency is dependent on small changes in large numbers measured against the industry changes.



Capital Expenditure Ratios

Operating Expenditure Ratios



Cost Ratio Positional Changes

Endeavour's changes in the period for each ratio are summarised below (where a position of 1 indicates the lowest cost and 7 the highest). Positive and negative changes in ranking are highlighted green and red respectively.

	Endeavour Energy Position			
	FY11	FY12	FY13	
Capex per km	4th	5th	5th	
Capex per customer	2nd	2nd	3rd	
Opex per km	4th	5th	5th	
Opex per customer	2nd	2nd	3rd	

System capex is a large target

System capex - variously reported by businesses as the aggregate of asset replacement, augmentation (both customer and distributor initiated) and other reliability, quality, environmental and legal capital investments - is by far the largest pool of expenditure for an electricity distribution business. The ratio of this system expenditure to capital expenditure on non-system assets such as buildings, plant and fleet and IT varies by the type of business (location, ownership structure, opportunities for shared corporate costs, etc), with a range of 85 to 95% of all capital expenditure attributed to network assets for businesses across the NEM. A breakdown of system and non-system capex per customer by major NEM state is shown below for FY2011, showing the differences between the capital allocation across the states in that year. Capex when measured on a per customer basis will always in be lower in Victoria due to the much higher population density. Observations from this data include the higher percentage of capex attributed to replacement in NSW and the higher levels of non-IT, non-network capex in the government owned businesses of NSW and QLD.

Spend Category	Victoria 2011	NSW 2011	QLD 2011
System Capex per Customer			
Growth - Demand & Connections	\$225.05	\$290.13	\$494.79
Replacement, Reliability & Quality	\$50.26	\$272.05	\$207.45
Environment, Safety, Legal	\$57.94	\$38.89	\$37.89
SCADA and Network IT	\$3.20	\$33.69	\$50.31
Subtotal - System Capex per Customer	\$336.45	\$634.76	\$790.44
Non-System Capex per Customer			
Non-Network IT	\$39.87	\$32.63	\$26.77
Non-Network Other	\$12.75	\$65.16	\$70.13
Subtotal - Non-System Capex per Customer	\$52.62	\$97.79	\$96.90
Total Capex per Customer	\$389.07	\$732.55	\$887.34

Notes:

1. Victorian expenditure for 2011 is based on the AER allowance.

2. NSW and QLD expenditure data is from Regulatory Information Notices and data supplied directly to Huegin.

Across all businesses the majority of system capital expenditure is spent on replacing and augmenting network assets - with a historical average of 89% of all system capital expenditure attributed to these two activities. The significance of this figure is highlighted through the AER's intention to forecast these expenditure categories for each business using two MS Excel models - known as the repex and augex models for replacement and augmentation capital expenditure respectively. As discussed previously, reproduction of these models is beyond the scope of this report. General limitations of the models have been well documented through the AER's consultation process, with acknowledgement that the models provide an alternative forecast for the AER to determine the potential existence of anomalies in the forecast of a DNSP, which may be further scrutinised by other means such as category benchmarking. Category benchmarking of capital expenditure is not without its own limitations, most significantly the disconnected nature of the work activity with the accounting of the expenditure. Replacement and augmentation projects can run over several years with inconsistent spend profiles, rendering many cost ratio benchmarks inadequate. For example, one of the category benchmarks for augmentation capex suggested by the AER in the expenditure guidelines is capex per MVA of capacity added. An example of issues encountered in this approach is provided on the following page - showing the volatility of the benchmark over time.

One of the reasons that this volatility exists is the discrepancy in time of the addition of the physical capacity and the capitalisation of the expenditure. Another is that at the macro level, the MVA differential from year to year is measured as a net difference - that is, it includes additions and subtractions through all activities. We understand that the AER intends to address these issues through a more specific data request in the category analysis data templates, however we hold reservations over the ability of each business to provide expenditure figures broken down as required by the category benchmarking RIN to the required level of accuracy.

Augmentation capex is difficult to benchmark; one readily available ratio is augmentation spend per MVA capacity added...



...but as illustrated by data from New Zealand, the ratio is limited in its ability to inform relative efficiency assessments



Not only are some individual years negative, but the volatility from year to year is significant, with the businesses ranked from highest cost to lowest on the basis of the FY10 results in each plot.

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Recent conditions will place a focus on augmentation capex

Notwithstanding the limitations of benchmarking augmentation capital expenditure outlined on the previous page, augmentation capex is likely to be of significant interest to the regulator due to flattening (and in some cases, falling) demand during this current regulatory period and the media and political suggestions that electricity price increases have largely been caused by an increased will of the businesses to augment the network³. The following pages show comparisons of augmentation capex within the benchmark group and over time - both in this period and the forecast for the next.

Network kilometres is a more stable comparator of augmentation capex, albeit limited in its describing power. Whilst augmentation capex per km can be compared in a given year (see below), the variation across businesses is due mainly to the size, nature and scale of the businesses - with higher unit costs for CBD/urban, underground assets than long, radial rural networks.



Augmentation Capex per km - FY13

To provide some level of context for these current cost ratios, the augmentation capex per km ratio is shown below over time for Endeavour and the three DNSPs in this study with conditions and attributes most similar to Endeavour.



Augmentation Capex per km - Current Period

³ Whilst this is a broadly held view, and somewhat supported by the step change in nationwide augmentation capex at the start of the current period, analysis of these augmentation costs over time and replacement costs over time show that in this period, increased rates of replacement of existing assets has outpaced augmentation growth rates.

As shown in the previous graphic, Endeavour's augmentation capex per km has remained relatively constant. To show the change in this ratio during this period in the context of the benchmarking group, the graphs below depict the Endeavour Energy augmentation capex per km over time against the group average and the relative change in this ratio for the latest three years.



Finally, the augmentation capex forecast can be compared to the group statistics in this period. The graph below shows the recent and forecast augmentation capex per km, long term trend, and the current period group average and minimum.



Augmentation Capex per km - Endeavour

Notes:

1. All figures in FY2013 dollars.

2. Network km for future years have been forecast using the historical growth rate (0.5%).

3. The group average and minimums shown on the graph above are the current period average extrapolated into the next period - that is, they are not the average of the forecast expenditure.

Replacement capex is a reasonably significant contributor to Endeavour's program

The following pages show comparisons of replacement capex within the benchmark group and over time - both in this period and the forecast for the next.

The comparison of the cost of replacing assets per kilometre of network amongst the group is shown below for the most recent year.



Replacement Capex per km - FY13

As shown below, the intensity of Endeavour Energy's asset replacement program has increased in the current period; as it has for some of Endeavour Energy's closest peers.



As shown in the previous graphic, Endeavour's replacement capex per km has increased recently. To show the change in this ratio during this period in the context of the benchmarking group, the graphs below depict the Endeavour Energy replacement capex per km over time against the group average and the relative change in this ratio for the latest three years. As shown, whilst Endeavour Energy's replacement capex per km has varied around the group average over time it has increased relative to the group average in FY12 and FY13.



Finally, the replacement capex forecast can be compared to the group statistics in this period. The graph below shows the recent and forecast replacement capex per km, long term trend, and the current period group average and minimum.



Replacement Capex per km - Endeavour

Notes:

1. All figures in FY2013 dollars.

2. Network km for future years have been forecast using the historical growth rate (0.5%).

3. The group average and minimums shown on the graph above are the current period average extrapolated into the next period - that is, they are not the average of the forecast expenditure.

Non-System capex has been influenced by reform initiatives

Non-system capex includes the capital spent on plant and motor vehicles, property and land and non-system IT assets. A primary driver of non-system capex is the number of employees in the business. A comparison of non-system capex per employee for FY13 is shown below.



Non-System Capex per Employee (FY13)

As shown below, Endeavour has significantly improved this benchmark ratio during this period.



Non-System Capex per Employee - Current Period

Appendix 2 includes further non-system capex category benchmarks.

To show the change in non-system capex performance during this period in the context of the benchmarking group, the graphs below depict the Endeavour Energy's non-system capex per employee over time against the group average and the relative change in this ratio for the latest three years. As shown, the decrease in this cost category for Endeavour Energy has seen it dip below the group average, which itself is decreasing. In the most recent three years, many businesses have had significant decreases in this category (industry reform has targeted this category).



Finally, the non-system capex forecast can be compared to the group statistics in this period. The graph below shows the recent and forecast maintenance opex per km, long term trend, and the current period group average and minimum.



Non-System Capex per Employee - Endeavour

Notes:

1. All figures in FY2013 dollars.

2. Employee numbers for future years have been held at the current (FY13) figure.

3. The group average and minimums shown on the graph above are the current period average extrapolated into the next period - that is, they are not the average of the forecast expenditure.

Endeavour Energy's maintenance costs are favourable amongst urban businesses

In most cases, more than half of a DNSPs maintenance costs are related to vegetation management and inspection activities (such as planned periodic pole inspections). As such, maintenances costs are largely dependent upon the mobilisation of resources along network routes. A primary cost driver of maintenance costs is therefore the geographic location of the network. Long, radial networks in regional and rural areas carry a significant cost premium in travelling between assets. Dense, urban networks require less travel between assets, however accessibility issues are usually greater (e.g. traffic congestion, proximity of other services, etc.). Comparison of maintenance costs per kilometre for the 2013 financial year is shown below.



Maintenance Opex per km - FY13

As shown below, Endeavour Energy's maintenance costs are relatively stable in the current period and lower than that of its closest peer networks.



Maintenance Opex per km - Current Period

To show the change in maintenance opex performance during this period in the context of the benchmarking group, the graphs below depict Endeavour's maintenance opex per km over time against the group average and the relative change in this ratio for the latest three years. In the most recent three years, many businesses have had significant increases in maintenance costs; Endeavour Energy is at the midpoint of the group.



Finally, the maintenance opex forecast can be compared to the group statistics in this period. The graph below shows the recent and forecast maintenance opex per km, long term trend, and also against the current period group average and minimum. Endeavour's maintenance opex is forecast to remain below the group average when measured per network kilometre.



Maintenance Opex per km - Endeavour

Notes:

- 1. All figures in FY2013 dollars.
- 2. Network km for future years have been forecast using the historical growth rate (0.8%).
- 3. The group average and minimums shown on the graph above are the current period average extrapolated into the next period that is, they are not the average of the forecast expenditure.

Endeavour's operations costs are similar to peer businesses of similar size and location

Operations costs include network control, systems operations, customer operations and support functions such as IT, property and fleet management. As such, these costs are largely driven by the location and complexity of the network, its customer base and the business scale. This makes comparison particularly difficult, as the number and relative influence of cost drivers varies across businesses. Operations costs for this study have been compared using the number of customers as the comparison basis. Comparisons of operations costs per customer for the 2013 financial year is shown below.



As shown below, Endeavour Energy's operations costs have decreased in the current period and are within the range of its closest peers.



Operations Opex per customer - Current Period

To show the change in operations opex performance during this period in the context of the benchmarking group, the graphs below depict Endeavour Energy's operations opex per customer over time against the group average and the relative change in this ratio for the latest three years. As shown, the Endeavour Energy operations cost per customer has tracked close to the group average. In the most recent three years, many businesses have had significant decreases in operations costs - due to many of the targets of NSW and QLD reform programs residing in this cost category.





Finally, the operations opex forecast can be compared to the group statistics in this period. The graph below shows the recent and forecast operations opex per customer, long term trend, and also against the current period group average and minimum - showing that Endeavour Energy's operations costs per customer are forecast to decrease further below the extrapolated group average.



Operations Opex per Customer - Endeavour

Notes:

^{1.} All figures in FY2013 dollars.

^{2.} Customer numbers for future years have been forecast using the historical growth rate (1.1%).

^{3.} The group average and minimums shown on the graph above are the current period average extrapolated into the next period - that is, they are not the average of the forecast expenditure.

Overheads are likely to be a focus of the determination

Augmentation, replacement, maintenance and operating activities can all be modelled to an extent through unit costs and volumes based on expected rates of growth in particular drivers. Overheads and indirect costs, however are largely a function of business structure and ownership, management decisions and legacy programs. This makes them difficult to forecast through modelling, other than extrapolating historical budget trends. It also makes them susceptible to unfavourable benchmarking outcomes.

Capital projects can be deferred or ceased immediately, but the overheads that build up over years of increased activity associated with those programs cannot be curtailed so readily. Overhead costs themselves cannot easily be compared across businesses due to the variation in cost allocation and accounting methodologies. A meaningful analysis requires significant data mining, treatment and analysis effort that many of the businesses are currently finding challenging within their own entity, let alone across businesses.

The accumulation of overheads is mostly associated with the supporting activities, or indirect costs, that underpin the direct cost of building, operating and maintaining network assets. As such, comparison of some of the noncore, or supporting, functions provides insight into relative productivity. Comparisons of several cost ratios and efficiency indicators are presented below and on the following pages.

Overhead Allocations

The functions that accumulate costs in the overhead pool could be compared directly to other businesses as a means of benchmarking overhead costs, however each business manages and reports overhead costs differently. As a high-level comparison of the overhead "intensity" of each business, the average overhead percentage of total spend was compared in the previous benchmarking report. An updated view of this information is provided below.



Overhead Percentage (FY13)

Changes to cost allocation methodologies by at least one business in the sample and the network reforms in most states and territories has narrowed the range between the lowest and highest proportions of overhead across the group since the previous benchmarking report.

Workforce Management

Whilst the capital expenditure associated with many non-system assets and functions is often reported in a way that allows comparison across peers, the operating expenditure associated with management functions and support activities are pooled into overhead accounts (to varying degrees) and allocated to direct expenditure functions via each DNSPs Cost Allocation Methodology. This makes comparison of costs difficult, however efficiency and productivity programs are inevitably associated with changes in the workforce. This section presents some key workforce management statistics for the NSW businesses and others.

The number of customers serviced by the workforce varies by network type - with urban distributors enjoying an "economy of proximity" over their rural counterparts. Whilst simple ratios such as customers per employee need to be considered in the context of the various structures, contractor policies, etc, they are at least a useful high level indicator of the service intensity of each network business. The graph below shows a comparison of customers per employee for several businesses.



Customers per Employee (FY13)

To understand the relationship between this ratio and location, the above figures can be plotted against the customer density of each network - showing a reasonable relationship between the two (below).



Customers per Employee vs Customer Density

Whilst it might be tempting to draw some inferences about relative efficiency posed by the previous analysis, it should be noted that some networks are more capital and maintenance intensive than others. Removing the employees that are associated with the capital program and maintenance (including apprentices) from the figures used in the ratio analysis above leads to a "customer per non-technical employee" ratio. As shown below, this level of analysis presents a different view of relative performance.



Customers per Non-Technical Employee

Endeavour Energy is achieving excellent performance on this measure.

In the absence of more detailed information about the structures and policies of the businesses, it is once again useful to analyse the changes in workforce size and output over time. Most of the businesses participating in the Huegin benchmarking study have undergone some sort of reform or efficiency program. Huegin analysed the changes in the workforce amongst those businesses with the key results shown below.

	Year on Year Change			9	2009-13	Year Maximum Size	Difference Between
DNSP	FY10	FY11	FY12	FY13	CAGR	Recorded	Current and Maximum
DNSP K	4.6%	2.7%	-3.3%	-2.7%	0.2%	FY 2011	-5.8%
DNSP M	4.2%	0.9%	1.6%	-5.5%	0.2%	FY 2012	-5.5%
Endeavour	0.6%	1.3%	-3.5%	-6.7%	-1.7%	FY 2011	-9.9%
DNSP B	1.4%	1.3%	-0.8%	-9.8%	-1.7%	FY 2011	-10.5%
DNSP C	-0.1%	2.6%	0.5%	-7.1%	-0.9%	FY 2012	-7.1%
DNSP D		7.3%	5.4%	2.0%		FY 2013	0.0%
DNSP J ¹	14.7%	-12.3%	-19.2%	-4.2%	-4.9%	FY 2010	-32.1%

Notes:

1. DNSP J's figures include the transition of a business unit to another entity.

To balance out the impact of customer growth, the change in the customer to employee ratio over time is also shown below - the CAGR figure on the right of each graph represents the compound annual growth rate in the ratio between the first and last measurement. The only business that has outperformed Endeavour Energy on the improvement in this measure is DNSP J, who transferred a business unit to another entity in FY12.













Customers per Employee - DNSP M



Customers per Employee - DNSP A 400 300 200 0 FY09 FY10 FY11 FY12 FY13

Customers per Employee - DNSP C



Customers per Employee - DNSP J



SUMMARY & CONCLUSIONS

Economic Benchmarking

Endeavour Energy is likely to benchmark around the first quartile using economic benchmarking methods.

Economic benchmarking is significantly limited in the Australian electricity supply context. Heterogenous networks and locations, unique environmental factors, data inconsistencies and a small sample size all contribute to statistically unstable and unsuitable economic models.

The movement of groups of DNSPs around the model solution space with the change in model specification or variable weightings demonstrates the existence of multiple clusters within the sample size, which all require a different model specification.

Expenditure Trend Analysis

Trend analysis will be used by the regulator; results using this method show Endeavour to above the group average for augmentation capex, replacement capex and maintenance opex.

Whilst economic benchmarking is unlikely to show Endeavour on the frontier, forecast downward trends for replacement capex and maintenance opex are indications that Endeavour are moving toward the industry frontier.

The forecast flattening and reduction of operating expenditure, and the forecast plunge in capital expenditure show indications at this early stage of being of a greater magnitude than Endeavour's peers.

System Capital Expenditure

Endeavour's capex is forecast to drop to decline significantly over the next regulatory period; system capital expenditure reduction is a major driver of this decline.

Whilst asset replacement appears likely to continue to be a major driver of capital works, augmentation is forecast to reduce significantly over the course of the next regulatory control period.

Non-System Capital Expenditure

A reasonably significant proportion of Endeavour's reduced capital expenditure is driven by savings in non-system assets - particularly property.

Previous benchmarking reports by Huegin have highlighted the cost premium associated with nonsystem capex costs for DNSPs operating in large capital cities.

In Sydney in particular, property management costs were found to be a major cost premium for Ausgrid, with land rates and taxes far beyond other cities.

Whilst in total, non-system capital expenditure has historically been high in other urban centres, Ausgrid has always displayed a 10 to 20% cost premium above the common benchmarks in this category. Ausgrid's forecast costs in this category however display a reduction to levels commensurate with many of its peers. Property management is a significant driver of this benchmark cost improvement.

Maintenance and Operations Opex

Endeavour Energy's maintenance and operations opex are forecast to continue at the current favourable levels.

Endeavour Energy's maintenance opex compares extremely well against other urban distributors; its maintenance opex per km is around half of the average for businesses with a customer density of over 25 customers per km. The forecast expenditure for maintenance shows no real increase from current levels.

Endeavour Energy's operations opex is comparable to similar peers on a per customer basis. Endeavour Energy's forecast for operations opex will see the operations opex per customer ratio decrease by around 10% on current levels, improving its position amongst the benchmark group.

Other Efficiency Indicators

Overheads and workforce size and productivity are other indications of absolute and relative efficiency, and changes in productivity.

Endeavour Energy's overhead percentage is at the higher end of the range for the benchmark group, although comparisons are skewed by the different cost allocation methodologies between businesses.

Endeavour Energy has reduced its workforce size by 10% since FY11 indicating its effectiveness in responding to the productivity and reform challenges in recent years. This reduction has seen further improvement in the customer to employee ratio for Endeavour Energy.





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