ATTACHMENT 5.4
ADRESSING THE BENCHMARKING FACTOR

essential energy

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ABOUT THIS REPORT

Essential Energy has prepared an attachment as part of its regulatory proposal which demonstrates how it has met the objectives, criteria and factors in the National Electricity Rules (the Rules) for capex and opex[1]. In the attachment, we set out how the criteria and factors should be considered as part of the AER's constituent decisions for opex and capex, and set out our evidence in relation to each factor. The purpose of this report is to provide further supporting information in relation to how we have addressed the benchmarking factor in the Rules.

Benchmarking is one of many factors the AER has to consider in making its decisions. The Rules require that the AER must:

> *" …. consider the most recent annual benchmarking report that has been published under rule 6.27[2] and the benchmark capital expenditure that would be incurred by an efficient Distribution Network Service Provider over the relevant regulatory control period. "*

Benchmarking is an undefined term in the Rules and can encompass many dimensions. The Productivity Commission has defined the term as any method for comparing a firm to other businesses, to itself over time (or between its various divisions) or to an ideal firm.[3]

We note that some of the measures of benchmarking our performance over time have been outlined in our responses to other factors in the Rules. In particular, we consider that a very important benchmark is our performance against the AER's allowance in the previous period. Under the AER's incentive schemes, DNSPs are provided incentives to reduce expenditure levels below the targets set by the AER, and share these benefits with customers. Our response to these inter-related benchmarking factors are set out in attachment 5.3 to our regulatory proposal.

Key analysis and findings

This report examines the inherent limitations of benchmarking Australian DNSPs, and the role that benchmarking should play as a partial indicator of efficiency. Our analysis identifies that benchmarking has inherent limitations such as inability to conduct 'like for like' analysis across peer firms, data inconsistency and inaccuracy, and failure to meet statistic principles. We think that valid benchmarking may have a role in guiding the regulator to areas requiring further granular analysis. It should not be used to reject a DNSP's proposal, or as a basis to substitute the forecast given the inherent limitations as a tool.

This report assesses the relative weight that should be applied to each of the benchmarking tools identified by the AER in its Forecast Expenditure Assessment Guidelines including economic analysis, aggregated category analysis, and cost category data including the augex and repex models. When deciding if a benchmark is appropriate, we have been guided by the Productivity Commission's review in 2013 which set out 6 criteria for when a benchmarking tool could be used in the process. This includes validity, accuracy and reliability, robustness, simplicity, not subject to manipulation and fitness for purpose. To complement this analysis, we have also sought to understand the available data that can be used for benchmarking and reported on these outcomes. This was based on a detailed Huegin Consulting study of 7 DNSPs in Australia, and data of other DNSPs where available.

Based on this assessment approach, we have placed limited weight on benchmarking analysis as a valid test of the efficiency of our forecast and consider that the AER should do likewise in its assessment. In all cases, the AER's techniques do not meet all the criteria specified by the Productivity Commission. In some cases, such as economic analysis we consider the method may actually provide misleading results and should not be used by a business or the AER to test efficiency. In other cases, the model may provide some insight into the efficiency of a DNSP's forecasts, for instance when the data quality is sound. In these cases, we have considered the underlying data and provided commentary on any observed differences in light of our circumstances and drivers of expenditure.

Our analysis of benchmarking tools suggests that trends in a DNSP's results over time are of more value, than relative efficiencies between DNSPs at a point in time. In this respect the data provided does demonstrate that

[1] Attachment 5.3: "Essential Energy: Addressing the Objectives, Criteria and Factors for capex and opex in the NER", May 2014.
[2] The AER intends to release its first benchmarking report in September 2014, and therefore we are not provided with an opportunity to demonstrate or make representations on this report at the time of submitting our regulatory proposal.
[3] Productivity Commission, *Electricity Network Regulatory Frameworks*, 26 June 2013, p147.

Essential Energy's growth rates in expenditure are among the lowest out of the peer group studies. Once again, however, we draw caution on such results as they cannot capture the reasons for observed differences between DNSPs.

Structure and contents of document

We have structured our response as follows:

- Section 1 identifies the inherent limitations of benchmarking data and the role of benchmarking. We provide an outline of how we have assessed each of the AER's benchmarking tools outlined in its Forecast Expenditure Assessment Guidelines.
- Section 2 sets out our findings on economic analysis benchmarking.
- Section 3 sets out our findings on aggregated cost benchmarking.
- Section 4 sets out our findings on cost category comparisons.
- Appendix B and C provide further information on a joint analysis undertaken by NSW DNSPs on the effectiveness of the augex and repex models respectively.

In this document we have referred to a series of reference material. In order to enable the AER to make a full assessment, we have attached these documents as indicated in the table below at the end of this document.

Appendix number	Name of document
Appendix A	The Huegin report for Essential Energy
Appendix B	Joint DNSP analysis on effectiveness of the augex model
Appendix C	Joint DNSP analysis on effectiveness of the repex model

1 Limitations and role of benchmarking

When addressing the capex and opex criteria in the Rules, the AER must consider all the factors in the Rules, including benchmarking. This means that the AER must come to a view on the extent to which benchmarking is relevant to its constituent decisions in respect of capex and opex, and the weight that should be applied to the analysis it examines. This requires the AER to consider the extent of information available and the probative value of the analysis.

The purpose of this chapter is to provide context on the role of benchmarking as a tool in providing a 'partial indicator' on the efficiency of a DNSP's forecast.

> We demonstrate that benchmarking data has inherent limitations, which means that extreme caution must be applied in using the analysis to draw conclusions on the relative efficiency of a DNSP.

> With this in mind, we demonstrate that benchmarking can play a role in helping the regulator or a business uncover potential inefficiencies in its forecasts, but that the data cannot be used directly to reject or substitute the proposed expenditure of a DNSP. Rather benchmarking can be used to target the AER's analysis.

> We conclude the chapter by setting out our method for reviewing the AER's benchmarking techniques in the Forecast Expenditure Assessment Guidelines.

Limitations of benchmarking

We consider that benchmarking data and techniques should be used with extreme caution due to the errors that arise when using such tools to measure efficiency. The errors arise from the inability of models to normalise for the inherent differences between DNSPs, data inconsistency and inaccuracy, and low statistical reliability.

The primary issue with benchmarking is that electricity distributors are not homogenous in the Australian market, and therefore 'like for like' comparisons cannot be used effectively to draw inferences on efficiency. For example:

- Each DNSP in Australia operates under unique conditions such as customer density, geographic area, topographic conditions, and the inherent design of the network (for instance number of sub-transmission assets). This makes 'like for like' comparisons highly problematic, as there is no statistically reliable method for normalising data. For example, a rural DNSP may perform better if expenditure data is normalised by line length, but will likely perform worse if the data is normalised on a per customer basis.
- DNSPs are at relatively different stages of the investment life cycle. These impacts heavily on relative replacement and maintenance costs, with older networks incurring a higher inherent cost of performing its functions relative to a younger network.
- Jurisdictional differences also play a major part in explaining differentials in cost structures. For example, jurisdictions differ in respect of licence conditions, markets for contestable services, and classification of services.

In addition to this issue, benchmarking is often plagued by data issues. Up to this point in time, there has been limited granular data on DNSP's expenditures and operating environment. Even when data is available, we note that it rarely is in a consistent form to draw meaningful judgments. For example, cost accounting policies are so varied between DNSPs that they do not even allow for effective comparison of opex and capex between DNSPs. This means that limited weight can be applied to this data when using it for the purposes of identifying efficiency at the high level.

Finally, we note that our experience with models used by the AER is that they largely fail to meet key principles of statistical validity such as:

> Sample size – In the absence of a large sample size, the results can be skewed by a few firms with similar outcomes. Further, low sample size is counter-intuitively related to the apparent strength of relationship that is observed in tests such as R squared, leading to misleading conclusions. In Australia, there are very few firms in the industry to develop a large enough sample size, especially for rurally based distributors.

> Comparability of data series – Even within the small sample of Australian DNSPs, there is a great degree of variability in the underlying conditions of distributors in Australia. This breaches a key test of statistical validity which requires the assumptions underpinning data inputs to be consistent.

- Correlation between dependent variables – In multi-variable models such as Total Factor Productivity, many of the factors are highly inter-related with each other. For example, SAIDI and SAIFI will be highly related to each other.
- Consistency in variations across data range –Tests such as R squared can be misleading if the data series does not show a consistent error range across the data series. This underscores once again the importance of a large sample size.
- Sensitivity analysis does not lead to wide variation in outcomes – An important aspect of statistical application is to test whether the outcome is relatively consistent when other likely variables are used in the analysis. For example, capacity and peak demand are two types of outputs delivered by a DNSP.

For these reasons, we have applied a high degree of caution in interpreting benchmarking analysis when testing the validity of our forecasts. In particular, our experience is that high level benchmarks serve to validate the inherent differences between DNSPs, or reflect data inconsistency and incomparability.

The limitations of benchmarking have been emphasised in a review by the Productivity Commission. In 2013, the Productivity Commission was commissioned by the Australian Government to review the extent to which benchmarking could be used by regulators in the electricity industry. . The Productivity Commission directly referred to academic articles on the need to select explanatory variables that describe the functions undertaken by a DNSP and the environment in which it performs. In particular it referred to an article by Turvey in 2008 which stated:[4]

> *"Comparisons between networks of the costs of these activities can only illuminate differences in the efficiency with which operations and maintenance are carried out if the magnitudes of the tasks of operation and maintenance can be compared. This is a platitude, yet failure to articulate it has led some authors to scrabble around among available data to select a set of "explanatory" variables without displaying any understanding of what an enterprise does and how it does it. Confusion about these matters is rife, as witnessed, for example, by the fact that while some econometric efficiency estimates for electricity distribution treat MWh distributed, km of overhead lines or number of customers as an input, others treat one or more of these variables as an output."*

The ACCC's comprehensive review of benchmarking capex and opex in energy networks also came to similar conclusions as the Productivity Commission. The ACCC observed that all benchmarking results in a degree of approximation due to its abstract nature in aggregating many factors into a few variables. It stated:[5]

> *"Effective benchmarking requires the modelling of relevant factors affecting the expenditure of the energy networks. These businesses provide a range of services using different types of inputs and may operate in different environmental conditions. Inevitably, benchmarking requires some aggregation of those services, inputs, or environmental conditions into a few variables, resulting in some degree of approximation in the estimation."*

Role of benchmarking as a partial indicator

Despite the limitations identified above, we consider that well designed tools can play a role for a business or regulator to test the efficiency of a forecast. In the sections below, we identify two principles in applying benchmarking information:

- Testing the relative effectiveness of the tool to provide insights into efficiency
- Using the information in a way that enables the decision maker to identify whether there is a potential inefficiency in the forecasts.

Effectiveness of benchmarking

Benchmarking tools need to be designed in a way that provide insights into potential areas of inefficiency, Poorly designed tools or misapplication can mislead the decision maker, resulting in outcomes that do not meet the long term interests of customers. This was a key finding of the Productivity Commission:[6]

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[4] Productivity Commission, *Electricity Network Regulatory Frameworks*, 26 June 2013, p160.
[5] Australian Competition and Consumer Commission, Benchmarking Opex and Capex in Energy Networks Working Paper no.6, May 2012, p12

"A key question is how to separate the wheat from the chaff among the various competing approaches, recognising that this will typically involve balancing various criteria …. There is a large literature on estimating the comparative costs of businesses, with much of that literature concentrating on using the 'right' techniques. However, it is equally important to be clear about how to interpret benchmarking results for policy purposes because the misuse of good technical analysis can result in adverse outcomes for consumers and businesses. In particular, comparing the costs between businesses in different jurisdictions without accounting for factors outside the control of the business could provide misleading indicators of managerial efficiency. If used in incentive regulation, this could lead to underinvestment or unwarranted transfers from consumers to the businesses."

The Productivity Commission set out six formal criteria for identifying the effectiveness of benchmarking. These include:

> Validity - A valid benchmark should relate to efficiency (or conversely inefficiency) in one or more meaningful dimensions. A valid benchmark should reflect the way that the businesses are run. In particular, comparing the costs between businesses in different jurisdictions without accounting for factors outside the control of the business could provide misleading indicators of managerial efficiency.

> Accuracy and reliability - Accuracy is the degree to which a benchmark provides an unbiased estimate of efficiency, while the reliability (used here in the normal sense of reproducibility) is about the variance of the measure.

> Robustness - This is a subset of accuracy and reliability, but worth emphasising in its own right. A particularly useful robust measure is one that provides information about the efficiency of an enterprise regardless of its operating environment.

> Manipulation and gaming of data - As in all systems where rewards and penalties depend on incomplete measures of performance, the measured party has incentives to 'look' like a highly performing entity. Accordingly, the regulator should consider the capacity of any particular benchmarking measure to create unforeseen business behaviours.

> Parsimony - A good model should be no more complex than required. This is important in assisting interpretability, avoiding data mining, achieving robust results, reducing data collection costs and allowing greater comparability of results across countries.

> Fit for purpose - Benchmarking has multiple purposes. Some require great accuracy, reliability and robustness. This is particularly important where benchmarking is used to determine a business's revenue allowance. Such benchmark estimates should be highly reliable across time, business types and jurisdictions. The concerns are less where benchmarking is indicative — used to identify areas for possible future investigation, or to reach some prima facie judgment.

The Productivity Commission's criteria set a very high threshold for an effective benchmark, and it is unlikely that any tool would meet all the criteria given the inherent limitations of benchmarking. Given this is the case, there needs to be an element of subjective judgment in deciding whether to disregard a tool in entirety, or whether it may still have some probative value as a partial indicator of efficiency. We consider that some tools may actually lead the decision maker into error, and cannot be verified by reference to a review of programs or projects.

Using benchmarking data to assess the efficiency of a forecast

In some cases, a tool may satisfy some of the Productivity Commission's criteria, and be suitable to be used as a partial indicator of efficiency. This does not mean that the tool can be used in a deterministic way to reject proposed expenditure, or to develop alternative or substitute forecasts.

Rather, the analysis could be used as an informative tool to identify potential areas of inefficiency in a forecast, and to target reviews on these areas. This would then require granular analysis of the proposed programs or cost category to check whether the observed result relates to inefficiency, or stems from a reasonable driver of expenditure. This in turn requires a degree of expertise by the decision maker using the tool both from a statistical and engineering perspective. The ACCC came to this view when undertaking its review of capex and opex benchmarking:

[6] Productivity Commission, *Electricity Network Regulatory Frameworks*, 26 June 2013, p163.

"Reflecting current practice and existing expertise, benchmarking should initially be used as an informative tool rather than a determinative one. For example, it can be used as a starting point for a conversation with regulated utilities about the level of operating and/or capital expenditures being incurred and proposed. A more sophisticated application could emerge over time.

Effective cost benchmarking requires a clear understanding of the structure of the costs of the regulated utilities. This, in turn, requires an understanding of the key outputs provided by the benchmarked utilities, the inputs used (and/or the prices of those inputs), and the key environmental factors. It is also useful to understand the nature of any economies of scale or scope in the industry. Engineering studies can help provide a picture of the likely cost drivers, including how the cost drivers interact. This involves complementing in-house resources through access to expert consultants with specialised engineering knowledge and experience in the application of cost-benchmarking methods."[7]

Analysis of available benchmarking data and models

We have applied the principles described in Section 1.2 above to the methods identified by the AER in the Forecast Assessment Expenditure Guidelines. We have sought to understand the probative value of these tools using the formalised criteria developed by the Productivity Commission.

We have also commissioned a report by Huegin Consulting which helped us to understand the data available at that point in time in respect of applying these tools, and reported on the results. We note that Huegin's report used data that related to our transitional year (2014-15) proposal, and do not fully reflect the updates we have subsequently made as part of our 2015-19 regulatory proposal. We consider however that the updates are not of a nature that alters the substance of Huegin's conclusions, and we therefore consider it is relevant as a partial indicator of our forecasts of required capex and opex for the 2015-19 regulatory proposal. In the following chapters we describe our findings in relation to:

- Economic analysis;
- Aggregated category benchmarking; and
- Cost category benchmarking including the repex and augex models.

We recognise that over time we will have access to better industry data, together with a better understanding of the factors that drive cost differences between DNSPs. The AER is currently undertaking its first information gathering exercise for the purpose of producing a benchmarking report. We consider that increased data does not necessarily improve the probative value of benchmarking tools, and that at all times the decision maker needs to consider whether the tool is effective, and can be used to support more granular analysis of programs and projects.

[7] Australian Competition and Consumer Commission, Benchmarking Opex and Capex in Energy Networks Working Paper no.6, May 2012, p14.

2 Economic benchmarking analysis

The AER has defined economic benchmarking as applying economic theory to measure the efficiency of a NSP's use of inputs to produce outputs, having regard to environmental factors. There are a number of methods and tools to undertake economic benchmarking such as Total Factor Productivity (TFP)[8] and Data Envelopment Analysis (DEA).[9]

Effectiveness of technique in guiding decision making

Previous concerns on effectiveness of economic analysis

In late 2013, the AER issued a Regulatory Information Notice to Essential Energy and other DNSPs to collect information relevant to economic benchmarking analysis. In our response to the AER's draft RIN on economic benchmarking, we noted that the application of the tool to guide regulatory decision making would result in error, leading to outcomes that are detrimental to the long term interests of customers. Our view was based on the following reasons:

- We are not convinced that economic benchmarking tools such as Total Factor Productivity (TFP) can be used to infer relative efficiency of DNSPs over time. We consider that the models cannot adequately normalise for differences between DNSPs, and do not provide meaningful assessment of the apparent differences in productivity levels. For example, TFP will show that a firm that replaces ageing assets has declining levels of capital productivity, as the model would show higher prices for capital while maintaining existing service levels. In our view this would be driven by the age of the asset base which is likely to vary between DNSPs.
- We consider that economic benchmarking models such as TFP do not provide the AER with guidance on how to target its review of expenditure forecasts, as the information provided is at too high a level to identify potential areas of efficiency. The models and data collected will not provide any guidance on the underlying drivers of apparent productivity rates, and therefore does not provide useful analysis that identifies which areas to review in a DNSP's capex and opex forecasts.
- Finally, the DNSPs in Australia have repeatedly noted that our finance and asset systems have not recorded much of the data in the form required by the AER, and that the information used to populate models would be highly unreliable. This has been independently confirmed by the Australian Energy Market Commission, who conducted a 2 year review of TFP and concluded that available historical data was of poor quality and reliability.

We provided the information required by the RIN to the AER on 30 April 2014. Our basis of preparation has noted areas where we have had to provide best estimates when data was not available in our systems. We have also noted instances where the definitions could be open to interpretation. We understand that this has also been the experience of other DNSPs, which draws into question the quality of information that would be used as part of economic benchmarking. In this respect, our experience under industry reform has also found significant differences between the three NSW DNSPs, which would not have been identified if further investigation had not occurred.

This is very concerning when models such as TFP and DEA rely on the totality of variables to form rankings and assessments of efficiency over time. An error in one variable can lead to significant deviations in observed performance. When these errors are multiplied across many variables, the outcomes of the analysis could not be used to infer efficiency.

In addition to data quality issues, we note that there are a number of model specifications being considered by the AER to undertake economic benchmarking.[10] The variety of model specifications shows the difficulty of deriving an input and output relationship that can adequately account for the nature of the industry, and the inherent

[8] The AER noted that 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. 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 business's efficiency will be affected by its outputs compared to the industry average and the share of expenditure that these outputs account for.

[9] The AER note that this is a more limited technique than MTFP, because it cannot incorporate as many input and output variables and it requires more data. Therefore, it proposed using it to cross-check the results of the MTFP analysis. It may be possible to decompose the efficiency scores of DEA to identify different types of inefficiency.

[10] We note that the AER has yet to provide DNSPs with its model specifications, meaning that we are unable to undertake meaningful analysis on whether the model specification is appropriate.

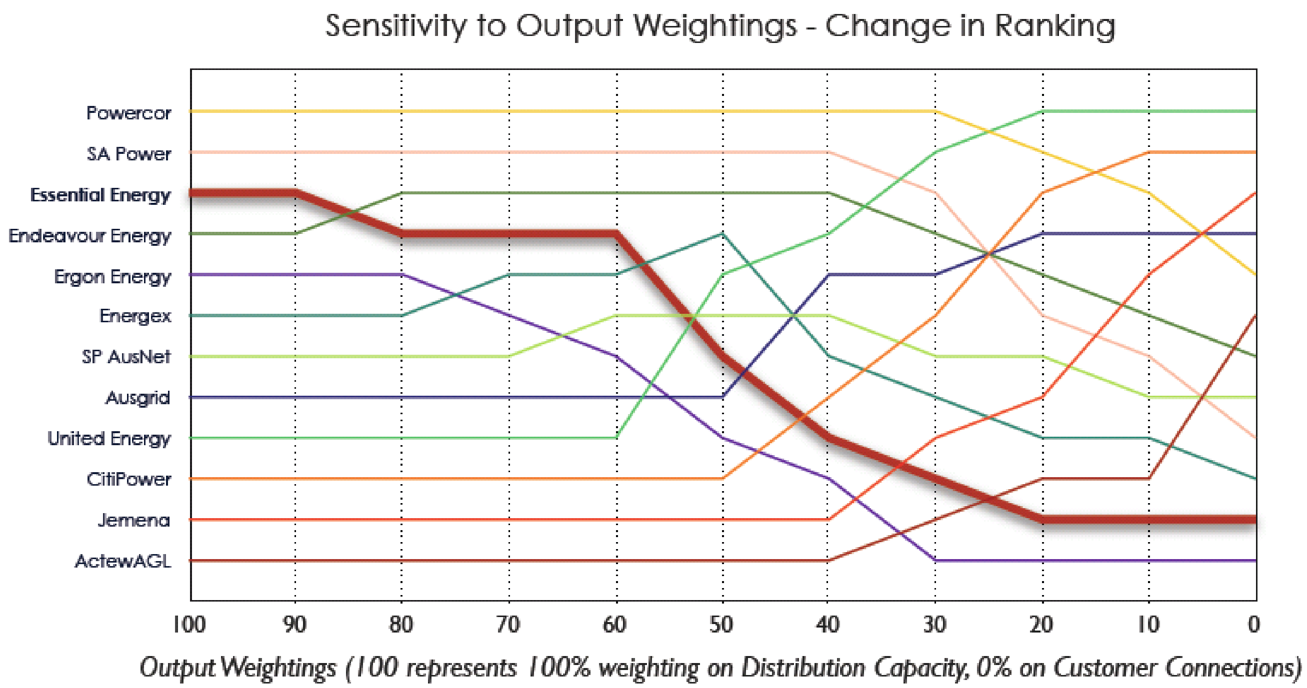
differences between DNSPs. For example, the outputs generally used are energy consumption, peak demand supplied, capacity of the network and reliability. These output variables are highly integrated, and often will have no relationship to input costs over time. A very simple example is when a DNSP has to undertake significant replacement of its network. While its costs increase, it is producing the same level of output[11] and therefore shows a decline in productivity.

The lack of a precise model specification means that there is a high degree of subjectively in the model applied by the analyst. This point has been borne out in the evidence provided by Huegin Consulting. Huegin noted that[12]:

> *"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."*

Huegin demonstrate this point by undertaking its own economic benchmarking models. Figure 2-1 shows that variable selection and weightings can skew the outcomes of models such as TFP. In the diagram it shows that Essential Energy ranks third among the DNSPs in Australia if distribution capacity is used as an output. In contrast, if customer connections are selected as the variable, then Essential Energy's ranking falls to 11th. Such sensitivity analysis demonstrates that economic benchmarking models reflect the underlying characteristics of the DNSP rather than suggest relative efficiency.

Figure 2-1 Economic benchmarking models reflect characteristics rather than efficiency[13]



Based on the analysis above, we consider that the use of economic benchmarking should not be used by the AER as it fails to meet any of the criteria identified by the Productivity Commission for effective benchmarking.

- Validity – We consider that economic analysis is not a good determinant of relative efficiency of a DNSP at a point in time, and is more likely to reveal the underlying network and accounting differences of each of the businesses. This can be seen in the diagram above, which shows that a change in the weighting of output variables (only one variable among many) results in vastly different outcomes. Similarly, performance over time can be misleading as a change in the value of one variable may lead to significant changes in perceived

[11] For instance, replacement does not increase capacity of the network. Replacement may improve reliability, but in most cases replacement is to maintain the existing level of reliability on the network (i.e.: stem a decline in reliability).
[12] Huegin Consulting, "Distribution benchmarking study: Essential Energy", 2014, p10.
[13] Huegin Consulting, "Distribution benchmarking study: Essential Energy", 2014, p13

efficiencies, even if this variable can be explained with reference to underlying circumstances. For example, the model could not explain when a DNSP is investing to meet a step change in the security of the network as a result of new licence conditions. In these circumstances the RAB would increase greatly, but there may not be a direct relationship with output factors such as reliability, although there may be some improvement in capacity of the network.

> Accuracy and reliability – We consider that the underlying data provided by Essential Energy and other DNSPs is not reliable across all variables. This is concerning given that economic analysis is based on multi-variable models that are only statistically credible if each variable is correct. In developing the data requirements to undertake economic benchmarking, the AER required DNSPs to submit information that could not be provided from systems and financial statements. The AER required that DNSPs provide a 'best estimate' in these cases, and document the methodology. The best estimates were subject to a less onerous form of external assurance. Our own experience is that much of the information provided to the AER was derived from estimates that cannot be verified, and therefore should not be used in economic analysis, which in itself is required to support changes to expenditure programs. We understand that other DNSPs have also submitted information derived from estimates, and therefore the data set upon which the models are based cannot be relied on by the AER.

> Robustness – We consider there are no robust model specifications that can be used for economic analysis. Huegin's analysis notes that all model specifications are subject to bias, and that the outcomes from economic analysis are highly sensitive to the model specification applied. This is particularly the case where there are a small number of DNSPs and they are highly heterogeneous.

> Manipulation of data – The AER's requirement that DNSPs provide best estimates where actual data cannot be provided, together with ambiguity of definitions may leave it open to a DNSP to report in a manner that puts its circumstances in the best light. This once again underscores the unreliability and accuracy of the information.

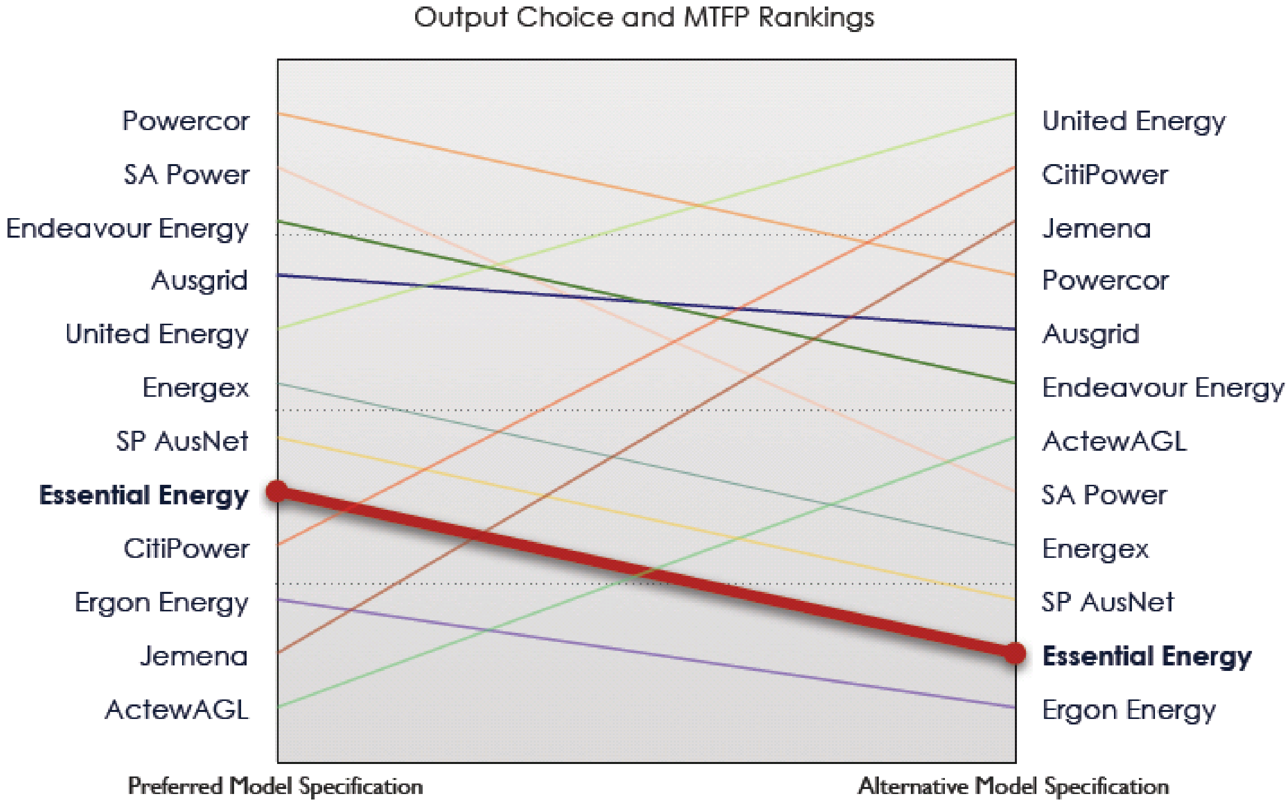
> Parsimony – In some respects, economic analysis is a simple tool to use, however the complexity of model specifications and the need for expert statistical application mean that the tool is not simply applied in practice. For example, the analyst needs a firm understanding of data quality and statistical principles when selecting the appropriate model design and drawing inferences from that method. At this stage, the AER has not identified the model specification it will use for economic benchmarking, which raises further questions over whether the tool to be applied will be simple.

> Fit for purpose – This is perhaps the deepest difficulty with economic analysis. Due to its lack of granularity, economic analysis makes it almost impossible to understand the drivers or potential inefficiency underscoring the outcomes. This means that it is an excessively poor tool for a business or a regulator to target areas of the program for further review. For instance, even if the analysis can be used to show that change in capex levels (i.e: change in value of regulatory asset base) is the driver of perceived inefficiency, it does not provide the business or regulator with any information on which programs or projects should be targeted.

Analysis of available data

Based on these considerations, we consider that economic benchmarking should have a zero weight in the AER's decision making. If the AER still consider that it provides some form of guidance in its decision making, we note that Huegin's analysis suggests that Essential Energy performs in the middle of the range for the preferred model specification, and relatively poorly in alternative model specifications as shown in Figure 2.2.

Figure 2-2 Output choice and MTFP rankings[14]



We consider that these results do not provide a cohesive argument for suggesting that Essential Energy is relatively inefficient relative to other DNSPs. While we consider that this would be misleading and that the outcomes relate to the model specification selected by Huegin and the underlying network characteristics of Essential Energy in relation to the model variables and weightings rather than inherent inefficiencies.

[14] Huegin Consulting, "Distribution benchmarking study: Essential Energy", 2014, p11

3 Aggregated category benchmarking

Aggregated category benchmarking captures information such as how much a NSP spends per kilometre of line length or the amount of energy it delivers. This can be undertaken for capex or opex.

Effectiveness of technique in guiding decision making

Aggregated benchmarks have certain advantages over economic benchmarking techniques. A key advantage is that data on actual expenditure and statistics such as line length, customer numbers, transformer capacity and square kilometres have a high degree of accuracy. It therefore meets the Productivity Commission's review of accuracy and reliability of data, and also limits the ability of DNSPs to manipulate the data in a favourable way. Further the simplicity of the tool in terms of regressing a single variable meets the criteria of parsimony.

The weakness of aggregated techniques is that they fail to meet the other important criteria of the Productivity Commission.

- Validity – There are many network and accounting drivers that underpin differences in the comparative data of DNSPs. They therefore form an important element of explaining relative cost differences, and it is almost impossible to identify whether any particular area of capex or opex is inefficient unless such costs are normalized or removed. This reflects that the tool is not sufficiently granular to identify where variations in costs are occurring and whether these relate to inherent inefficiencies.
- Robustness – Similar to economic analysis, aggregated category benchmarking is subject to model specification issues, and therefore it is difficult to form conclusive opinions on relative efficiency. For instance we note that normalising the data for line length, customer numbers, peak demand, or energy consumption can skew the outcomes. This shows that while DNSPs may not be in a position to manipulate the data, that the analyst is able to choose metrics that may provide support for a pre-conceived view.
- Fit for purpose – The difficulty with the approach is that it is undertaken at a very high level, and does not contain any additional information on where potential inefficiencies may lie. At worst, it can mislead the business or regulator into considering there are inefficiencies which may bias bottom up reviews of expenditure programs.

We consider that using aggregated benchmarks to infer the relative efficiency of DNSPs should be used with extreme caution, and with regard to all factors that may explain performance. Our view is that, if the information is used, it should be accompanied by detailed granular benchmarking of cost categories as discussed in Section 4.

While there are key difficulties with inferring the relative efficiencies of DNSPs, we consider that aggregated benchmarks do provide insight on how a DNSP performs over time, such as growth rates in expenditure. The advantage of comparing growth rates is that it uses a consistent data series. This was noted by Huegin Consulting when it stated:[15]

> *"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' forecasts is useful."*

We consider that growth rates over time are useful for the AER's trend analysis, and to identify if there is a particular driver at play for explaining relative growth rates of DNSPs. For instance, at a macro level the AER may identify that a higher relative growth rate is related to a new licence condition, or change in replacement approach which requires further investigation. For a business, it also provides a macro marker of whether efficiency initiatives, such as those we have undertaken as part of industry reform in NSW, are yielding positive results in comparison to expenditure trends of other DNSPs. Caution needs to be attached to any firm conclusions drawn from this type of analysis, as there are questions of validity, robustness and fitness for purpose which must be examined.

With this frame in mind, we sought to understand where Essential Energy fits with respect to different forms of aggregated benchmarks.

Analysis of available data

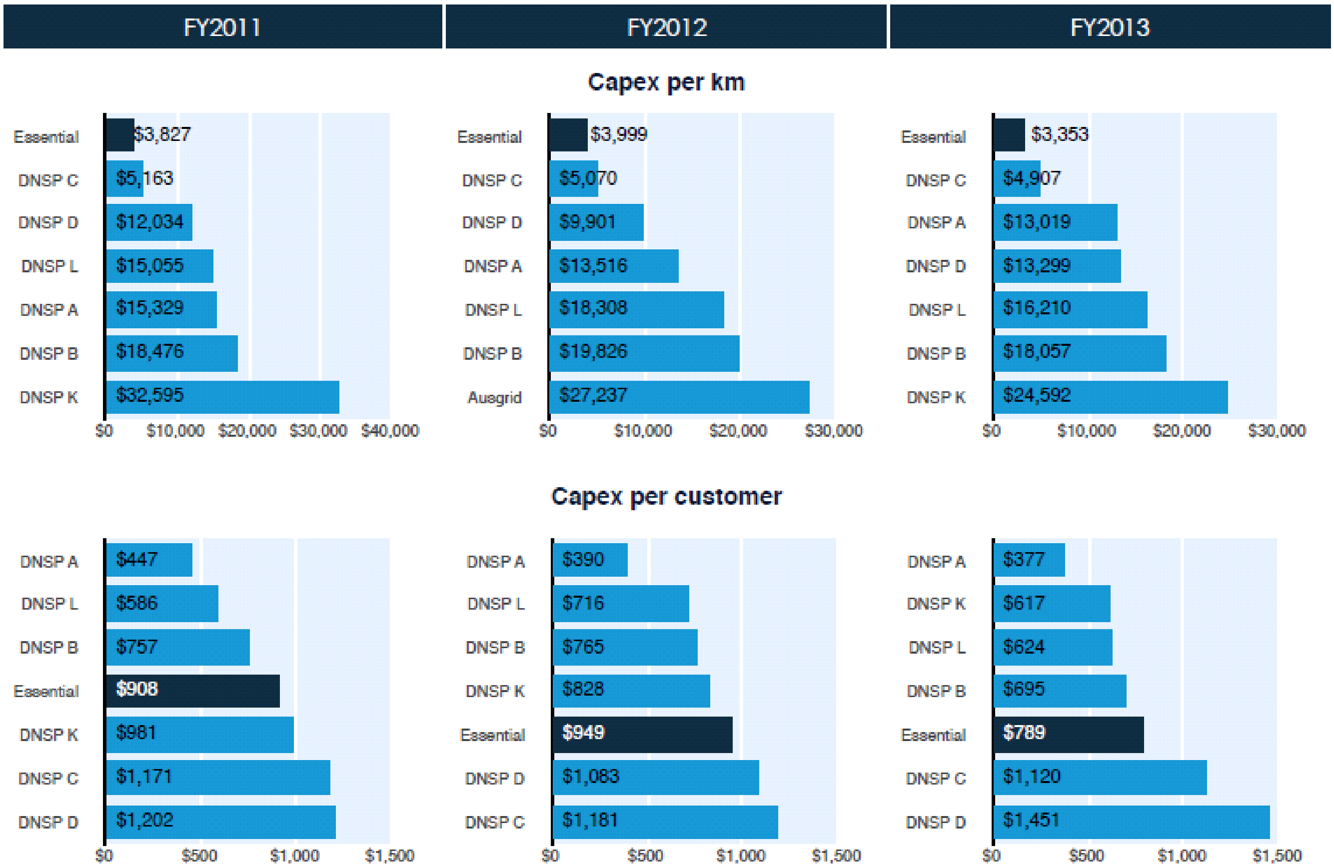
[15] Huegin Consulting, "Distribution benchmarking study: Essential Energy", 2014, p12.

Capex

Figure 3-1 shows Essential Energy's capex per kilometre and by customer for each year from 2010-11 to 2012-13. The analysis underscores the weaknesses of using aggregated benchmarks in assessing our relative performance. For instance, on a kilometre of line basis we perform exceptionally well, while on a capex per customer basis we perform in the middle of the range of the group. Once again this highlights our inherent network characteristics as a rural DNSP operating in a large network area with long stringy radial networks.

More importantly, the diagram also shows that Essential Energy has made significant reductions in capex over time, particularly since the introduction of industry reform in NSW. For instance capex per customer has fallen from $908 to $789 between 2010-11 and 2012-13. The same trend is observable for capex per kilometre which has fallen from $3,827 to $3,353.

Figure 3-1 Capex ratios[16]



Huegin has provided information which compares Essential Energy's capex levels over the current period (2009-14) through to the forecast period (2014-19) relative to other DNSPs, shown in Figure 3-2. In the 2009-14 period, Essential Energy's compound annual growth rate was 2.6 per cent. Essential Energy's growth rate is expected to decline over the 2014-19 period, with a compound annual growth rate of -7.4 per cent.

[16] Huegin Consulting, "Distribution benchmarking study: Essential Energy", 2014, p18

Figure 3-2 DNSP capex trends - actual and forecast[17]

Notes:

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

[17] Huegin Consulting, "Distribution benchmarking study: Essential Energy", 2014, p17

In our view, this analysis provides a high level view on the effectiveness of industry reforms in driving efficiency within our businesses. We believe that the evidence provided by Huegin provides a rough ‘rule of thumb’ to support the position that industry reform has delivered significant efficiencies in our capex forecasts. However, we consider the data by itself does not provide compelling data for the AER to draw sound conclusions on the efficiency of the forecast. This is for three reasons:

> Granular data would need to be reviewed to compare the underlying drivers of Essential Energy’s capex trends, including granular assessment of the investment programs, drivers and processes. Despite the apparent reductions in capex, we consider that it is not possible to ascertain whether the profile is consistent with changes in our regulatory obligations, demand environment and condition of our network assets.

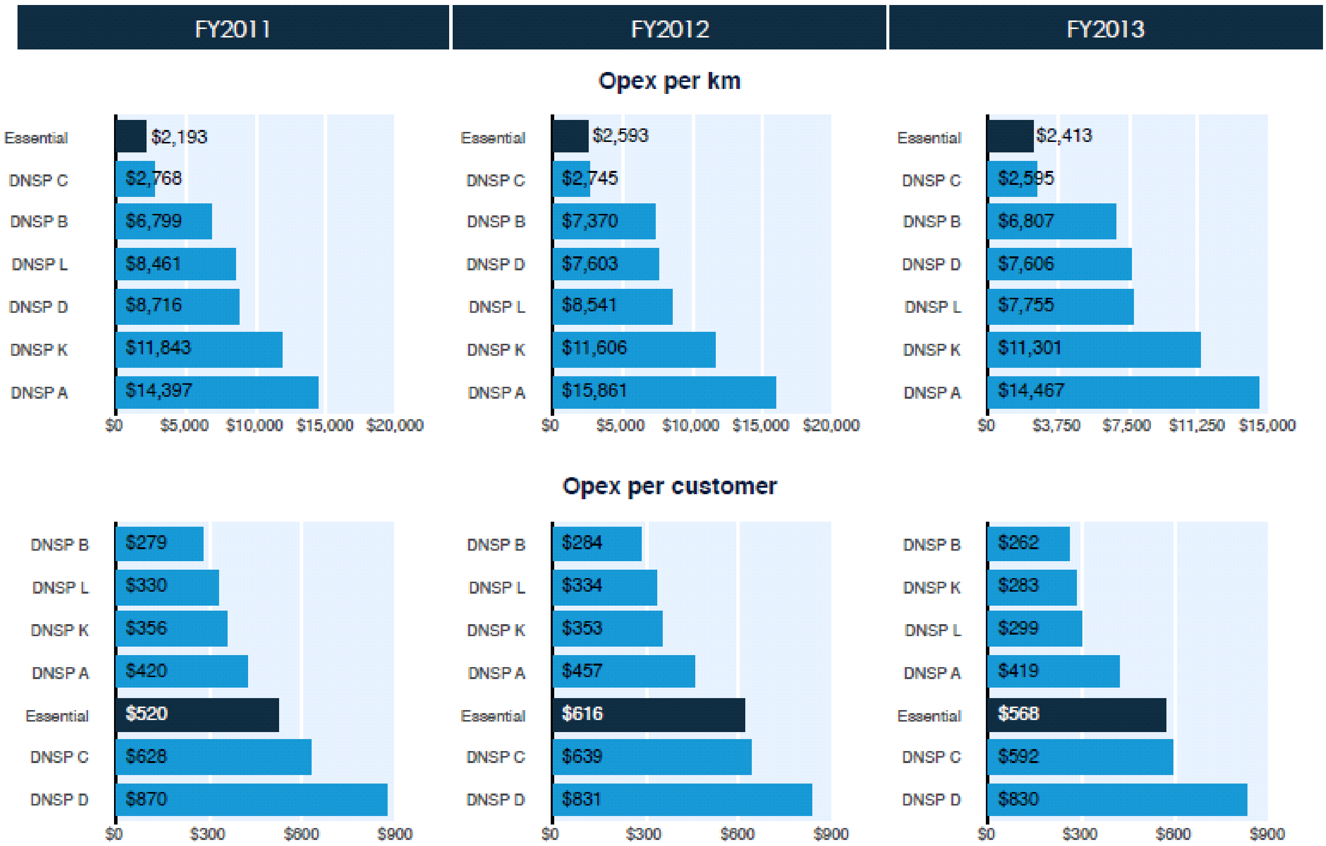
> Similarly trend data comparisons with other DNSPs cannot adequately account for circumstances driving investment in other DNSPs. For instance, other DNSPs may be undertaking similar efficiencies at the same time, or may have found a need to increase their replacement programs.

> We note that capex-opex substitution possibilities can impact the comparison over time. For instance, the reductions in capex may have an impact on opex forecasts.

Opex

Figure 3-3 shows Essential Energy’s opex per kilometre and by customer for each year from 2010-11 to 2012-13.

Figure 3-3 Opex ratios[18]



Similar to capex, the analysis underscores the weaknesses of using aggregated benchmarks in assessing our relative performance. For instance, on a kilometre of line basis we perform best out of our peers, but on an opex per customer basis we are in the mid-range of the participants. Once again this highlights our inherent network characteristics as a rural DNSP operating over a large network area.

[18] Huegin Consulting, “Distribution benchmarking study: Essential Energy”, 2014, p19

Figure 3-3 also shows that Essential Energy opex on a per kilometre and per customer basis increased between 2011-12 and 2013-14 but our relative ranking for these measures stayed consistent. As noted later in the document, these cost trends can be explained by a number of drivers including higher vegetation management costs.

Huegin also provided information which compares Essential Energy's opex levels over the current period (2009-14 period) through to the forecast period (2014-19) relative to other DNSPs, shown in Figure 3-4.

In the 2009-14 period, Essential Energy's compound annual growth rate was 3.9 per cent, but will fall to -0.7 per cent for the 2014-19 period.

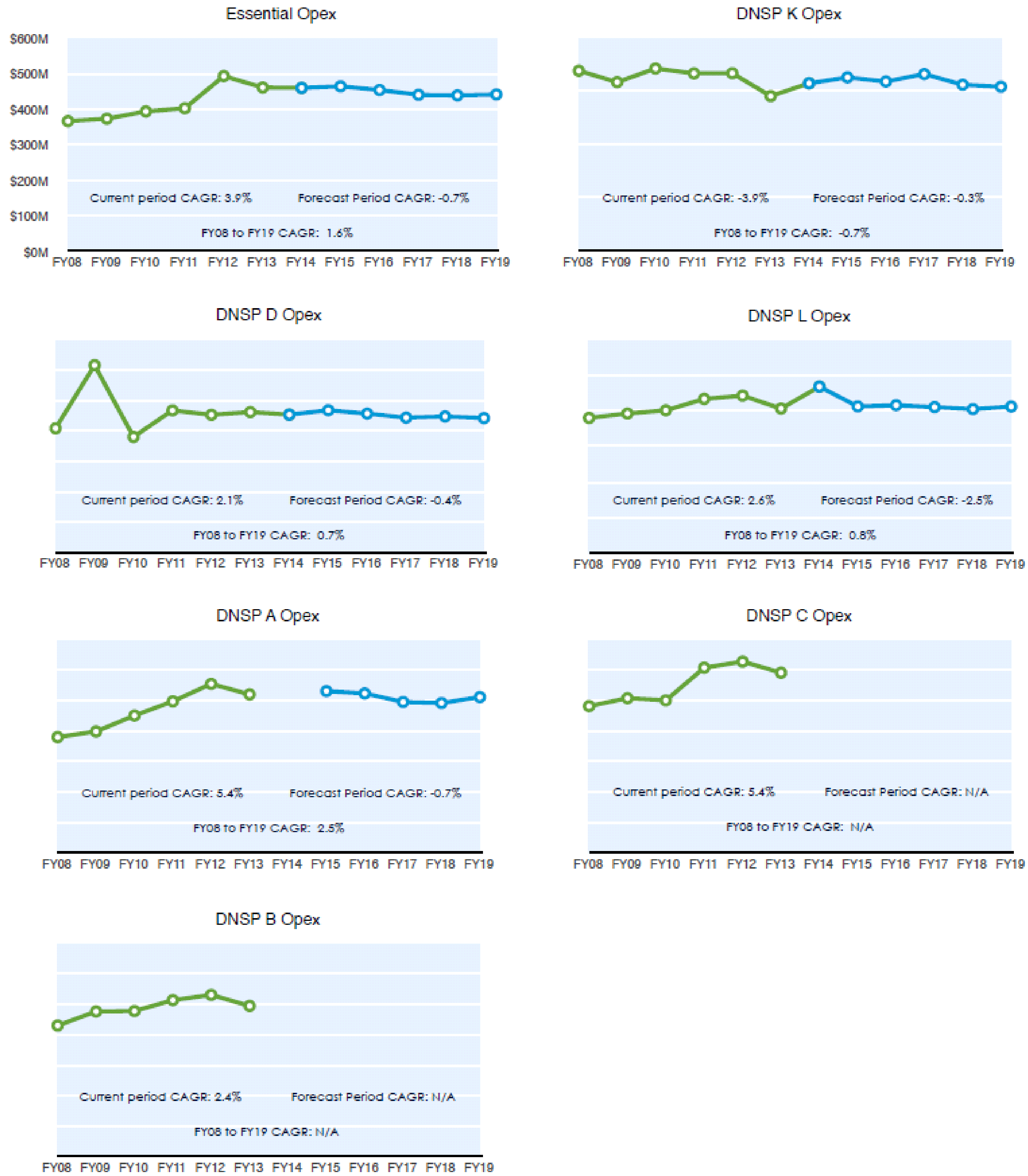
In our view, this is important in providing a high level view on the effectiveness of industry reforms on driving efficiency within our businesses. We believe that the evidence provided by Huegin provides a rough 'rule of thumb' to support the position that industry reform has delivered significant efficiencies in our opex forecasts.

We note that trends in opex over time are likely to provide more information than trend data for capex which is lumpy in nature. Nevertheless comparisons need to consider:

- The underlying drivers of Essential Energy's opex trends, including assessment of trends in cost categories. For example the trend may be affected by deterioration or improvement in underlying asset condition, which in turn influences maintenance costs. Similarly, the net benefit of efficiency programs (ie: the savings minus the costs) may be influencing costs in particular categories of expenditure.
- Whether the circumstances impacting other businesses is driving trends relative to the DNSP. For instance, other DNSPs may be undertaking similar efficiencies at the same time, or may have found a need to increase their replacement programs.

We note that capex-opex substitution possibilities can impact the comparison over time. For instance, the reductions in capex may have an impact on opex forecasts.

Figure 3-4 DNSP opex trends - actual and forecast[19]



[19] Huegin Consulting, "Distribution benchmarking study: Essential Energy", 2014, p16

4 Category level benchmarking

The AER notes that category level benchmarking allows it to compare expenditure across NSPs for categories at various levels of expenditure. Such benchmarking can provide granular cost assessments at the total level, or relative to operating conditions such as vegetation management costs per kilometre. Cost category analysis can also be used as a predictive model such is the case for the AER's repex and augex models.

Effectiveness of technique in guiding decision making

In our view category analysis partially meets some of the criteria identified in the Productivity Commission's report, but even this is dependent on the manner in which the tool is being used. For the most part, we consider that the benchmark outcomes will be highly unreliable and cannot itself be used to infer relative inefficiency.

- Validity – Theoretically, cost category analysis can lead to more valid conclusions on efficiency of operations than high level benchmarking tools such as economic and aggregate analysis. This rests on the assumption that cost categories are reported consistently across DNSPs and that the data can take into account the drivers of expenditure. From a practical perspective these assumptions do not hold true:
    - The DNSPs in Australia have historically defined and recorded costs using different categorisations. The AER has sought to solve the issue of inconsistency by defining common categories in the RIN for benchmarking purposes. However, the definitions are still open to considerable interpretation, and the data provided will not be on a 'like for like' basis due to historical accounting practices. For example, overheads can be interpreted in many ways and will depend on the intrinsic way in which a DNSP has recorded costs in the past.
    - In addition to definitional issues, many of the cost categories are highly inter-related with each other such as maintenance and replacement expenditure. If the category is seen in isolation, it may mislead an analyst to conclude that a DNSP is efficient in one area, and highly inefficient in another.
    - Even within cost categories there is often limited financial information to adequately account for a particular driver of expenditure. For example, data on distribution network projects generally are recorded in bulk on financial systems, and therefore there is limited ability to identify whether drivers of investment relate to a particular issue with a technology type, or a local driver such as a large new customer connection.
    - Finally there is no statistical method available to normalise for drivers underlying apparent cost differences. For instance, there is no sound method to account for the different costs that a DNSP incurs from constructing an asset in the CBD compared to an urban area.
- Accuracy and reliability – In many cases, the data can be verified with reference to financial systems and statements, and are accurate and reliable for that DNSP. However, due to the definition and interpretation issues identified above, the data cannot be relied on for the purposes of comparative data. Further, the AER's cost categorisations require DNSPs to map historical data and in some cases use 'best estimates'. Key examples are in splits by cost types of overheads which may draw on 'rough methods' due to insufficient data in financial systems. Given that this type of information is not drawn from actual data, there will be occasions when the data is not accurate or reliable to use for comparison.
- Robustness – As identified above, we consider that the data cannot be provided in a 'like for like' form and therefore cannot adequately control or normalise for operating differences between DNSPs.
- Manipulation of data – The AER's requirement that DNSPs provide best estimates where actual data cannot be provided, together with ambiguity on definitions may leave it open to a DNSP to report in a manner that puts its situation in the best light. This underscores issues with the reliability and accuracy of data when comparisons are drawn between businesses.
- Parsimony – To a degree, the AER's method of splitting opex and capex into cost categories is relatively straight forward. However, the AER has requested a high degree of granularity in data such as costs split by labour, materials and contractors. In our view this adds an additional degree of complexity that may lead the AER to form erroneous conclusions, and therefore do not meet the objective of parsimony.

- Fit for purpose – As explained below, cost category analysis may be fit for purpose, if used as a guide to the AER's detailed assessment of programs and projects rather than as a determinant or substitute for expenditure.

Despite not meeting the Productivity Commission's criteria, we consider that category benchmarking is potentially the best tool for a DNSP and regulator to apply when addressing the benchmarking factor. This is because it allows the business and AER to consider whether there is a particular driver underlying cost differences (higher or lower) than peer DNSPs, or where the costs of the DNSPs are changing compared to trend levels for a well explained reason.

In these cases, further examination should be undertaken of the high level cost drivers that may explain the variance. For example, a DNSP's replacement costs may be explained by the relative age or failure rates of the assets on its network, or a new safety standard for a jurisdiction. If variances cannot be explained by different cost drivers, then this would signal that further work needs to be undertaken to assess the reasons for the variance. In this case, the AER may seek to identify the forecast method that was implemented by the DNSP, and the application of that forecasting approach to investment programs and projects. For example, an apparently high unit cost may be explained by a large project that is conducted in the urban network which provides a false picture of cost trends over time.

In the sections below we show how available benchmarks have informed the development and review of our forecasts. We provide information on cost category data, and also address the repex and augex models.

Essential Energy's forecasts have been heavily influenced by industry reform that has focused on customer affordability. Comparative data between the three DNSPs and our industry peers have played a role in identifying areas of efficiency, although this has been limited by the inherent issues with undertaking benchmarking. Our experience is that granular data can often paint a misleading picture on the relative efficiency in an area. Even when assessing data amongst the three NSW DNSPs, we noted that variances were impacted by definition and cost accounting issues. For example, even simple metrics such as travel costs which form a component of overheads, could not be normalised given that the underlying drivers across the three DNSPs are so different. For instance, a rural DNSP such as Essential Energy is likely to have higher relative travel costs per employee than Ausgrid.

For this reason, the reform process and our review of our forecasts have used comparative data with a high degree of caution. Where data has been assessed, we have not taken a simplistic view of assuming that the variance relates to efficiency. Rather we have undertaken a 'bottom up' assessment of underlying policies, forecast methods and cost controls of the DNSPs, in combination with available data and the ground experience of our staff. In this way, we were able to precisely identify the actions within the control of management to deliver efficiencies, whilst continuing to deliver services to our customers.

For the purposes of addressing the benchmarking criteria, we commissioned Huegin to provide cost category comparisons of the benchmarking group using 2009-14 and 2014-19 data if available.. Further, we have examined the validity of specific cost category models such as augex and repex, including more detailed reviews of the model in Appendix B and C respectively.

Analysis of available data

Huegin Consulting undertook analysis of Essential Energy's expenditure levels for key categories relative to the six other DNSPs in the study. In the section below we set out the key results from the study for capex and opex categories.

Capex

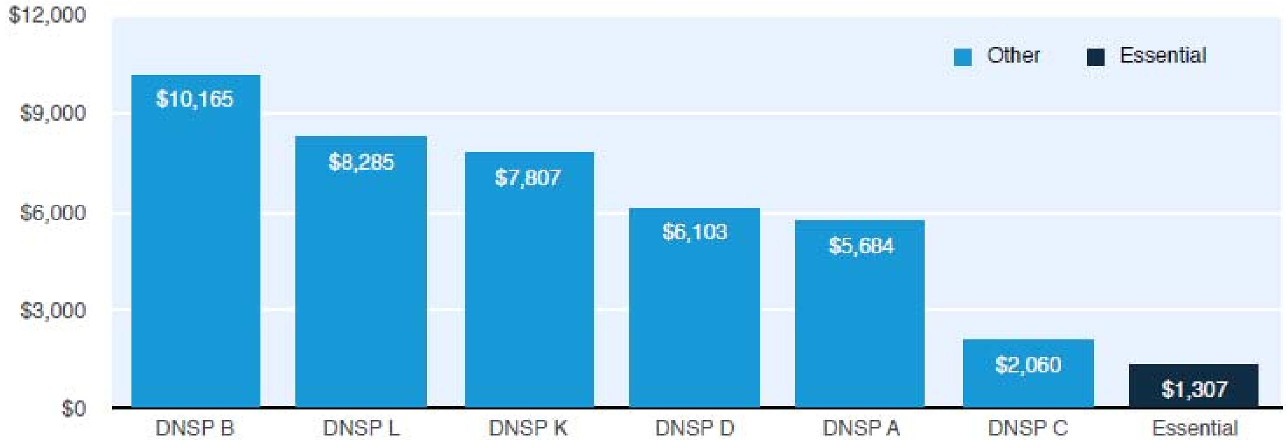
The Huegin study assesses the expenditure of DNSPs across three broad categories – augmentation, replacement and non-system capex. We note that these definitions are not common across DNSPs and in some cases a project may be driven by a combination of these drivers.

Augmentation expenditure

The AER note that this category of expenditure typically involves augmenting network components to ensure they have sufficient capacity to meet forecast demand. The AER have not been entirely clear about whether augmentation also includes works required to connect a new customer, as the AER refer to this as customer initiated connections. Huegin's report includes both customer initiated capex and reinforcements of the network for standard control services.

Huegin's study finds that Essential Energy's costs are far lower than the group average on a per kilometre basis, as shown in Figure 4-1, but higher on an MVA basis in the 2009-14 period. This relates more to the underlying drivers of augmentation at Essential Energy which has a large geographic area, and where the costs of increasing MVA of capacity are expected to be higher.

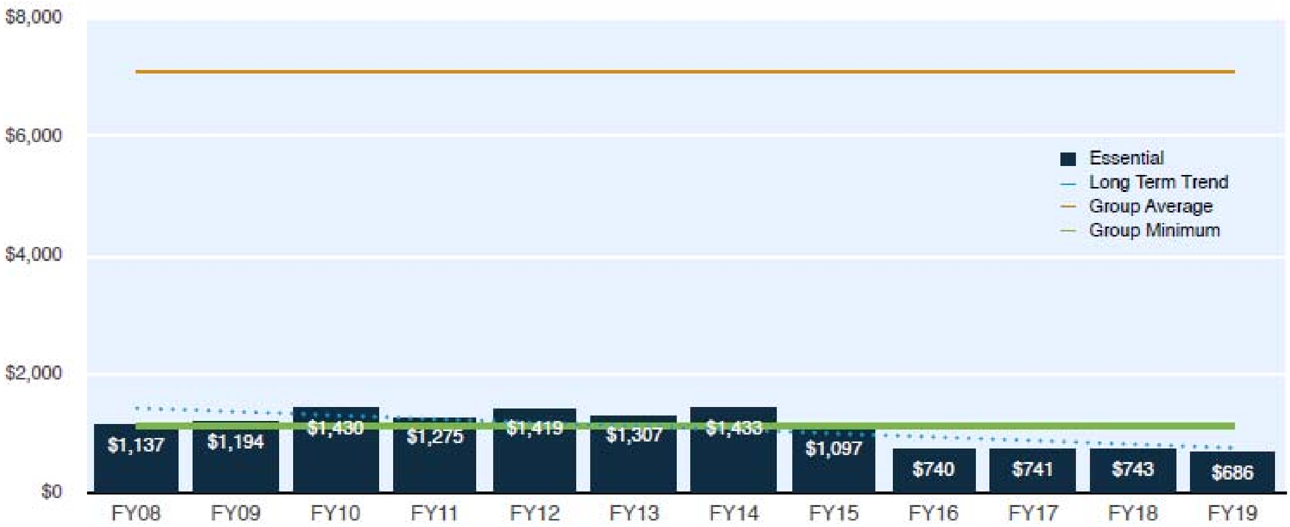
Figure 4-1 Augmentation capex per kilometre - FY13[20]



Essential Energy's augmentation expenditure is forecast to be considerably lower in the 2014-19 period than in 2009-14, as shown in Figure 4-2. These reductions in spend are associated with the industry reform process, and that we made significant inroads into meeting our backlog of works in response to new security criteria and reliability standards in our licence conditions.

[20] Huegin Consulting, "Distribution benchmarking study: Essential Energy", 2014, p22

Figure 4-2 Augmentation capex per kilometre - Essential Energy[21]



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.

In addition to the analysis of augex expenditure, the AER has indicated that it will also be using the augex model as part of its cost category analysis. The augex model compares utilisation thresholds with forecasts of maximum demand to identify the parts of a network segment that may require augmentation. The model then uses capacity factors to calculate required augmentation, and unit costs to derive an augex forecast for the DNSP over a given period. The model is applied to segments of the network such as the sub-transmission network, 11kV network and low voltage network.

The AER has not provided us with sufficient information to use the augex model as a basis for comparing our forecasts to that predicted by the model. While we have sought to undertake preliminary analysis, we have noted that data limitations and uncertainty on the AER's preferred segmentation have limited its use. For this reason our response focuses on the effectiveness of the model from a conceptual point of view.

The NSW DNSPs have prepared joint analysis which assesses the effectiveness of the augex model as a benchmarking tool (see Appendix B). Our key finding is that the model cannot be used to develop an alternative or substitute forecast due to deficiencies in functional form and data limitations.

We note that the tool has almost no use as a test of our forecasts given that the model cannot accurately account for the drivers of capex in the 2014-19 period. In particular, much of our augmentation expenditure is related to pockets of localised growth on the network as a result of spot loads from customer connections or urban infill. The model is not capable of segmenting sufficiently at these localised sections of the network. More information is found at Attachment B.

Replacement

The AER define replacement expenditure as the non-demand driven capex to replace an asset with its modern equivalent where the asset has reached the end of its economic life. Economic life is determined by the age, condition, technology or environment of the existing asset. The capital expenditure is regarded as replacement expenditure if it is primarily determined by the existing assets ability to efficiently maintain its service performance requirement.

Huegin note that replacement capex for Essential Energy is significantly lower than other DNSPs on a per kilometre basis, shown in Figure 4-3. However this also reflects the underlying characteristics of a rural DNSP that operates across a wide network area.

[21] Huegin Consulting, "Distribution benchmarking study: Essential Energy", 2014, p23

Figure 4-3 Replacement capex per kilometre - FY13[22]

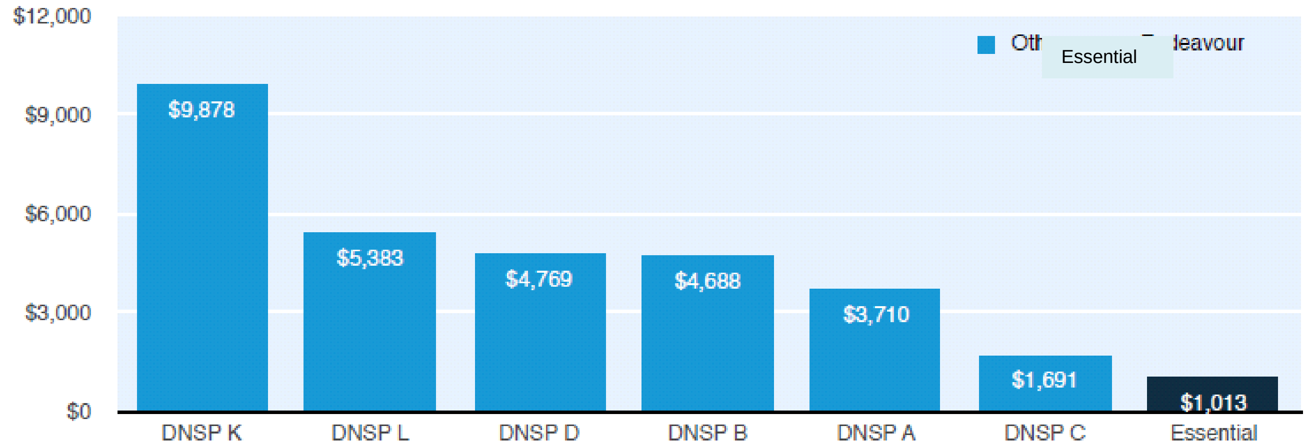
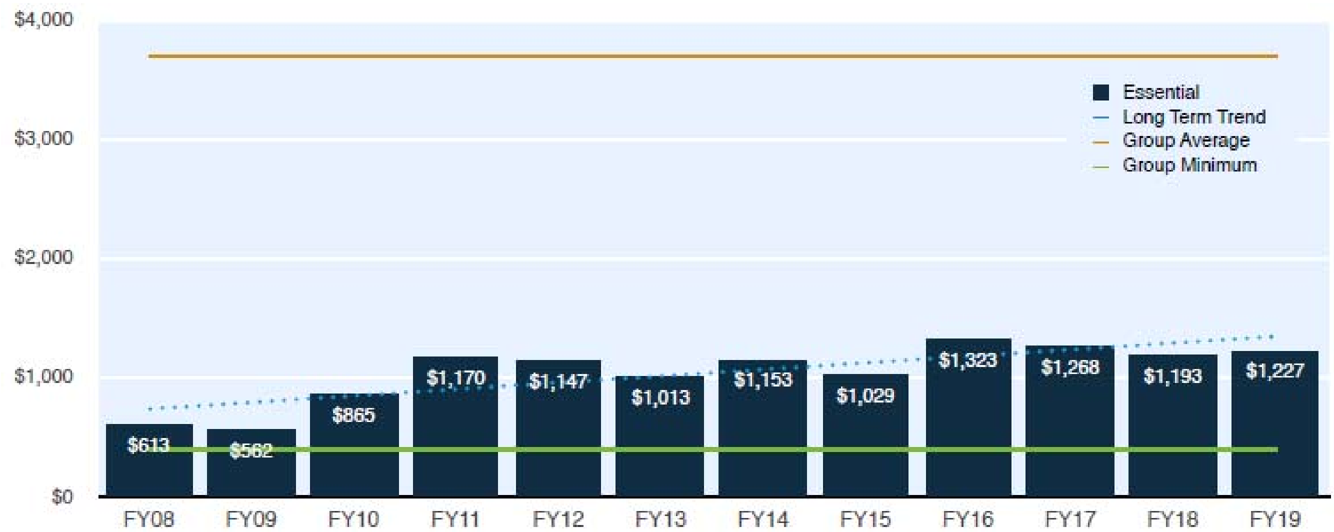


Figure 4-4 compares Essential Energy's replacement capex in the 2014-19 period relative to the 2009-14 period. It shows that Essential Energy is forecasting a higher level of capex relative to the current period, but reflects the long term trend (blue dotted line).

Figure 4-4 Replacement capex per kilometre - Essential Energy[23]



The continued upward trend in replacement expenditure (the blue dotted line) reflects the underlying deterioration in condition of assets on the Essential Energy network.

While we have sought to minimise expenditure, we still need to incur capex to maintain the reliability and safety of the network and ensure infrastructure is compliant. The majority of our proposed capex is to replace existing network assets that are reaching the end of life and exhibiting increasing risk of failure. In the current regulatory control period, we have made significant inroads into addressing condition issues. Despite this, the average age of our distribution network has continued to increase, and an ongoing investment program is needed to limit maintenance and breakdown costs, and manage safety (including public safety), environmental and other risks.

[22] Huegin Consulting, "Distribution benchmarking study: Essential Energy", 2014, p24
[23] Huegin Consulting, "Distribution benchmarking study: Essential Energy", 2014, p25

The key driver of replacement is the degradation of the condition of assets in the network. One of Essential Energy’s largest programs is the replacement of wooden poles. We estimate that over 40,000 poles will need to be replaced during the next regulatory control period.

In addition to replacement cost analysis, the AER will also be using the Repex model. It has been described by the AER as a high-level probability based model that forecasts repex for various asset categories based on their condition (using age as a proxy) and unit costs. The AER has used it in determinations to compare NSP forecasts with the repex model outputs to identify and target areas in its forecast program that required detailed engineering and business case review.

The AER has not provided us with sufficient information on how it will apply the Repex model as a basis for comparing our forecasts to that predicted by the model. While we have sought to undertake preliminary analysis, we have noted that data limitations and uncertainty on the AER’s preferred asset categorisations have limited its use. For this reason our response focuses on the effectiveness of the model from a conceptual point of view.

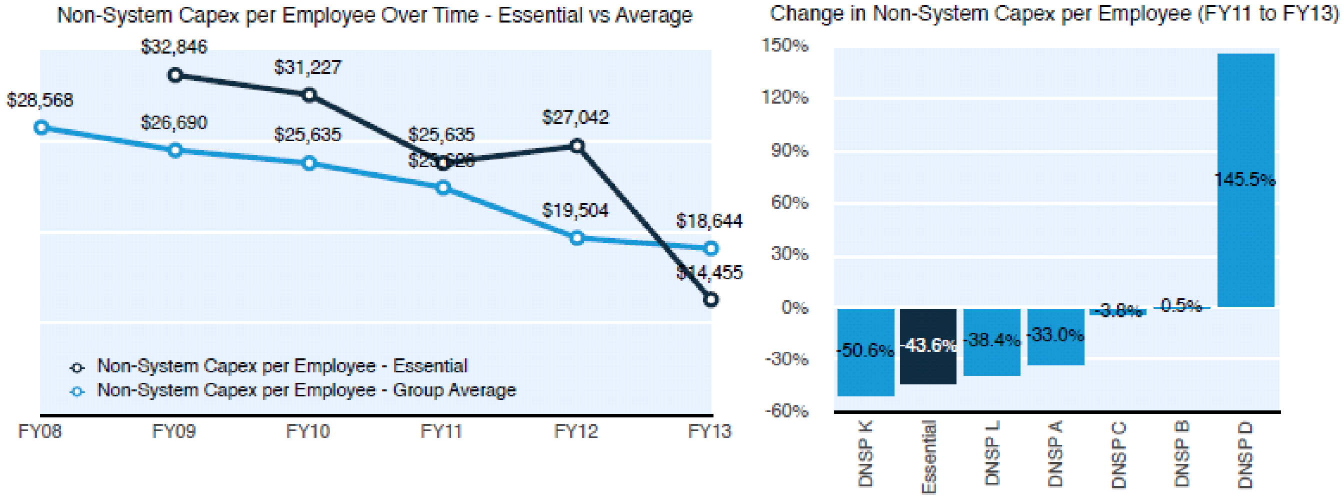
The NSW DNSPs have prepared joint analysis which assesses the effectiveness of the repex model as a benchmarking tool (see Appendix C). Our key finding is that the model cannot be used to develop an alternative or substitute forecast due to deficiencies in functional form and data limitations. We note that the tool may have limited use as an informative tool for particular asset categories when there is insufficient population size, instability in replacement cycles over time, non-uniformity in technology type, and the costs are relatively unstable over the population size.

Non system capex

The AER identified IT, motor vehicles, property, SCADA and network control expenditure as non-system capex. Huegin have assessed relative levels of non-system capex based broadly on these categories of expenditure.

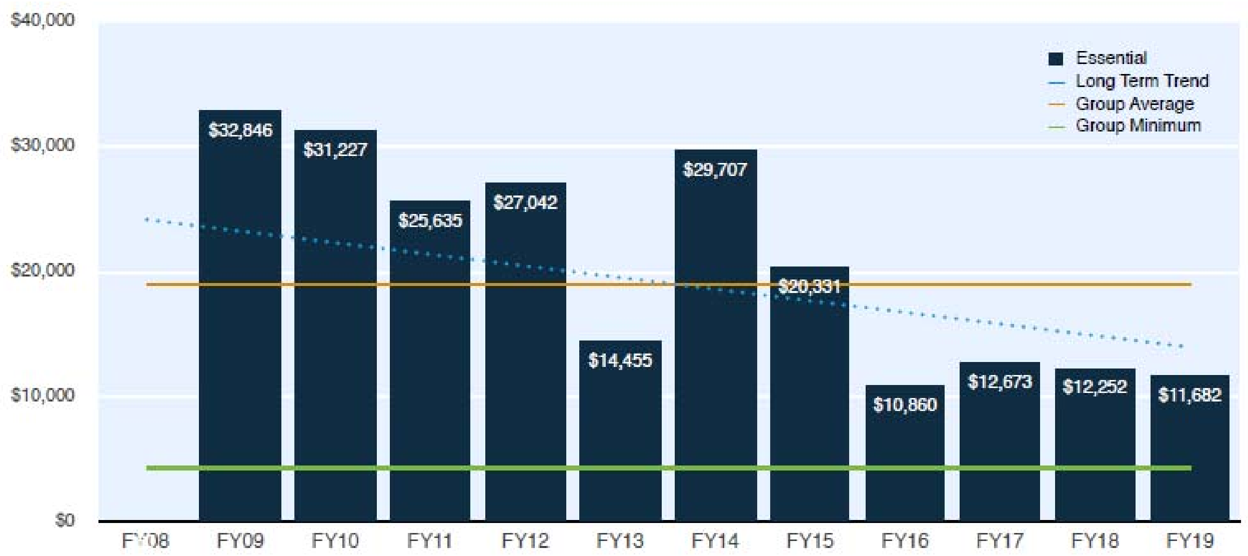
Essential Energy’s non-system capex was significantly higher than other DNSPs in the study in the first three years of the 2009-14 period as shown in Figure 4-5. Expenditure levels have shown a significant decline since 2011-12.

Figure 4-5 Non-system capex per employee[24]



As can be seen in Figure 4-6, this trend continues in the 2014-19 period, with average expenditure levels declining in comparison to the current regulatory control period. This indicates that industry reform has delivered significant results in reducing non-system capex through changes in strategy and leveraging non-system capex across the three DNSPs. It also may be indicative of the high levels of capex in the early years of the period that delivered new functionality to support the larger capex programs, and the change in strategy which changes the focus of expenditure from delivering new capabilities to maintaining existing functions.

Figure 4-6 Non-system capex per employee - Essential Energy[25]



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.

Opex

[24] Huegin Consulting, "Distribution benchmarking study: Essential Energy", 2014, p27
[25] Huegin Consulting, "Distribution benchmarking study: Essential Energy", 2014, p27

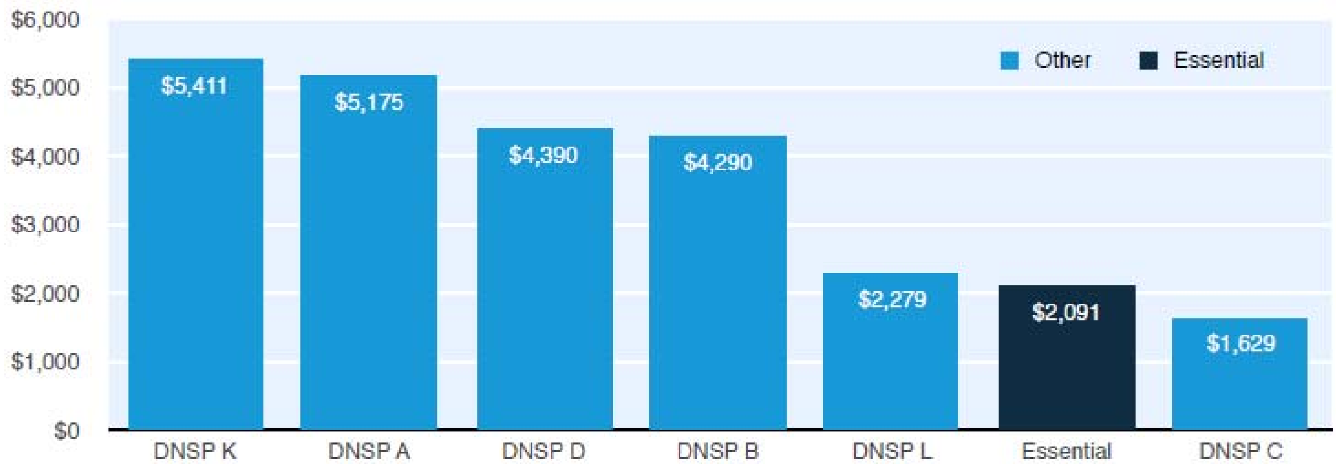
The Huegin study assesses opex of DNSPs across two broad categories – maintenance and operations costs. We consider that relative costs among DNSPs are likely to be shaped by capitalisation policies, age and other factors outside the control of management

Maintenance

The AER define maintenance and emergency response to include all works to maintain the current working condition of an asset or to address the deterioration of an asset. These works include those that may be driven by reliability deterioration or an assessment of increasing risk of failure or performance degradation of a network asset. The AER consider that maintenance related to vegetation management is a separate category of expenditure defined as the process of keeping trees and other vegetation clear of electricity lines to reduce related outages and the potential for fire starts. Vegetation management also includes clearing easements and access tracks associated with electrical assets. Huegin's analysis includes vegetation management as part of its definition of maintenance.

Figure 4-7 shows that Essential Energy's maintenance costs on a per kilometre basis is the second lowest of the seven DNSPs in the study. Huegin note that there are a number of costs drivers of maintenance. For instance, long and radial networks in regional areas carry a significant cost premium in travelling between assets. At the same time, costs can be higher for DNSPs such as Ausgrid that operate in dense, urban areas where there is traffic congestion and greater sharing of common infrastructure.

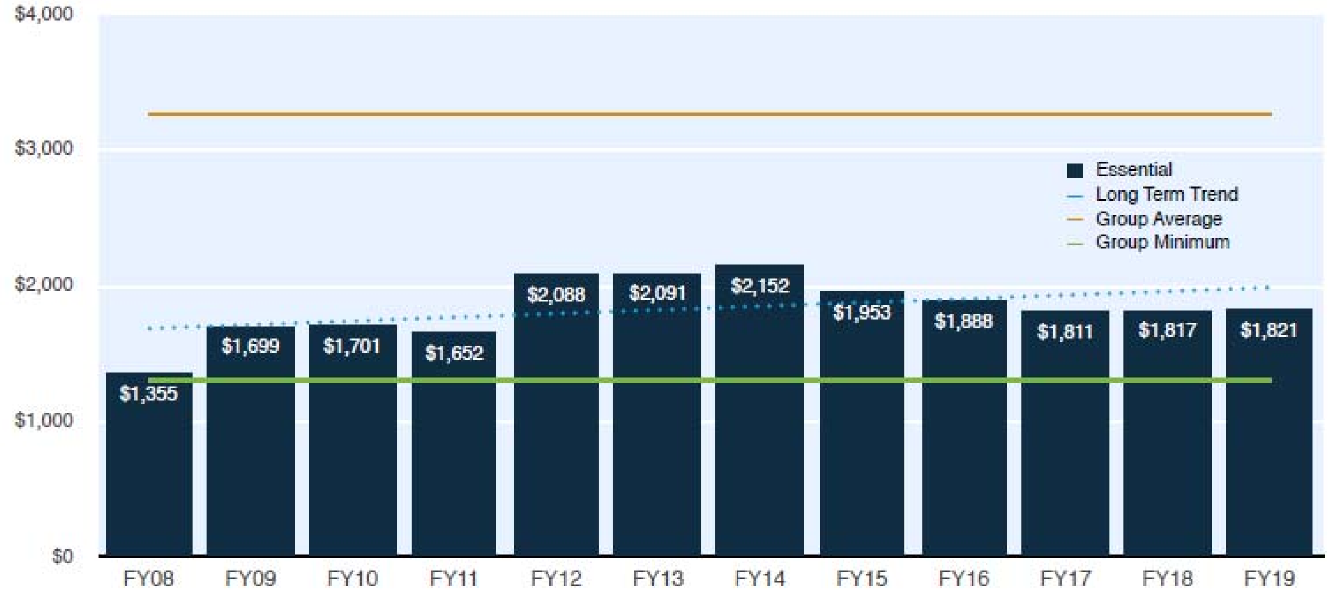
Figure 4-7 Maintenance opex per kilometre - FY13[26]



Huegin also compared the trend in Essential Energy's performance from 2009-10 to 2014-19 and compared this to forecasts for the 2014-19 period. Figure 4-8 shows that Essential Energy's maintenance expenditure is falling compared to the last year of the 2009-14 period, and is relatively flat. The change in the opex profile is largely explained by Essential Energy's largest opex category – vegetation management.

[26] Huegin Consulting, "Distribution benchmarking study: Essential Energy", 2014, p28

Figure 4-8 Maintenance opex per kilometre - Essential Energy[27]



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.

Due to the wide expanse and overhead nature of Essential Energy's distribution network, vegetation management is the most significant operating expenditure category in dollar terms. Our policy is to clear vegetation from power lines in accordance with ISSC3 28. Compliance with this policy is a critical control measure associated with management of bushfire risk.

The majority of vegetation management work is generated and undertaken in one of two ways:

> a systematic and regular program of vegetation clearance work carried out on power lines based on a prescribed cutting cycle (referred to as cyclic vegetation clearance); and

> spot cutting of defects arising from annual aerial patrols carried out to remove higher risk, individual incursions of vegetation into the clearance envelope.

Spot trimming removes risk quickly but it is not the most efficient measure in the long term. Our strategy is to keep vegetation to allowable standards by moving to a mainly cyclic vegetation clearing process over a period of time. Recent action has been taken to reduce spot trimming backlogs and shift resources into cyclic trimming. We expect the number of problem areas detected through our annual aerial inspections to be significantly reduced in future.

The total indicative forecast for this regulatory control period has been based on achieving efficiencies through a number of strategic reform initiatives, including the adoption of the approach described above, ensuring appropriate end-to-end management capability and having an adequate vegetation management system as the key enabler. This will deliver the best long-term cost outcome whilst also managing the risks associated with vegetation encroachment on power lines.

[27] Huegin Consulting, "Distribution benchmarking study: Essential Energy", 2014, p29
28 Industry Safety Steering Committee, *ISSC 3 Guideline for Managing Vegetation near Power Lines*, December 2005.

Operations opex

Huegin define operations opex as network control, systems operations, customer operations and support functions such as IT, property and fleet management. This broadly relates to the AER's definition of non-network costs.

Huegin's 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 are shown in Figure 4-9.

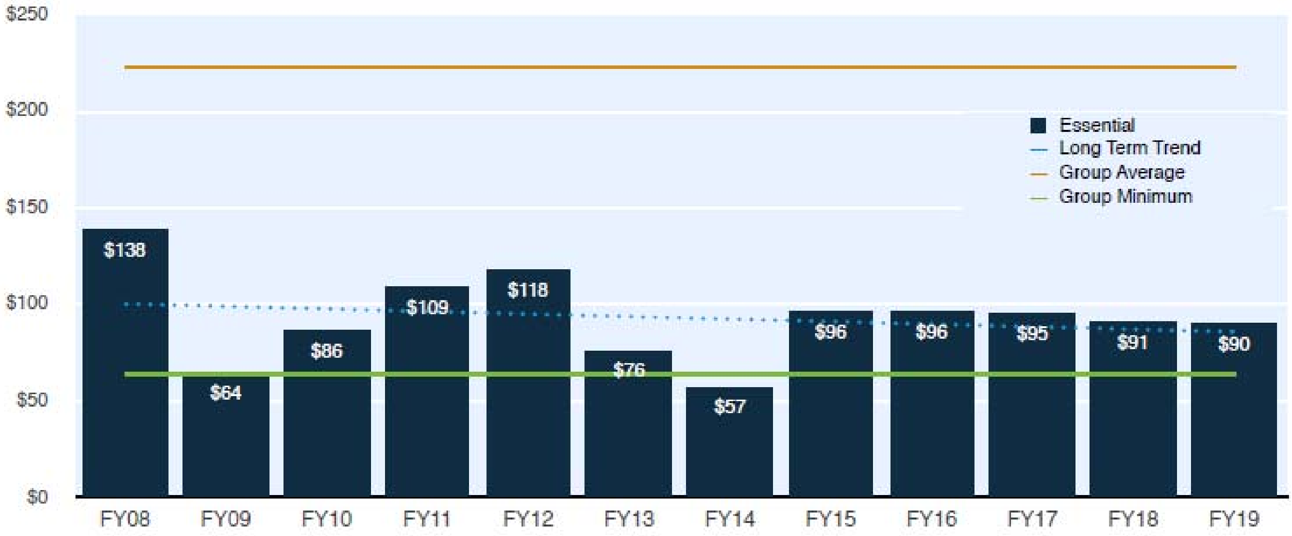
Figure 4-9 Operations opex per customer - FY13[29]

Huegin's analysis shows that Essential Energy's operations opex is the lowest of the DNSPs surveyed, Huegin note that operating costs are largely driven by the location and complexity of the network, customer base and the business scale. This makes comparison particularly difficult, as the number and relative influence of cost drivers varies across businesses.

Huegin also compared the trend in Essential Energy's performance from 2007-08 to 2018-19. Figure 4-10 shows that Essential Energy's operating costs were significantly higher in 2011-12 compared to forecasts in the 2014-19 period. We consider there are a range of drivers influencing lower costs including industry reform.

[29] Huegin Consulting, "Distribution benchmarking study: Essential Energy", 2014, p30

Figure 4-10 Operations opex per customer - Essential Energy[30]



Notes:

1. All figures in FY2013 dollars.
2. Customer numbers for future years have been forecast using the historical growth rate (0.7%).
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.

[30] Huegin Consulting, "Distribution benchmarking study: Essential Energy", 2014, p31

Appendix A – The Huegin report

Report commences overleaf.

Distribution Benchmarking Study

2014

Essential Energy

Essential Energy Distribution Business Benchmarking Study

An updated analysis of comparative cost performance for Essential 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. Attempts to use benchmarking to gauge efficiency are likely to bring attention to some areas of the Essential Energy current and forecast expenditure.
4. Whilst there may be few surprises in the specific areas of attention, understanding the performance of peers and the magnitude of differences is useful to gauge efficacy of current cost management efforts.
5. Essential Energy has arrested this period's growth in opex for its upcoming period forecast, however the regulator may expect more.
6. The forecast increase in maintenance opex will require strong justification, although it is offset by a considerable decrease in operations opex from an already strong position in this category.
7. Reduction of system capital expenditure is likely to be a target of the regulator - Essential Energy's moderate replacement capex forecast and significant augmentation capex reduction should compare favourably.
8. Non-System capex has been one target of industry reform, and the recent halving of these costs by Essential Energy, and the forecast holding of this position, should benchmark well.
9. Overhead structures and expenditures are likely to be in focus during the determination; Essential Energy's dispersed locations constrain the potential for scale efficiencies, however Essential Energy should at least be benchmarking itself against the other one or two DNSPs in Australia with similar rural, geographically dispersed assets and customers.

Inside

Disclaimer

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Note that information provided by participating businesses was used by Huegin in the formation of conclusions and recommendations detailed within this presentation.

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About the Report

This report represents an analysis of Essential 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 demonstrated an evolving approach 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, myriad reviews of the electricity industry from bodies such as the Productivity Commission and Australian Competition and Consumer Commission (ACCC) 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 then led to the release by the AER of its Expenditure Forecast Assessment Guideline which outlines the 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 benchmarking[1]

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

Technique	Description
Tornqvist Multilateral Total Factor Productivity (MTFP)	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. 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 Analysis (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
- Category analysis
- Targeted review of projects and programs
- Sample review of projects and programs

The focus of this report is the benchmarking aspect of the approach.

Multiple approaches produce multiple results to choose from

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: o Augmentation capex o Replacement capex o Non-network capex o 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: o Maintenance and emergency response opex o Vegetation management opex o 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 approached 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

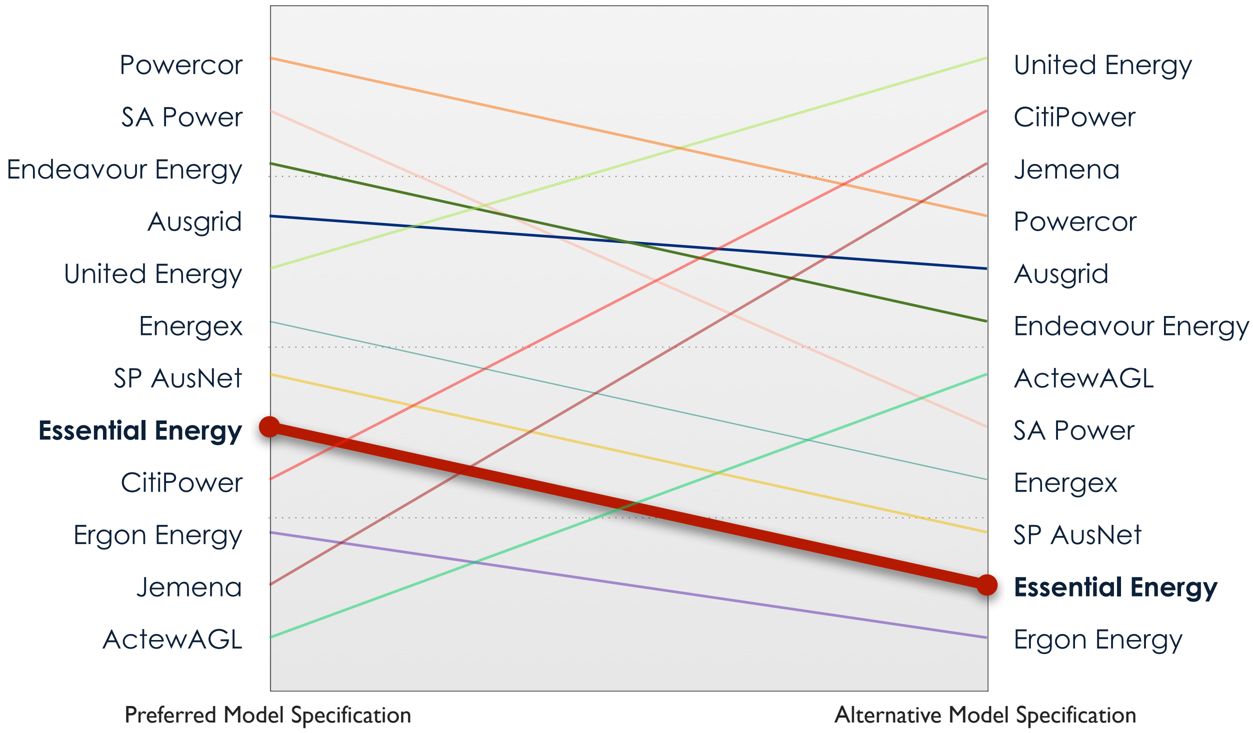
Errors and bias are natural outcomes when striving to fit an academic construct such as an economic model to the real world. An economic model is a simple abstract of a very complex reality and is thus limited in its ability to describe complex, non-linear relationships between variables that are often 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. Other common outputs include peak demand, energy delivered, service area and network length. Below are benchmarking rankings using 2008/9 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 (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 Essential Energy, the preferred model is 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.

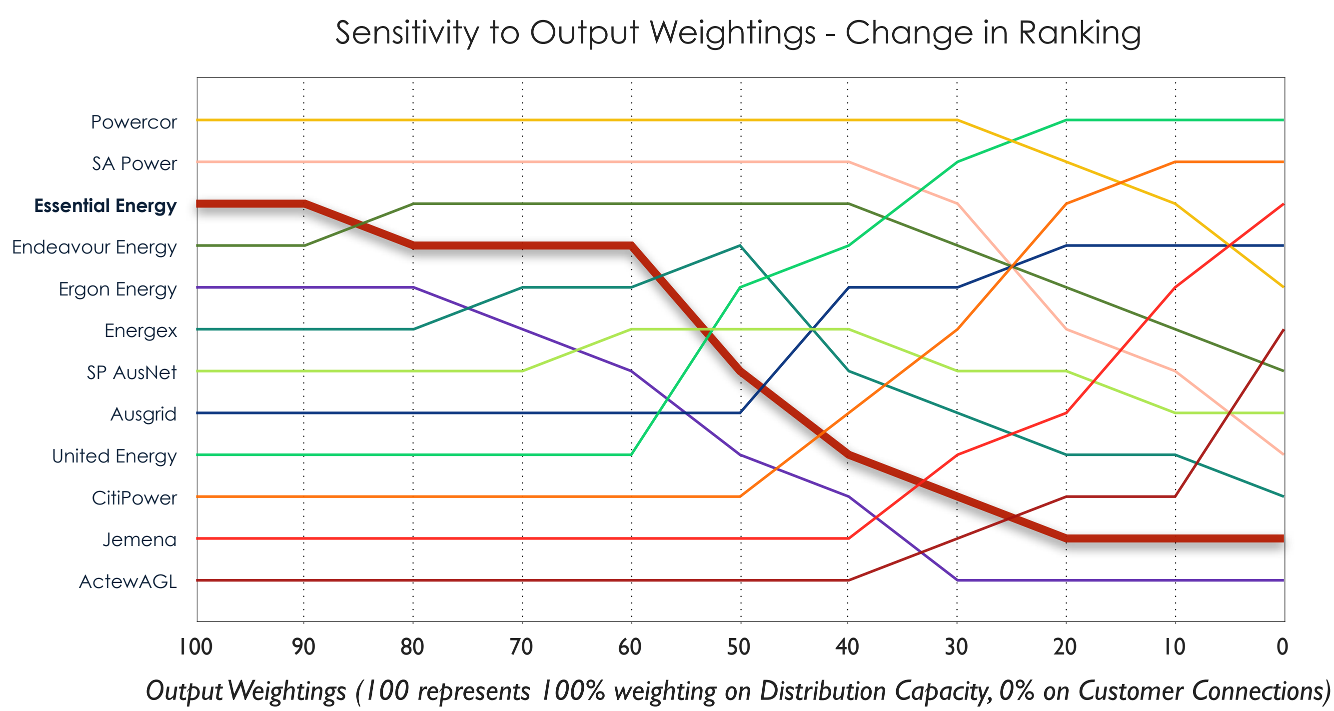
Signals for Essential Energy

To the extent possible by the available data and without confirmation of the exact specification of the economic benchmarking models, Huegin has developed its own economic benchmarking models to present analysis of likely outcomes for electricity distributors. Focusing on Essential 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, Essential Energy is unlikely to be the most efficient through an MTFP ranking - using the model specification and data from our model, Essential Energy can expect to land somewhere between eighth most efficient to the bottom of the sample.

Variable selection is not the only degree of freedom in the construct of the economic models. 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.



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, Essential Energy can expect to be placed between fifth and eleventh ranked for efficiency.

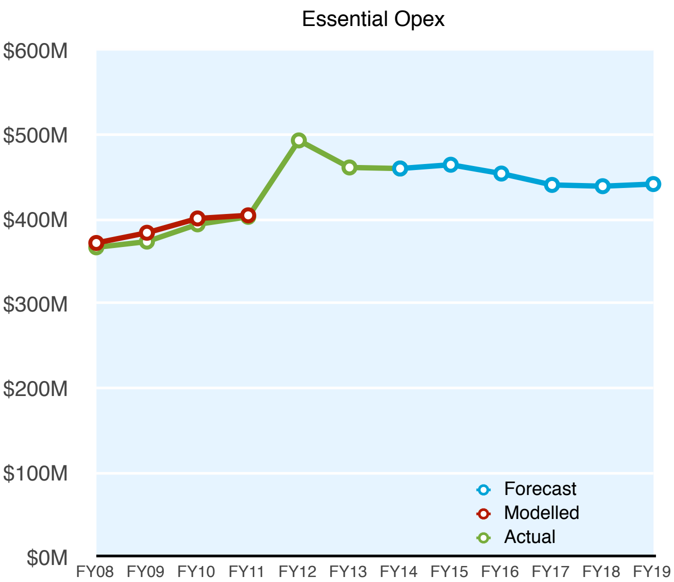
Again, the analysis will change with the release of the AER's exact model specification and industry data, however these ranges are not unexpected for Essential Energy based on previous studies and our experience with the application of economic benchmarking in Australia.

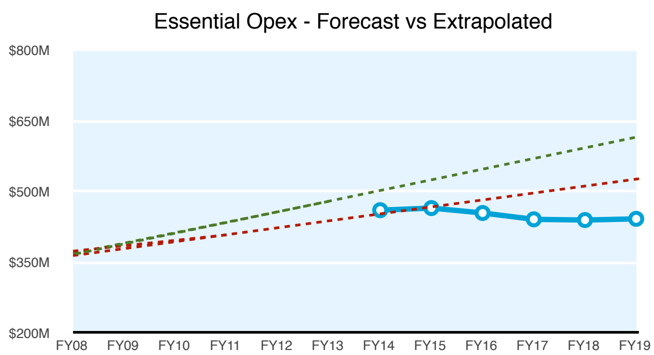
Analysis can identify potential outcomes for individual businesses within the industry

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 Essential Energy, compared to actual and forecast opex. Essential's opex in the current period has increased 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 below the extrapolated trend of historical expenditure and similar to the extrapolated econometric prediction.

Essential - *forecasts are below both the predicted and extrapolated historical trend*





Variation between:	$	%
Extrapolated Actual and Forecast		
Extrapolated Modelled and Forecast		
Extrapolated Actual and Extrapolated Modelled		

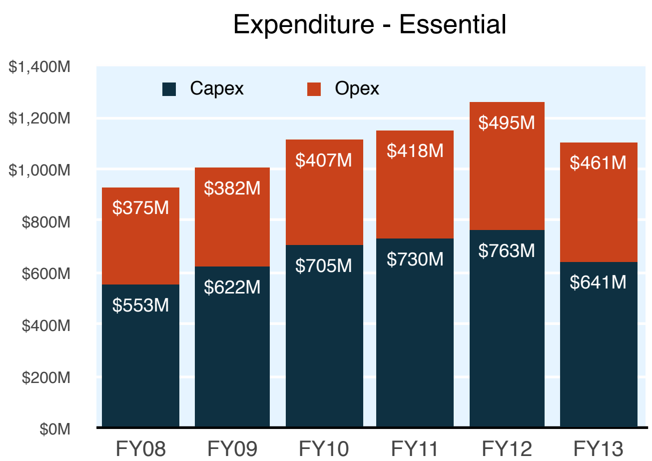
Notes:
1. All dollar figures converted to FY13/14 dollars.
2. No adjustments made to actual figures for non-recurrent costs.
3. Modelled opex is based on extrapolated values from the Huegin econometric model - the AER analysis will differ.

There are more simple means of testing performance

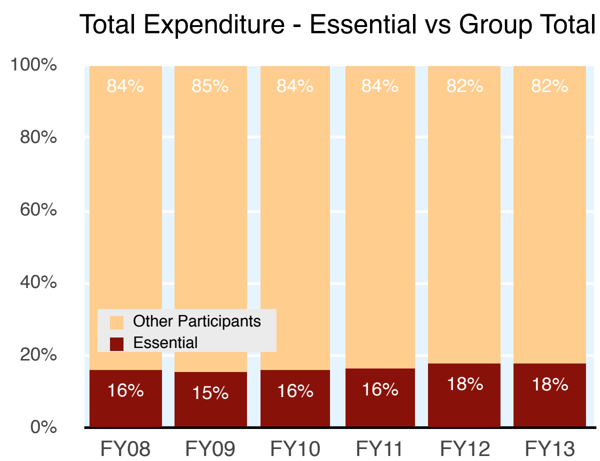
Much of the economic analysis is dependent upon incremental changes in the inputs and outputs defined in the models compared to the industry changes in inputs and outputs. Given the inherent inaccuracy of models, often simple comparisons of rates of change can provide just as much information as to productivity 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 amount 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 Essential Energy versus the benchmarking group average in the period 2008 to 2013 and current and forecast (where available) trends for each individual business.

Aggregate Trend Analysis - Essential and the Benchmark Group



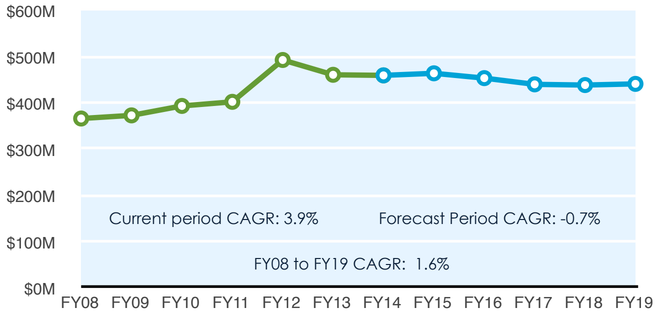
Essential's expenditure has fallen in the most recent complete financial year after several years of increases in both opex and capex.



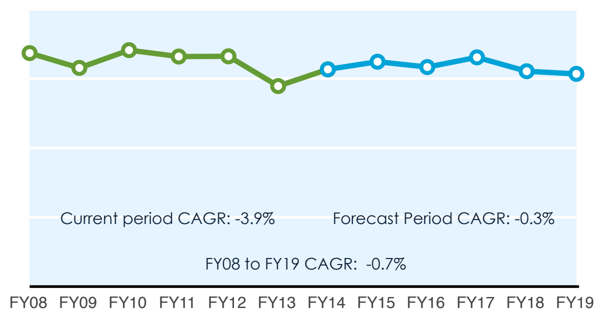
*Amongst the benchmark group, Essential's "share" of total group expenditure has risen from **16%** in FY08 to **18%** in FY13, with a low point of **15%** in FY09.*

DNSP Opex Trends - Actual and Forecast

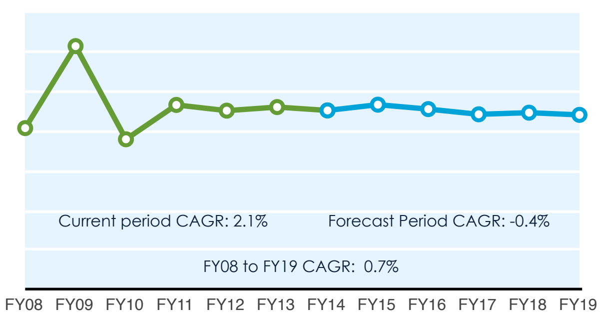
Essential Opex



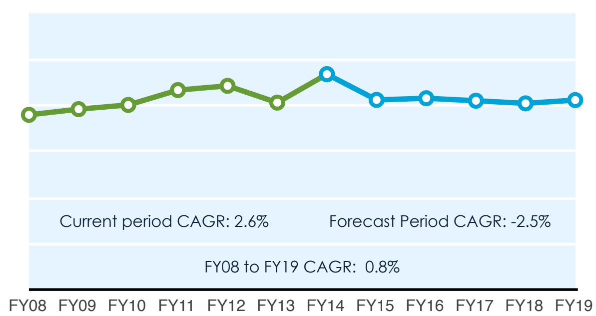
DNSP K Opex



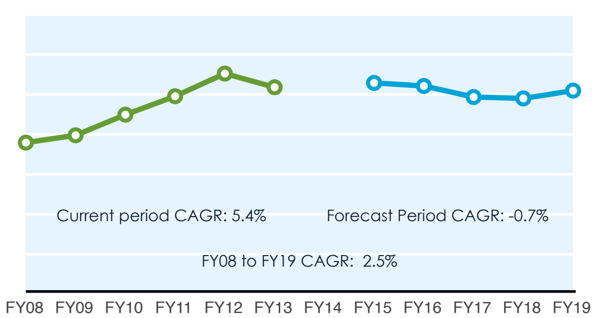
DNSP D Opex



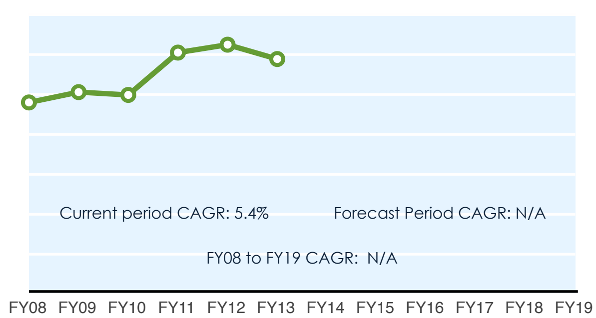
DNSP L Opex



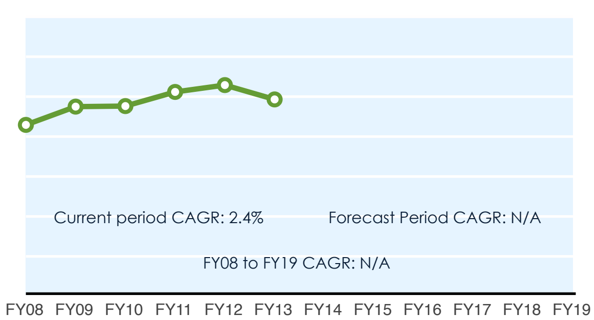
DNSP A Opex



DNSP C Opex

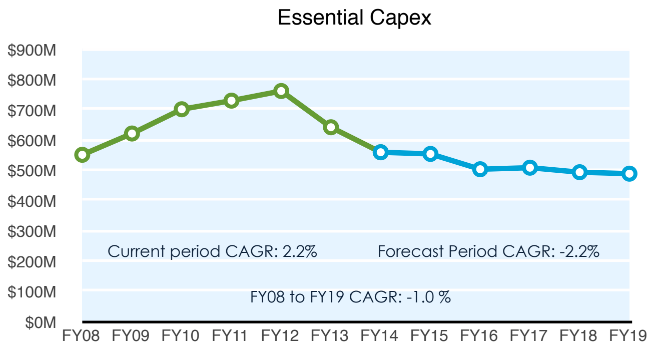


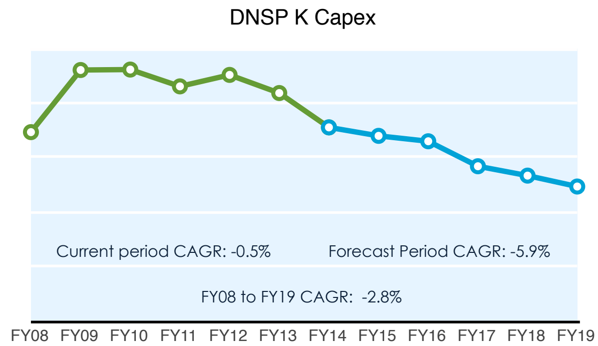
DNSP B Opex

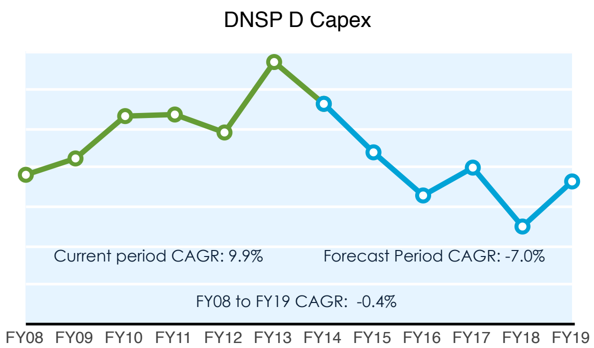


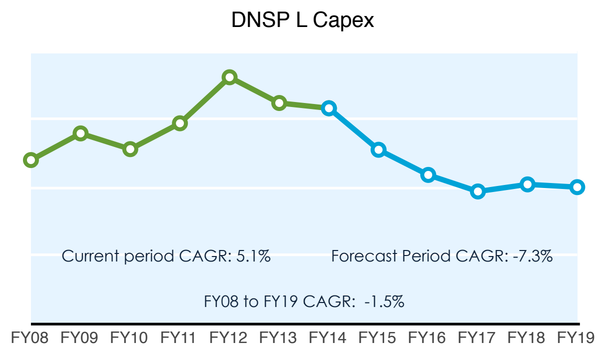
Notes:
1. All figures in FY2013 dollars.
2. Data sources are the RINs and directly supplied data from DNSPs.

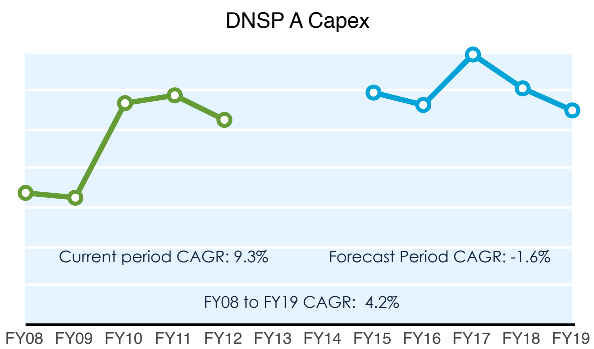
DNSP Capex Trends - Actual and Forecast

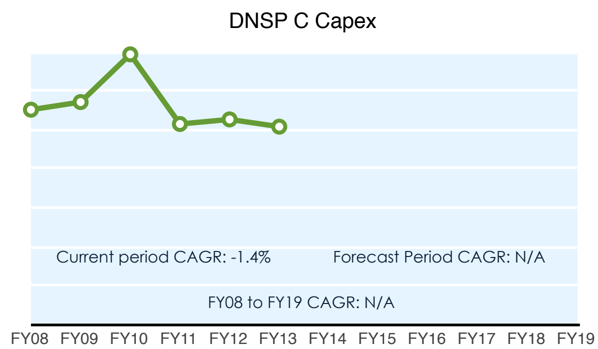


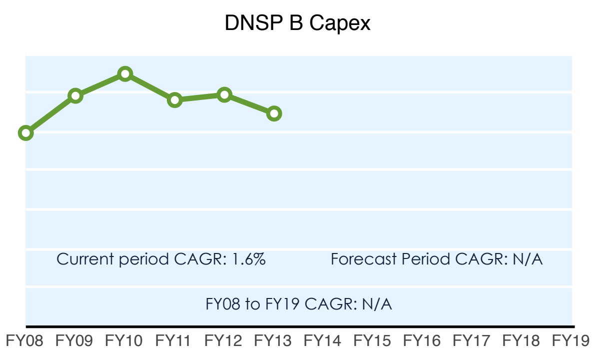












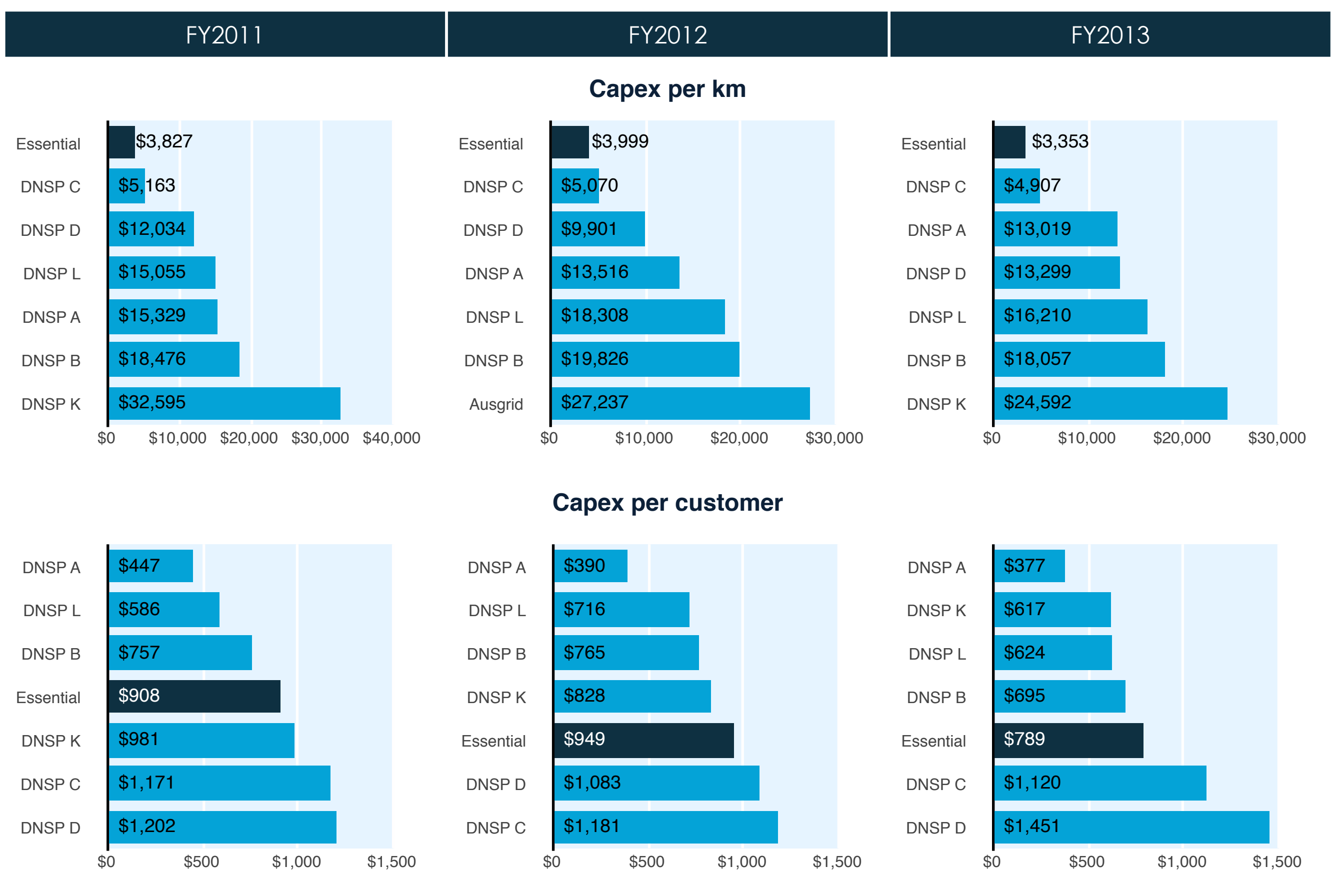
Notes:
1. All figures in FY2013 dollars.
2. Data sources are the RINs and directly supplied data from DNSPs.

Measuring Reform Progress

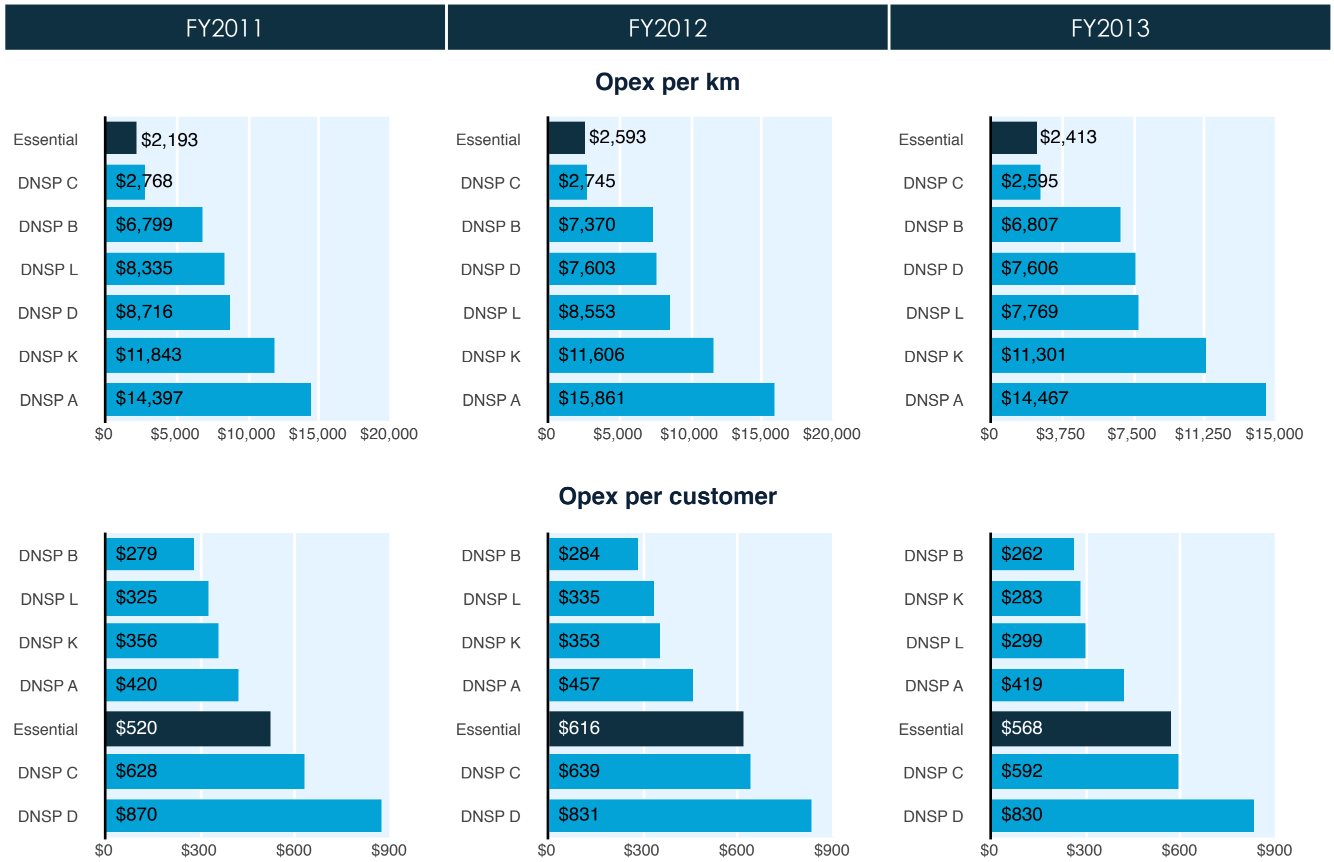
It is useful to understand the current benchmark position of the NSW businesses relative to peers given the considerable change in the past two years. The previous Huegin benchmarking report compared costs across many categories for nine distribution businesses. The report highlighted some differences in cost outcomes and also identified many cost 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

Changes in the period for Essential Energy for each ratio is 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.

	Essential Energy Position		
	FY11	**FY12**	**FY13**
Capex per km	1st	1st	1st
Capex per customer	4th	5th	5th
Opex per km	1st	1st	1st
Opex per customer	5th	5th	5th

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:

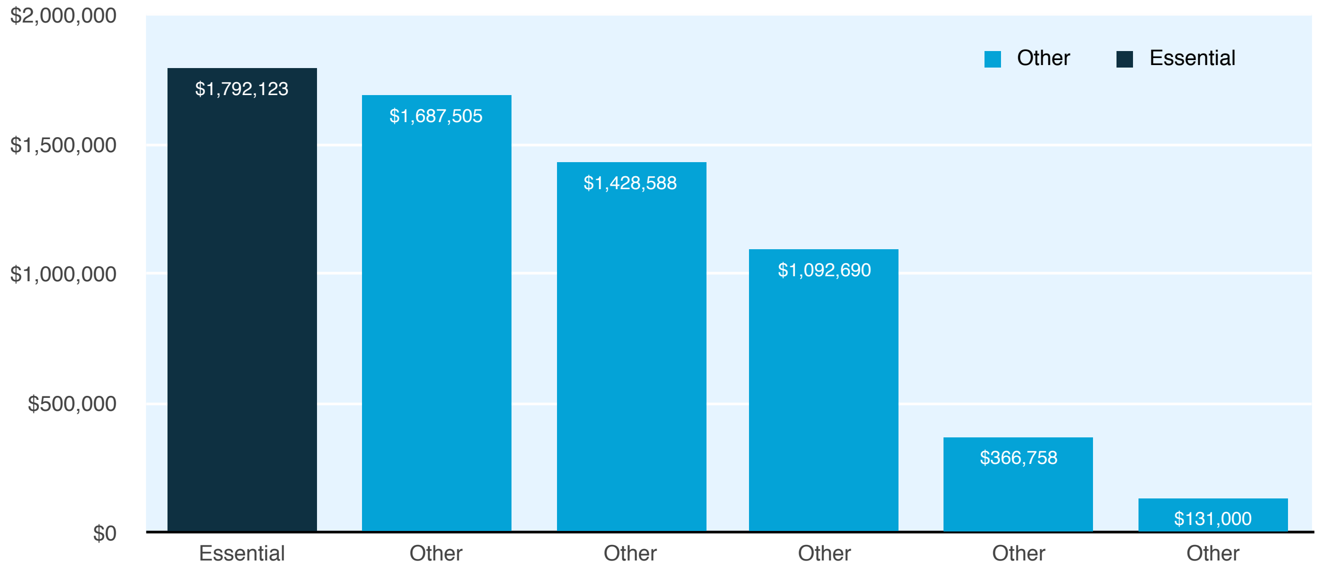
1. Victorian expenditure for 2011 is based on the AER allowance.
2. NSW and QLD expenditure data is from Regulatory Information Notices and data supplied directly to Huegin.

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.

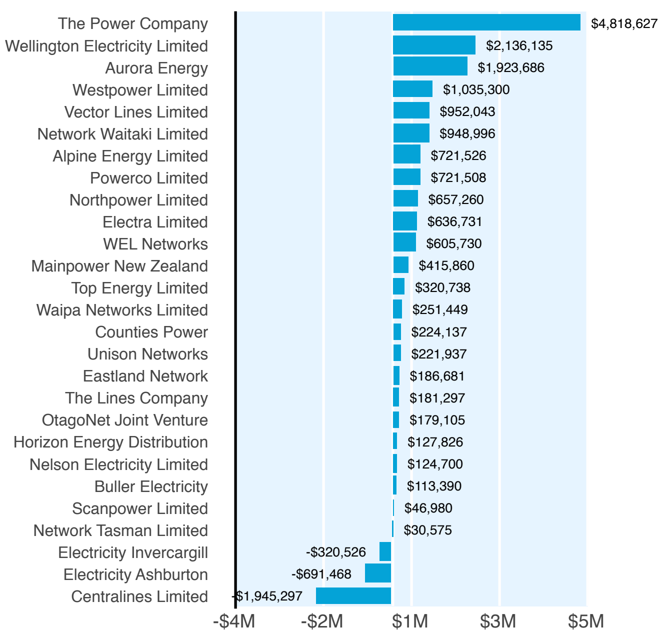
Augmentation capex is difficult to benchmark; one readily available ratio is augmentation spend per MVA capacity added...

Augmentation Capex per MVA added (FY12)

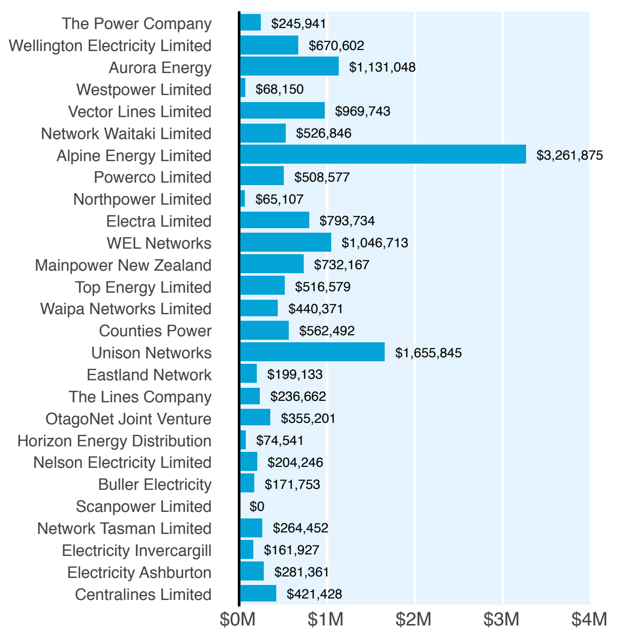


...but as illustrated by data from New Zealand, the ratio is limited in its ability to inform relative efficiency assessments

Augmentation Capex per MVA added (FY10)



Augmentation Capex per MVA added (FY11)

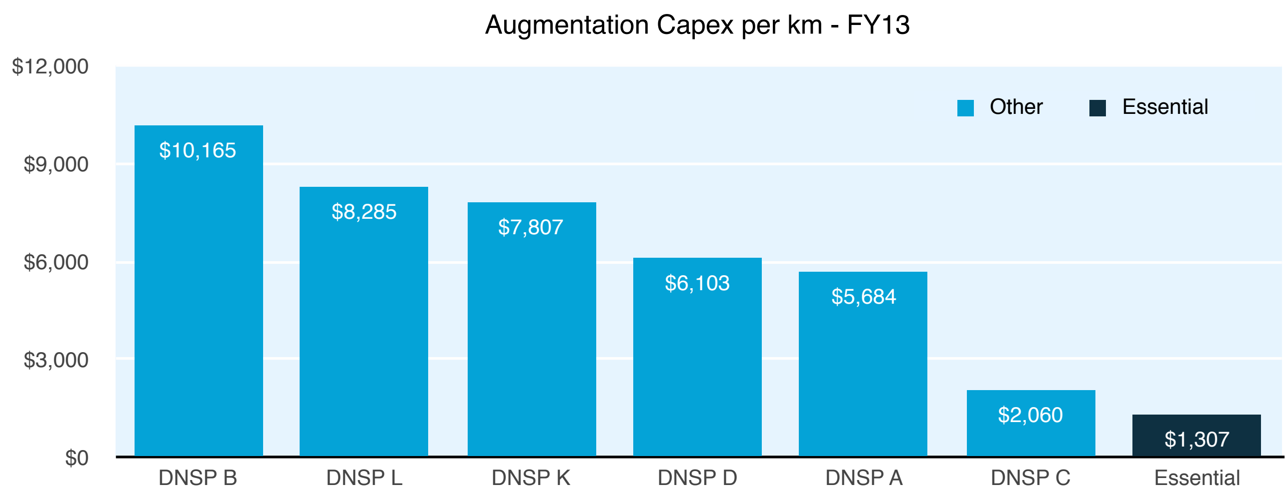


Not only are some individual years negative, but the volatility from year to year is significant, with the businesses ranked from highest cost to lowest on the basis of the FY10 results in each plot.

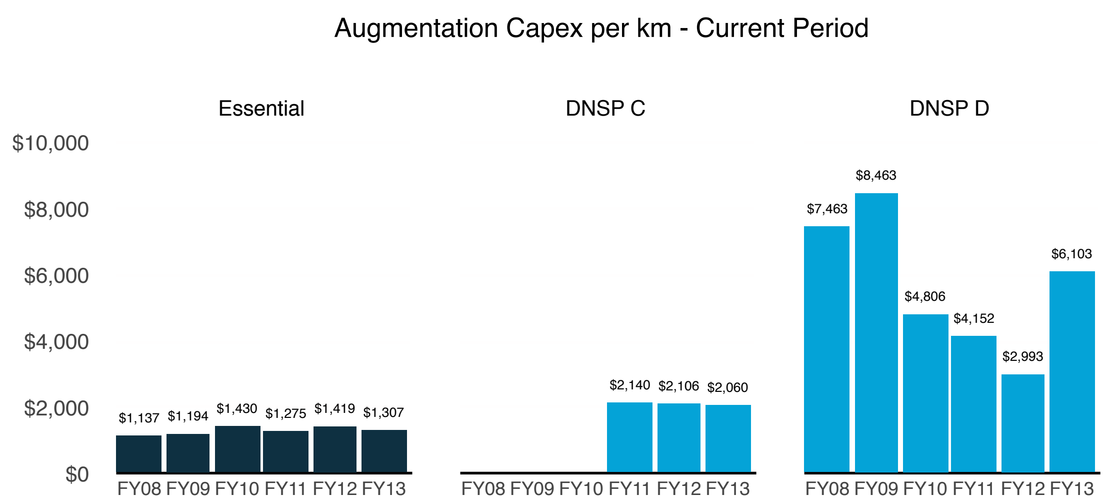
Recent conditions will place a focus on augmentation capex

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 network[2]. 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.

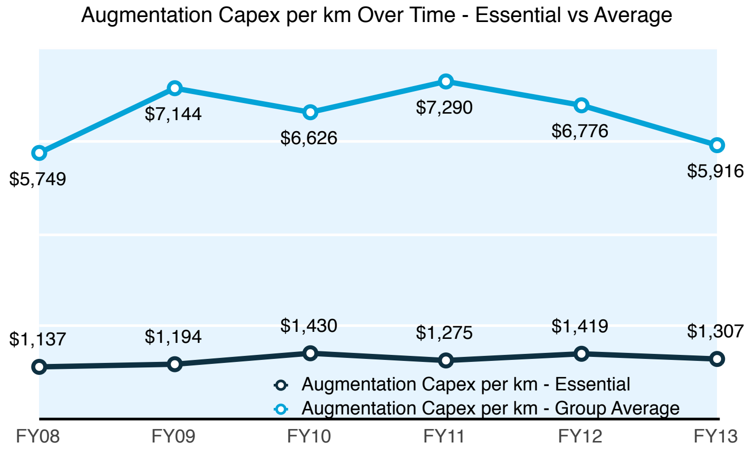


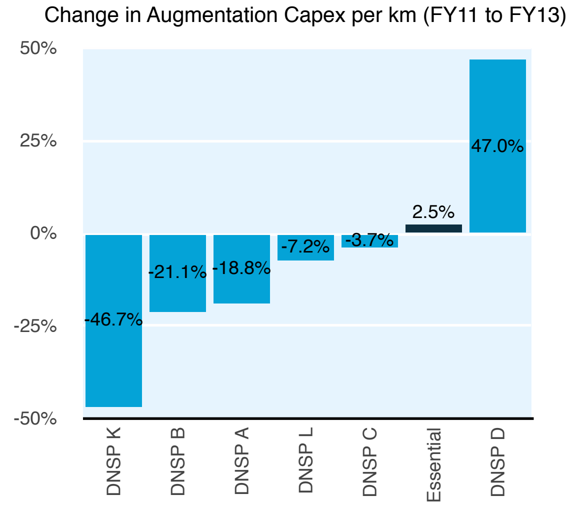
To provide some level of context for these current cost ratios, the augmentation capex per km ratio is shown below over time for Essential and the two DNSPs in this study with conditions and attributes most similar to Essential.



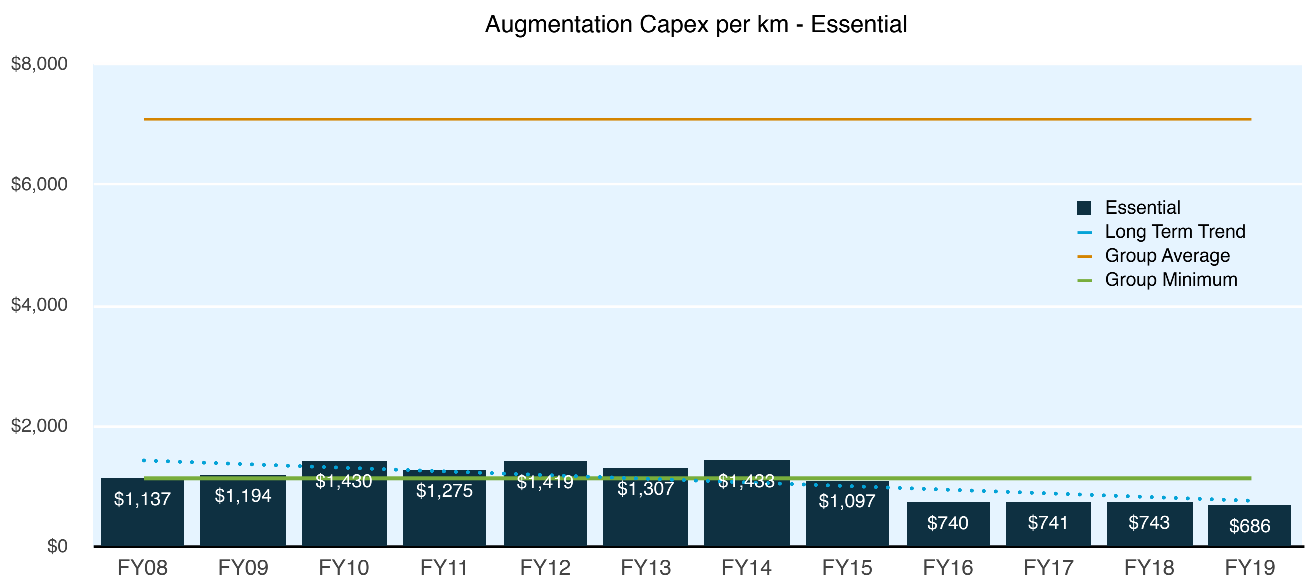
[2] Whilst this is a broadly held view, and somewhat supported by the step change in nationwide augmentation capex at the start of the current period, analysis of these augmentation costs over time and replacement costs over time show that in this period, increased rates of replacement of existing assets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

As shown in the previous graphic, Essential'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 Essential 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 also against the current period group average and minimum.



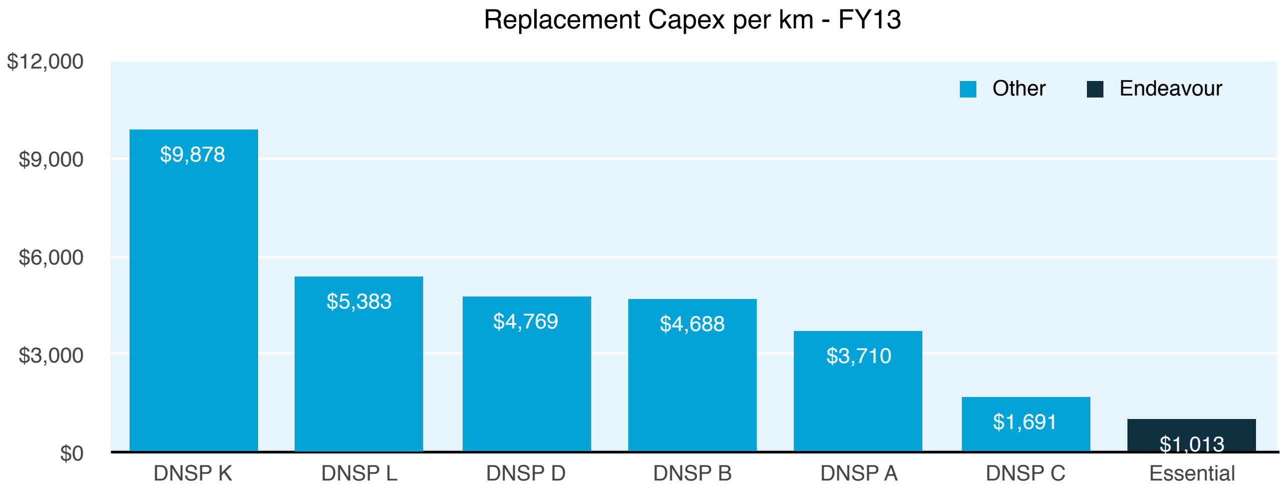
Notes:

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.

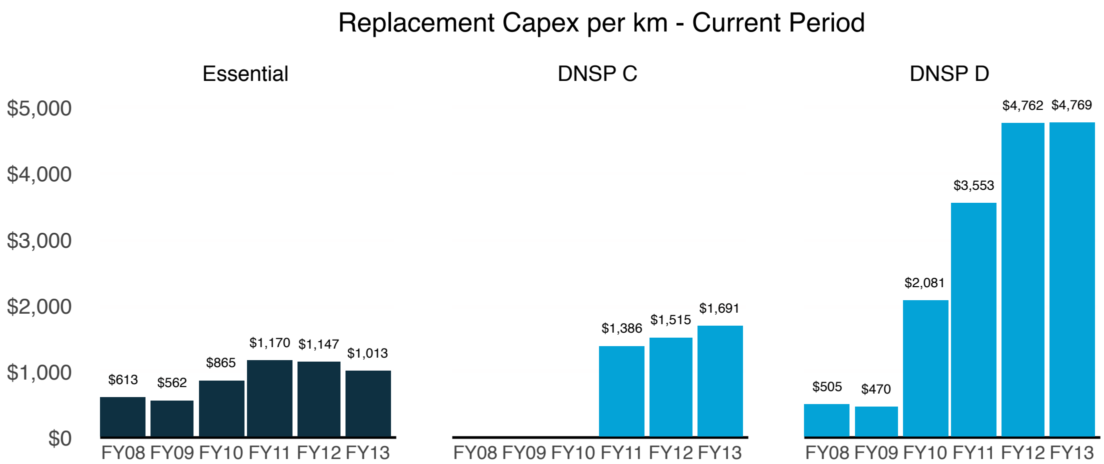
Replacement capex is forecast to be a more significant contributor to Essential's program

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.

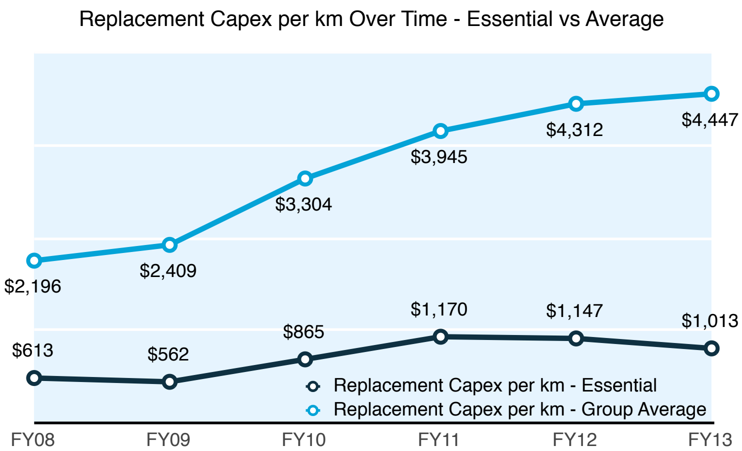
The comparison of the cost of replacing assets per kilometre of network amongst the group is shown below for the most recent year.

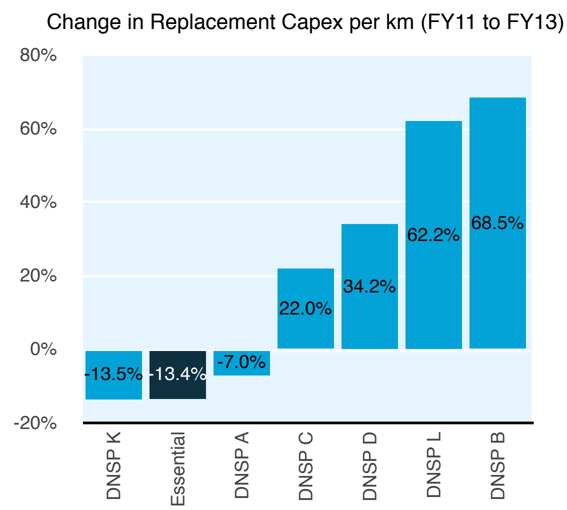


As shown below, the intensity of Essential Energy's asset replacement program has increased in the current period; as it has for some of Essential Energy's closest peers.

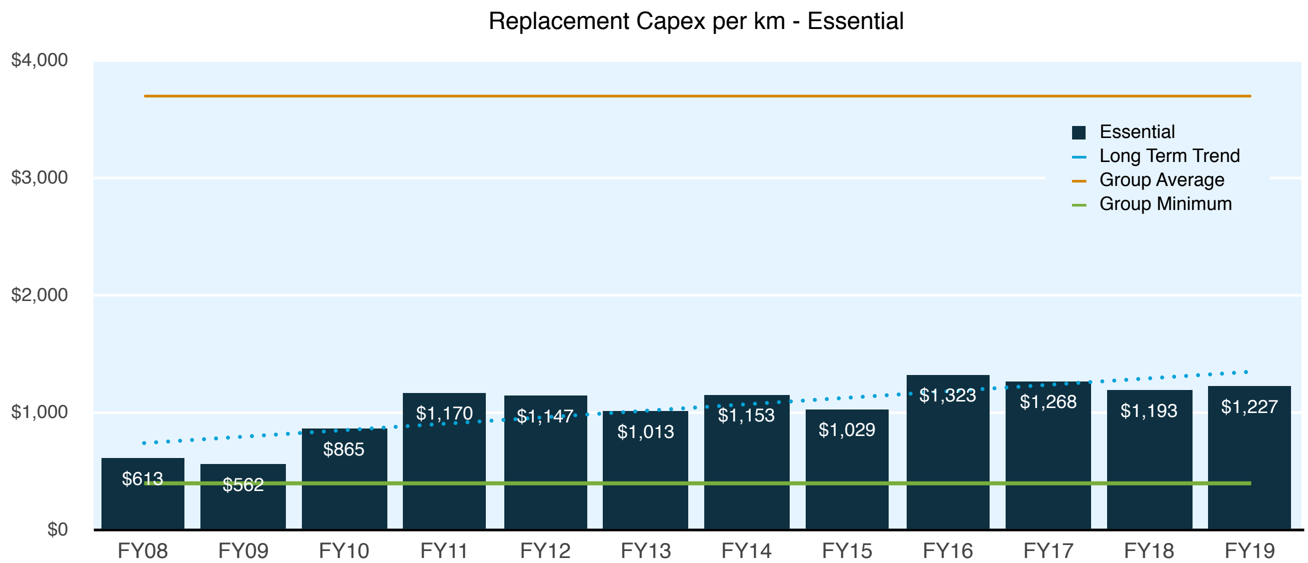


As shown in the previous graphic, Essential's replacement capex per km has increased recently. To show the change in this ratio during this period in the context of the benchmarking group, the graphs below depict the Essential Energy replacement capex per km over time against the group average and the relative change in this ratio for the latest three years. Essential Energy's replacement capex per km has remained well below the group average over time - with the gap widening in recent years.





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 also against the current period group average and minimum.

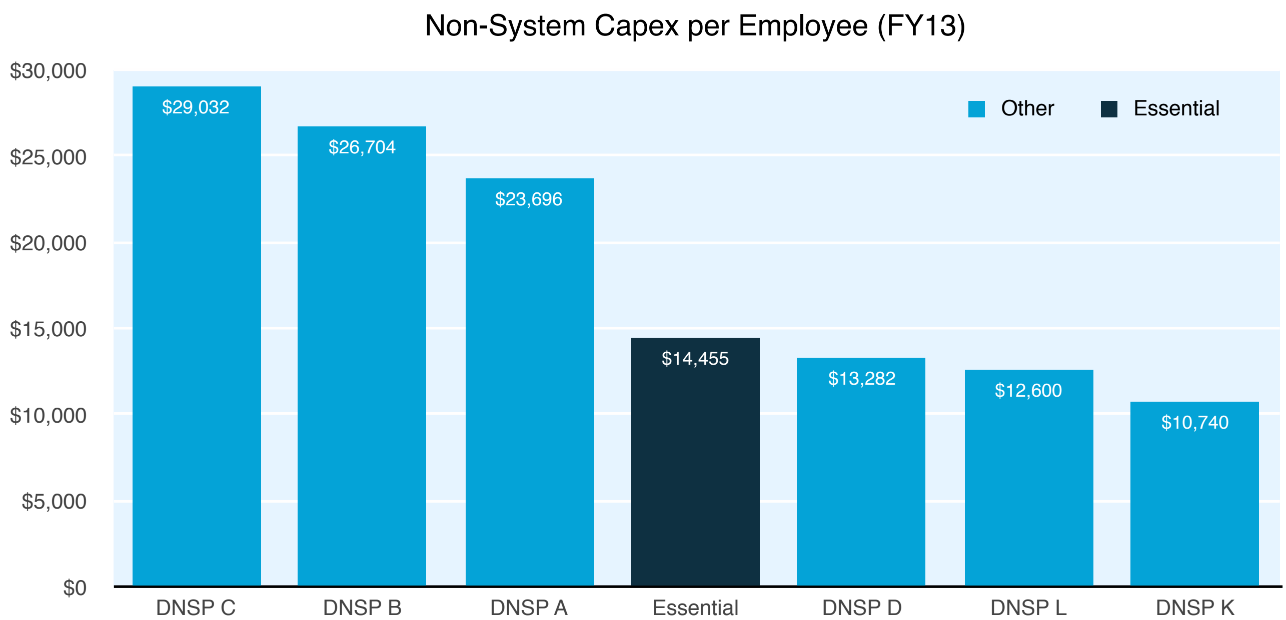


Notes:

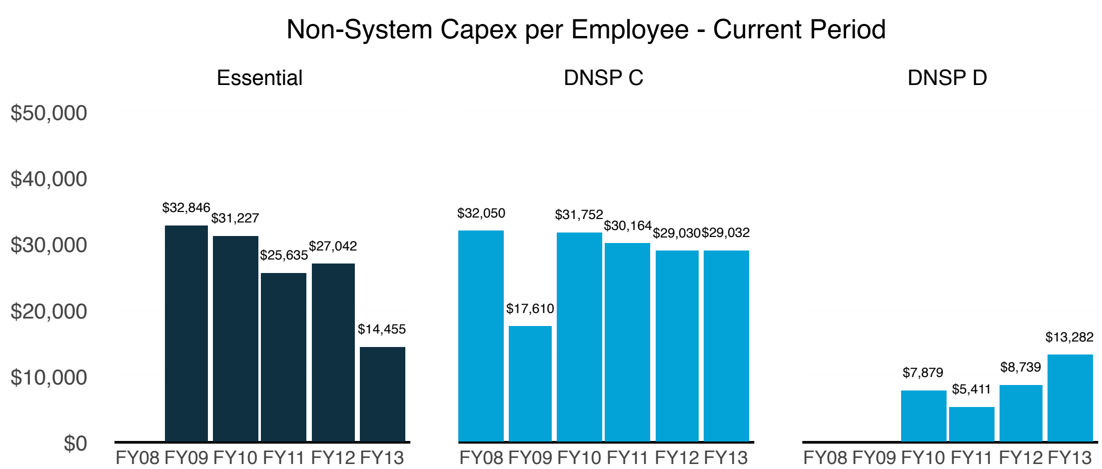
1. All figures in FY2013 dollars.
2. Network km for future years have been forecast using the historical growth rate (0.5%).
3. The group average and minimums shown on the graph above are the current period average extrapolated into the next period - that is, they are not the average of the forecast expenditure.

Non-System capex has been influenced by reform initiatives

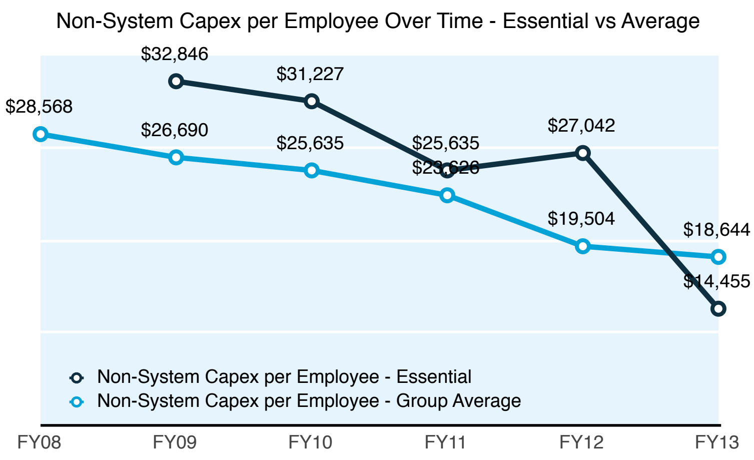
Non-system capex includes the capital spent on plant and motor vehicles, property and land and non-system IT assets. A primary driver of non-system capex is the number of employees in the business. A comparison of non-system capex per employee for FY13 is shown below.

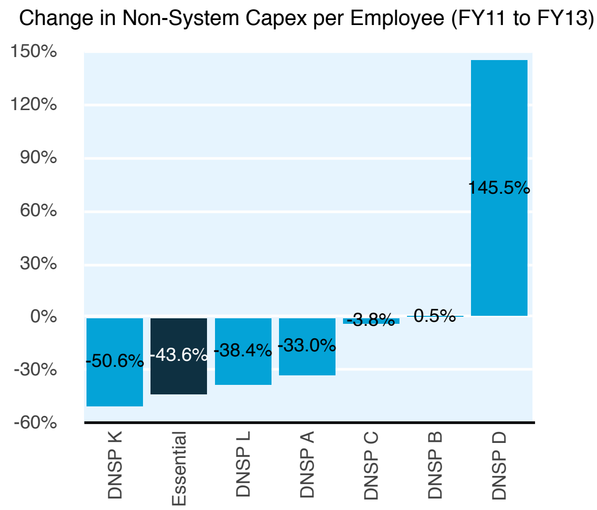


As shown below, Essential has significantly improved this benchmark ratio recently.

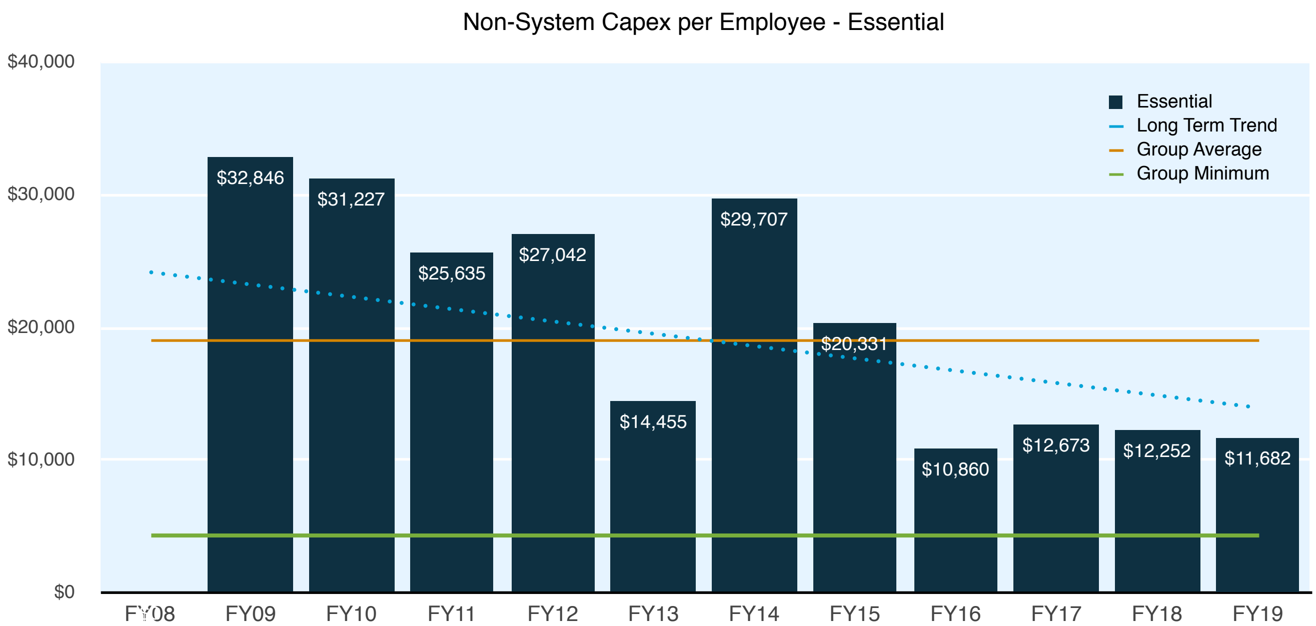


To show the change in non-system capex performance during this period in the context of the benchmarking group, the graphs below depict the Essential Energy non-system capex per employee over time against the group average and the relative change in this ratio for the latest three years. As shown, the decrease in this cost category for Essential 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 affects this category); Essential Energy has had the second-largest decrease.





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 also against the current period group average and minimum.

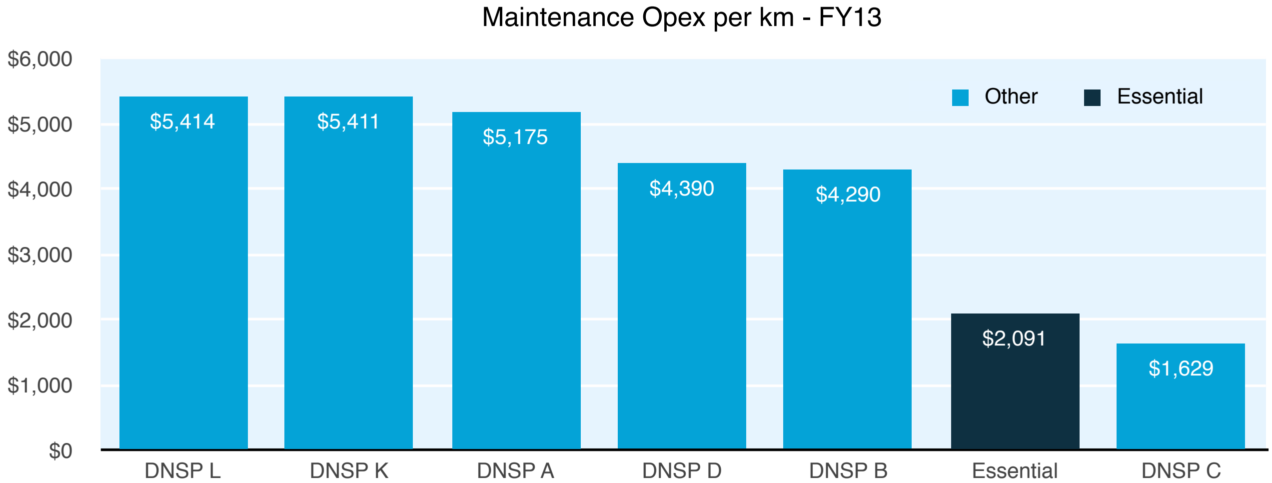


Notes:

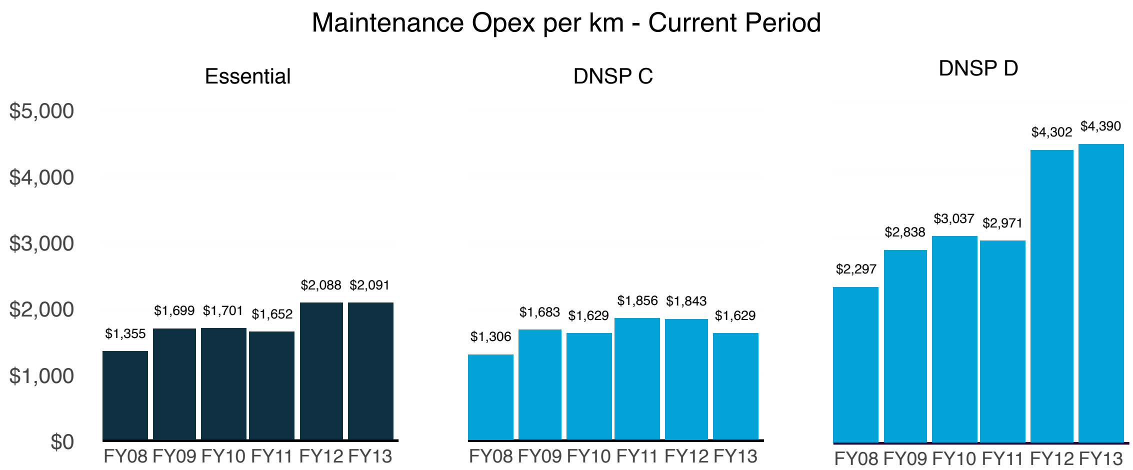
1. All figures in FY2013 dollars.
2. Employee numbers for future years have been held at the current (FY13) figure.
3. The group average and minimums shown on the graph above are the current period average extrapolated into the next period - that is, they are not the average of the forecast expenditure.

Essential Energy's maintenance costs have increased, as have industry averages

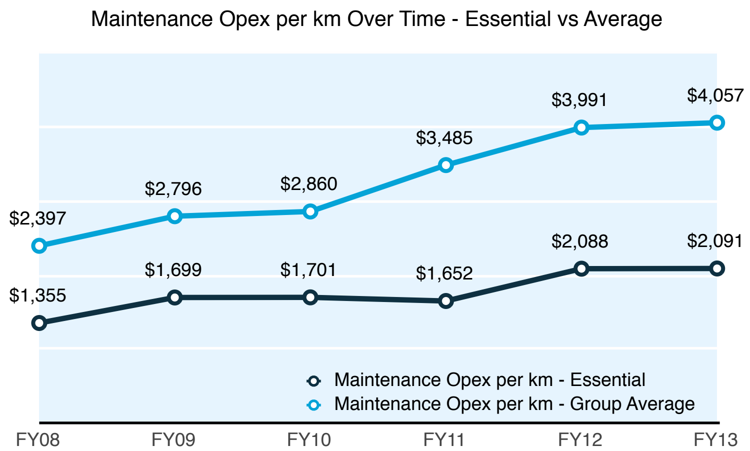
In most cases, more than half of a DNSPs maintenance costs are related to vegetation management and inspection activities (such as planned periodic pole inspections). As such, maintenances costs are largely dependent upon the mobilisation of resources along network routes. A primary cost driver of maintenance 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.). Comparisons of maintenance costs per kilometre for the 2013 financial year is shown below.

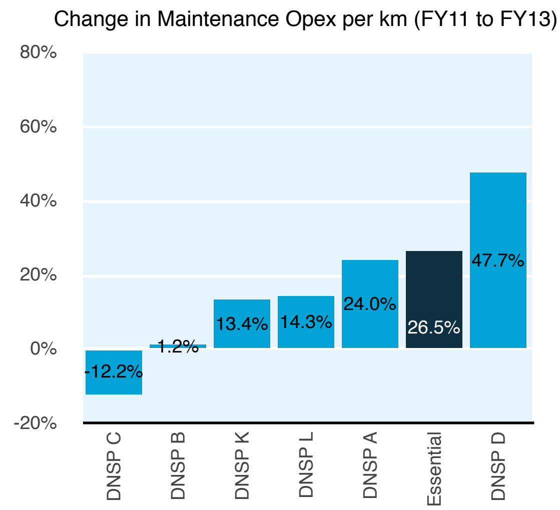


As shown below, Essential Energy's maintenance costs are relatively stable in the current period and within the range of its closest peer networks.

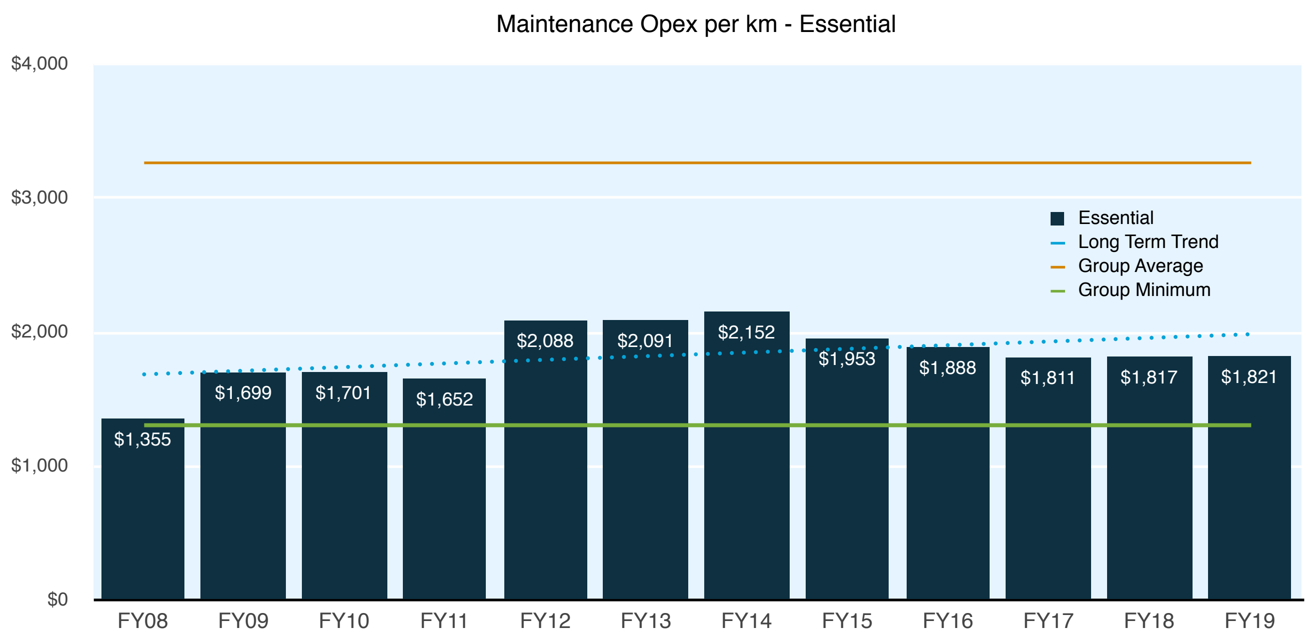


To show the change in maintenance opex performance during this period in the context of the benchmarking group, the graphs below depict the Essential Energy maintenance opex per km over time against the group average and the relative change in this ratio for the latest three years. In the most recent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





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.

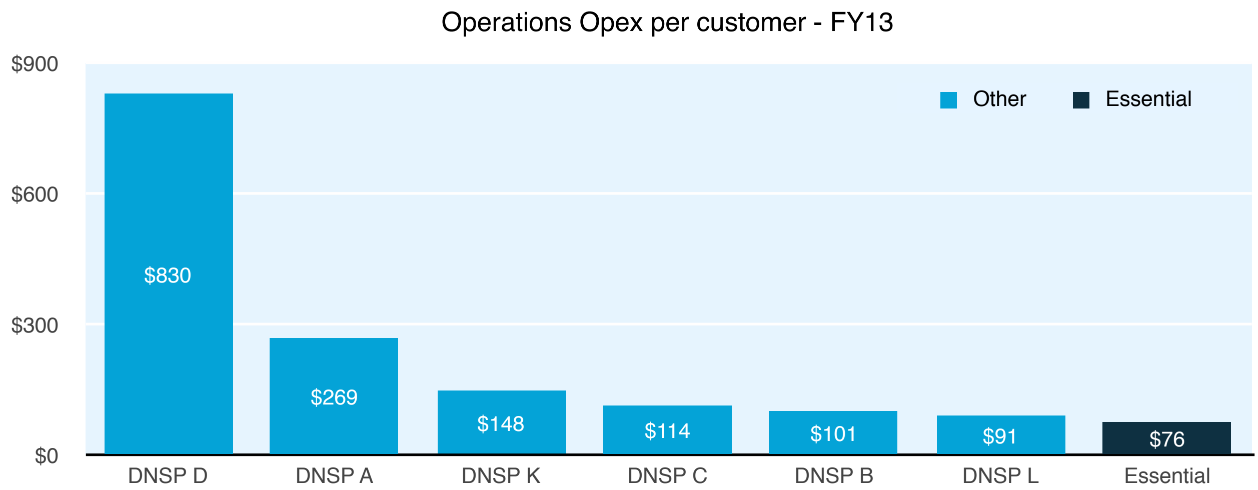


Notes:

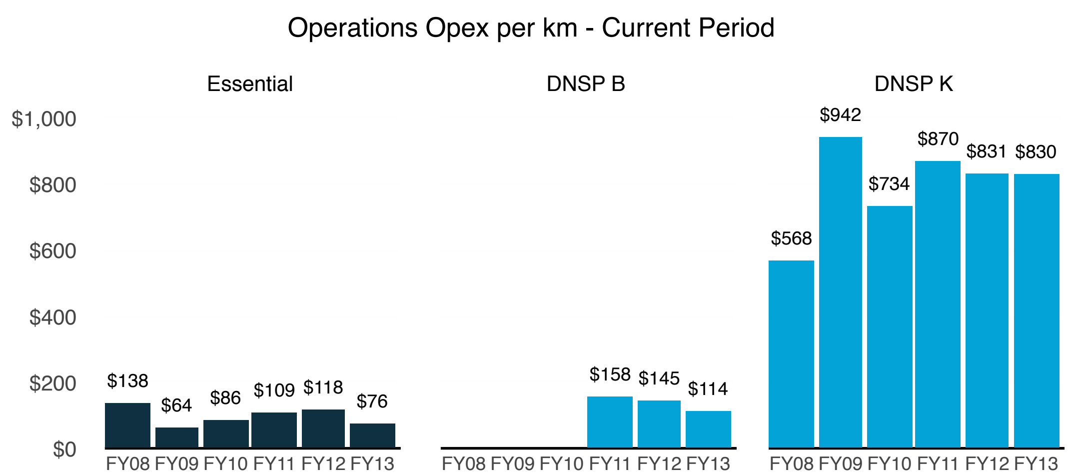
1. All figures in FY2013 dollars.
2. Network km for future years have been forecast using the historical growth rate (0.5%).
3. The group average and minimums shown on the graph above are the current period average extrapolated into the next period - that is, they are not the average of the forecast expenditure.

Essential's operations costs are very low for a rural business

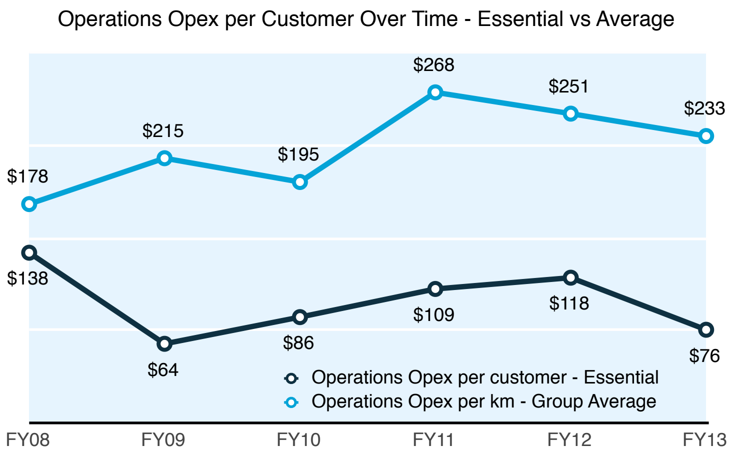
Operations costs include network control, systems operations, customer operations and support functions such as IT, property and fleet management. As such, these costs are largely driven by the location and complexity of the network, its customer base and the business scale. This makes comparison particularly 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.

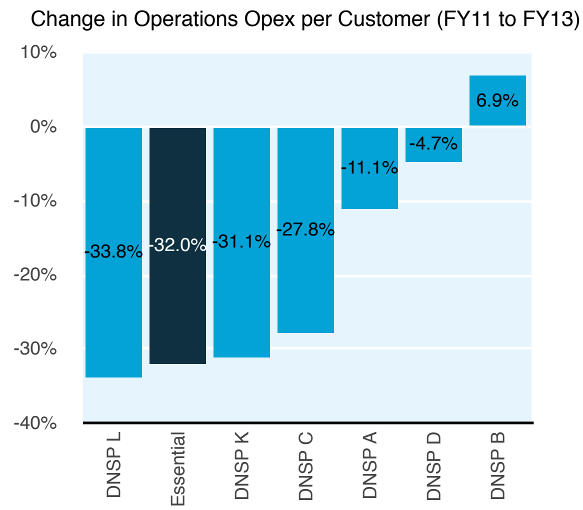


As shown below, these costs are relatively volatile, however Essential Energy's operations costs compare favourably to its closest peers.

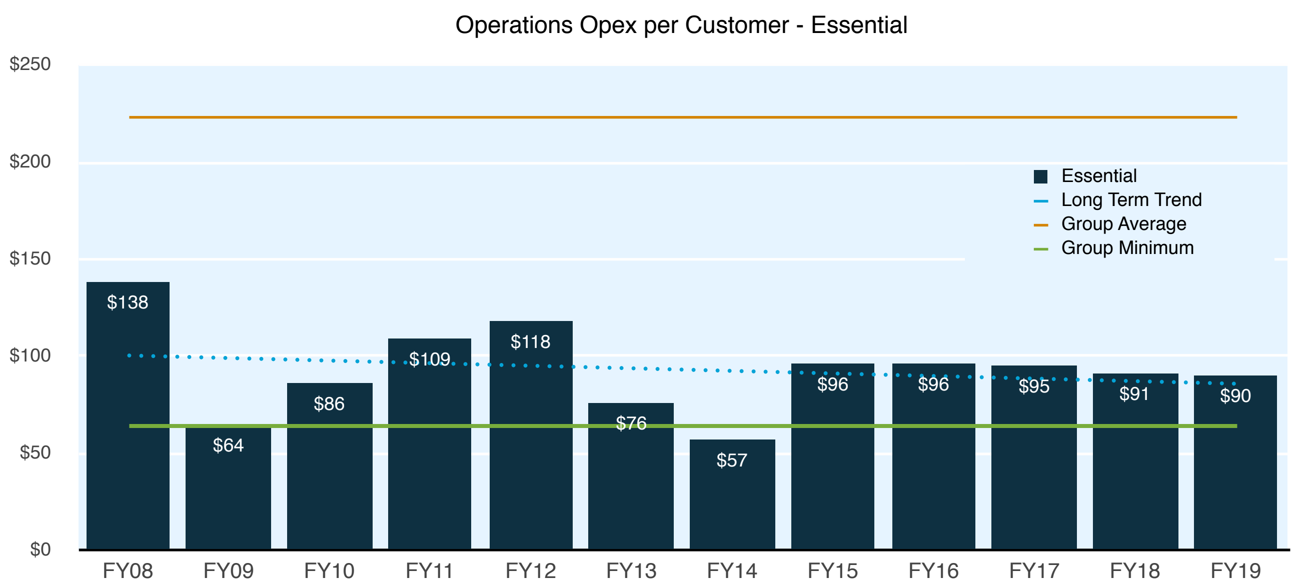


To show the change in operations opex performance during this period in the context of the benchmarking group, the graphs below depict the Essential Energy's operations opex per customer over time against the group average and the relative change in this ratio for the latest three years. As shown, the gap between the Essential Energy operations cost per km and the group average has been relatively consistent over time, widening in recent years. 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 Essential Energy's operations costs per customer are forecast to decrease to below the current group minimum.



Notes:

1. All figures in FY2013 dollars.
2. Customer numbers for future years have been forecast using the historical growth rate (0.7%).
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

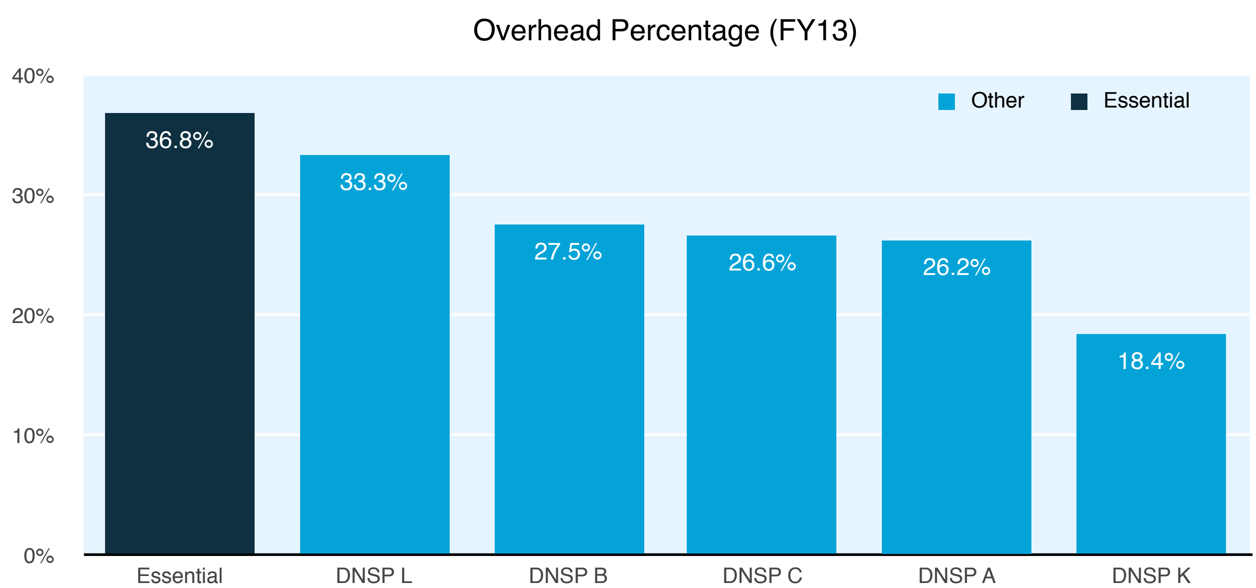
Augmentation, replacement, maintenance and operating activities can all be modelled to an extent through unit costs and volumes based on expected rates of growth in particular drivers. Overheads and indirect costs, however are largely a function of business structure and ownership, management decisions 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 non-core, 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.

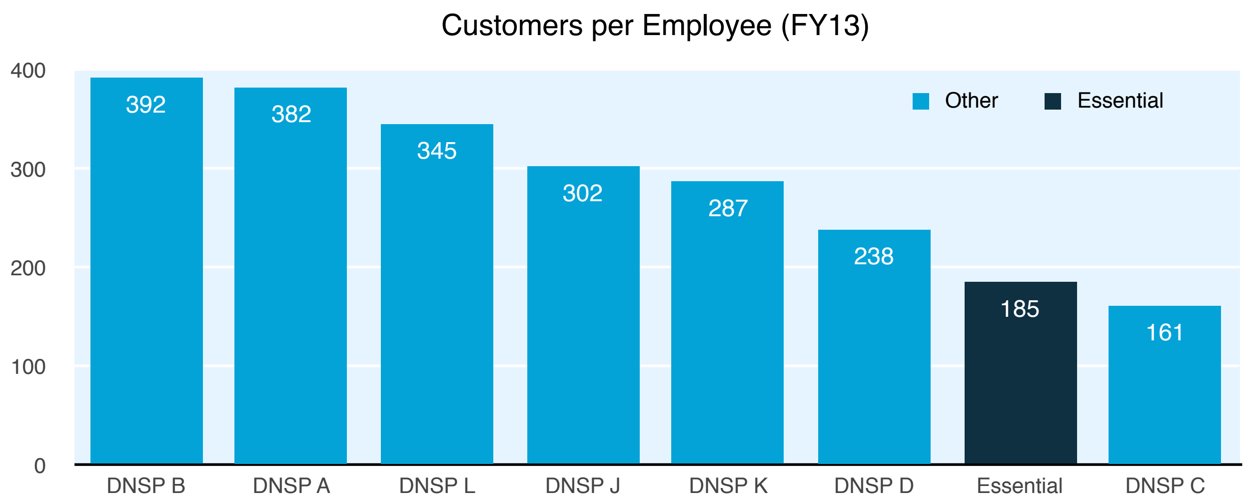


Changes to cost allocation methodologies by at least one business in the sample and the network reforms in most states and territories has narrowed the range between the lowest and highest proportions of overhead across the group since the previous benchmarking report.

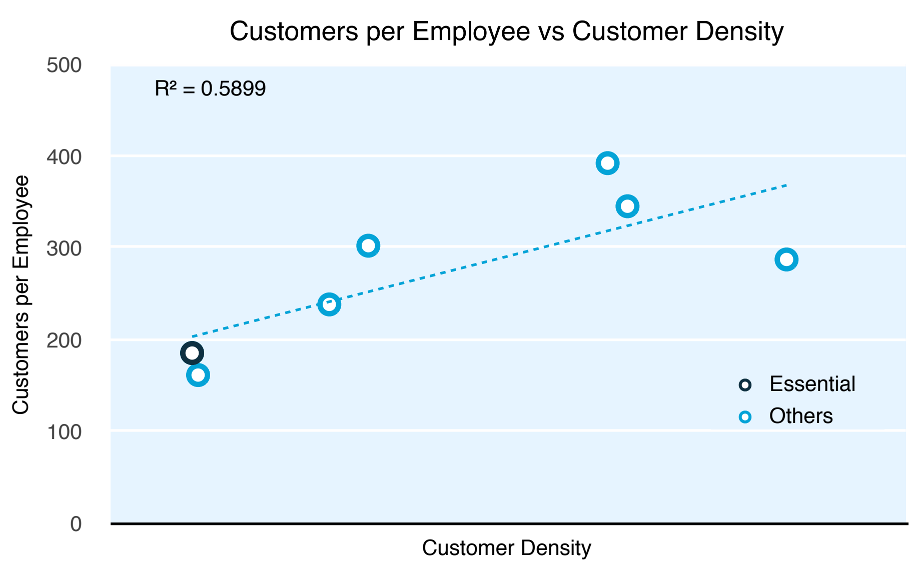
Workforce Management

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.

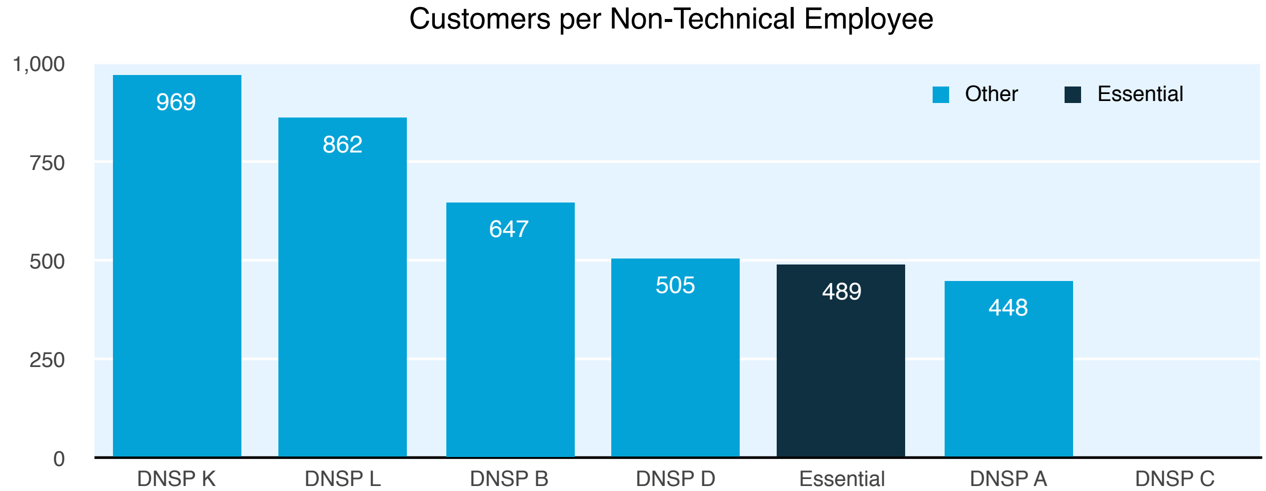
The number of customers serviced by the workforce varies by network type - with urban distributors enjoying an "economy of proximity" over their rural counterparts. Whilst simple ratios such as customers per employee need to be considered in the context of the various structures, contractor policies, 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.



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).



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.



Essential Energy is achieving reasonable performance on this measure, its scale affording it a better outcome than the much smaller DNSP A.

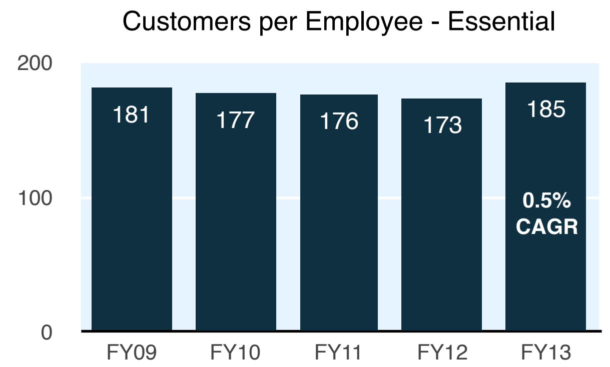
In the absence of more detailed information about the structures and policies of the businesses, it is once again useful to analyse the changes in workforce size and output over time. Most of the businesses participating in the Huegin benchmarking study have undergone some sort of reform or efficiency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

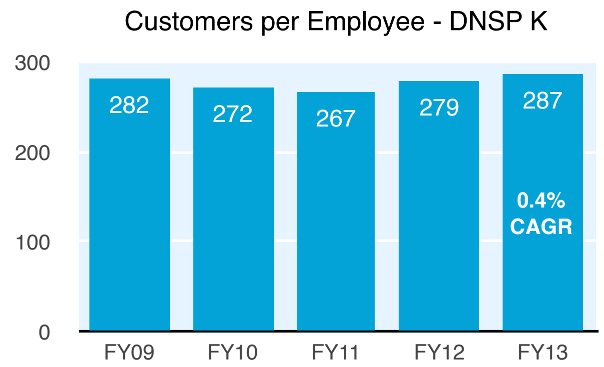
DNSP	Year on Year Change FY10	FY11	FY12	FY13	2009-13 CAGR	Year Maximum Size Recorded	Difference Between Current and Maximum
DNSP K	4.6%	2.7%	-3.3%	-2.7%	0.2%	FY 2011	-5.8%
Essential	4.2%	0.9%	1.6%	-5.5%	0.2%	FY 2012	-5.5%
DNSP L	0.6%	1.3%	-3.5%	-6.7%	-1.7%	FY 2011	-9.9%
DNSP B	1.4%	1.3%	-0.8%	-9.8%	-1.7%	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%

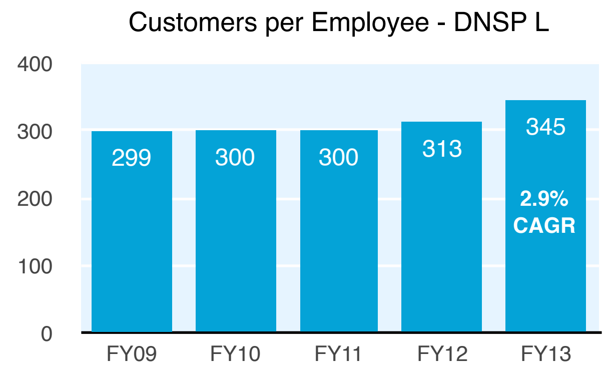
Notes:

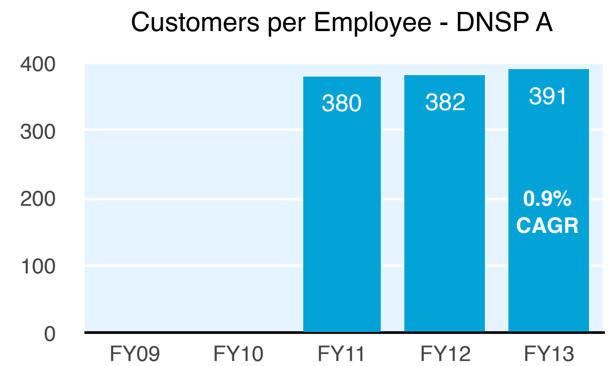
1. DNSP J's figures include the transition of a business unit to another entity.

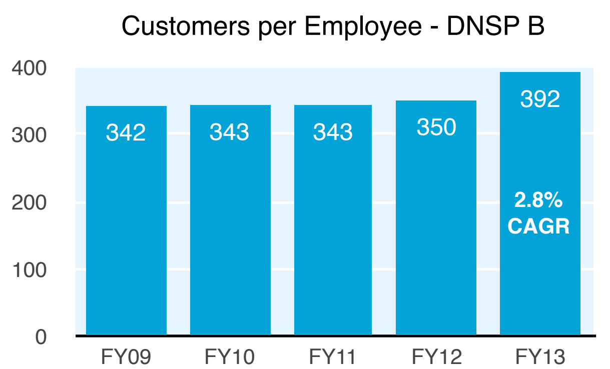
To balance out the impact of customer growth, the change in the customer to employee ratio over time is also shown below - the CAGR figure on the right of each graph represents the compound annual growth rate in the ratio between the first and last measurement.

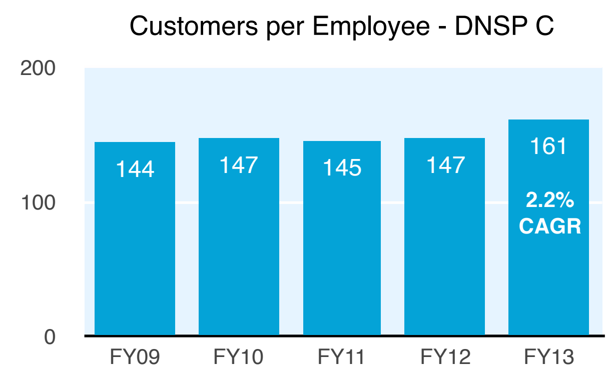


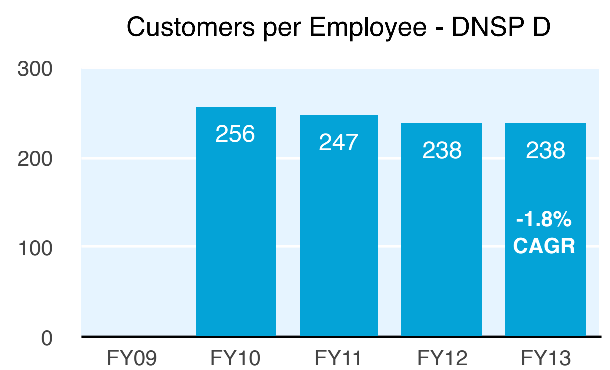


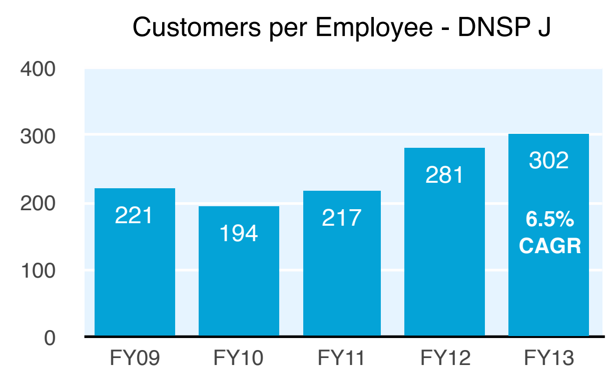












SUMMARY & CONCLUSIONS

Economic Benchmarking

Essential Energy is likely to benchmark in the bottom 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. Attempts to normalise are likely to favour Essential Energy (and Ergon Energy) somewhat, but the weight of numbers in the urban network category will prevent truly rural networks from approaching the frontier.

Expenditure Trend Analysis

Trend analysis will be used by the regulator; the recent efforts of Essential Energy to reduce costs will provide a favourable indication.

With economic benchmarking unlikely to show Essential Energy on the frontier, recent and forecast trends of expenditure will perhaps be more informative to the regulator.

Whilst Essential Energy's capex has fallen and has been forecast to continue to fall, other DNSPs have forecast greater reductions. The counterpoint to this observation is that at the commencement point of the analysis, Essential Energy had a lower relative capex than its peers.

Opex has flattened and is forecast to remain relatively flat, but the risk for Essential Energy is the application of an efficiency "catch up" adjustment to its opex by the regulator.

System Capital Expenditure

Essential Energy's capex is forecast to track at levels similar to those at the beginning of the current period (FY08).

Essential Energy's forecast reduction in augmentation capex will see this category drop to levels much lower than the minimum achieved by any of the businesses in the benchmark group in this period.

The drop in augmentation capex is somewhat offset by a predicted rise in asset replacement capex.

Non-System Capital Expenditure

Essential Energy has halved non-system capital expenditure per employee, with this performance level forecast to continue into the next period.

Previous benchmarking reports by Huegin have highlighted the cost premium associated with non-system capex costs for DNSPs operating over large, rural network areas.

At a unit cost level, non-system capex items are often significantly less expensive (land, for example) than urban counterparts, but the significantly higher number of assets (depots, etc) required drives higher total costs.

Essential Energy's current and forecast non-system capital expenditure performance benchmarks well against peers - even those with urban networks.

Maintenance and Operations Opex

Essential Energy's opex forecast trends are moderate, however an adjustment may be made under the base-step-trend model.

Essential Energy's maintenance expenditure is forecast to increase, which will move it away from its closest peers in ratio benchmarks. Vegetation management has always been a significant factor in Essential Energy's maintenance program, and strong evidence of the drivers of maintenance costs will need to be articulated to explain the benchmark position.

Essential Energy's operations opex costs, however, are the lowest in the group on a per customer basis and forecast to fall even further. Essential Energy should examine its opex costs to determine whether the very strong benchmark performance in operations opex relative to the less favourable performance in maintenance opex and overheads is in fact a cost allocation issue. That is, the allocation of opex costs differs from its peers to the extent that Essential Energy is "pushing" operations opex into overheads and/or maintenance.

Other Efficiency Indicators

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

Essential Energy appears to have relatively high overheads, although the results are skewed by the different cost allocation methodologies between businesses.

When comparing the ratios of customers to employees (albeit this is a flawed comparator, without knowledge of the level of outsourcing in each business), Essential Energy benchmarks between its two closest peers (C and D).

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Appendix B – NSW DNSP joint analysis on effectiveness of the Augex model

B.1 Purpose of Augex model

The AER has indicated that it will also be using the augex model as part of its cost category analysis. The augex model compares utilisation thresholds with forecasts of maximum demand to identify the parts of a network segment that may require augmentation. The model then uses capacity factors to predict required augmentation volumes, and unit costs to derive an augex forecast for the DNSP over a given period. The model is applied to segments of the network such as the sub-transmission network, 11kV network and low voltage network.

The augex tool has not been used in previous determinations, and is therefore untried and untested. The AER has indicated that it will use the model in various ways. Including

- As a point of comparison with a DNSP's augex forecast – We understand that the AER would test the forecasts at a segment level to test whether the forecasts are higher or lower than predicted by the model. The AER has been unclear as to whether it would 'calibrate' the information to fit the model to our levels of expenditure in the past.
- For benchmarking - Presumably the AER would benchmark key variables such as utilisation thresholds and average costs per MVA of capacity to test whether the predicted forecasts of the model would change if inputs from other DNSPs are used.
- As a filter to identify areas of the augex forecast that require detailed engineering review – We understand that the AER would use the information to target its sample reviews of replacement programs.
- For informing any adjustments to make to a DNSP's augex forecasts – The AER has noted that while the model is one of several techniques to assess augex forecasts, it does not preclude substituting some or all of the forecasts from the augex model for some or all of the augex components of a NSP's capex forecast.

The AER has not provided us with sufficient information to use the augex model as a basis for comparing our forecasts to that predicted by the model. While we have sought to undertake preliminary analysis, we have noted that data limitations and uncertainty on the AER's preferred segmentation have limited its use. For this reason our response focuses on the effectiveness of the model from a conceptual point of view.

Our response to the AER's regulatory proposal RIN provides detailed information on variables used to populate the augex model such as capacity, demand and average unit costs. In the RIN, we have detailed our methods and sources we have used to populate the information required for the AER to use its augex model. We will comment further on the results of the populated augex model relative to our proposal, once the AER has released this to stakeholders.

B.2 Testing the validity of the augex model to our circumstances

In preparing our proposal we have sought to test whether the augex model can provide an indicator of the efficiency of our augex forecasts. We have prepared responses to the questions asked by the AER in the RIN. Our view is that the model does not meet the criteria of the Productivity Commission for effective benchmarking, and does not provide a strong basis to test a DNSP's forecast in relation to its own circumstances, or relative to industry peers.

Our key finding is that the functional form of the model and underlying data is not of a sufficient quality to test the reasonableness of our augmentation forecasts. At best, the tool may be used to identify potential areas of further investigation for certain network segments such as the 11kV network. In other cases, we think the deficiencies in the model preclude it from use at all, as it may lead a business or regulatory to form false conclusions.

Functional issues with the model

The functional form of the augex model should be able to accurately take into account the relevant drivers of expenditure, be of sufficient granularity to provide information on network segments, and be able to accurately reflect the future costs of addressing the drivers.

We identified a number of deficiencies in the functional form that limit the validity and robustness of the outcomes of the model:

- Does not account for other drivers of augmentation - The model does not adequately address the full suite of drivers of augmentation of the network including non-demand related issues such as voltage issues.
- Focus on organic growth ignores that augmentation is driven by spot loads in localised areas - The model assumes that growth is consistent in the network segments (ie: that the nature of growth is organic) and the predicted need to invest in capacity is related to changes in organic growth for a segment of assets. This assumption may have some validity in a high peak demand environment, but in times of more moderate growth, the likely driver of expenditure are 'spot loads' associated with connecting new customers in pockets of the network. For instance, while 11kV urban expenditure may have more moderate rates of system peak demand, there may be pockets of the network which have significant growth rates as a result of large new connections, increased household density (such as suburban in-fill), or greenfield type development. The augex model would predict low levels of expenditure in these cases, when our current experience is that the key driver of augmentation are spot loads.
- Cross over between segments – The model allows for granularity and segmentation as a means of capturing the underlying drivers of augmentation on different element types. This type of approach cannot capture the prudent planning processes of DNSP's who may seek to address a need using a range of solutions including different configurations. A practical example is the use of 11kV load transfers to address constraints on elements of the sub-transmission network. In this case, the 11kV transfer enables us to shift load from an overloaded zone to one which has spare capacity. The augex model is too simplistic to cater for these circumstances and therefore may form the view that the additional capacity relates to the 11kV network, thereby providing misleading outcomes for both segments of the network.
- Augmentation expenditure is dependent on connection policies - The augex model would only include expenditure incurred by a DNSP to increase capacity on the network. This ignores that capacity is also related to connecting new customers, and that this will be subject to customer funding arrangements.
- The augex model assumes the past is an appropriate proxy for the future – We note that the model relies on historical data to develop capacity factors and average expenditure profiles. The model may also be calibrated to compare actual expenditure undertaken in the last period. We consider that the past may not be an appropriate proxy for the future. For instance, expenditure and capacity in the network in the 2009-14 period was driven by augmentations to improve security of the network. This means that capacity was increasing mainly as a result of a one-off factor that does not hold in the 2014-19 period where investment is likely to return to more of a steady state. This example demonstrates that the functional form of the model has implicit assumptions that invalidate its use.

Accuracy and robustness of data

The issues with the augex model also extend to the accuracy and robustness of the data. For sub-transmission assets there is a high degree of granularity on project costs, however there is less information on 11kV and low voltage projects at the project level. Insufficient data means that there is less granularity of data available to segment the low voltage and 11kV networks. In turn, this reduces the ability to account for drivers of augmentation at the lower levels of the network.

The advantage of the low voltage and 11kV networks is that there is a greater sample size of projects to draw average costs of completing works. On the sub-transmission network, there are less sample of projects and greater variability in costs due to the inherent differences in the projects. This means that average cost data at the sub-transmission level of the network is of far less quality.

When the deficiencies in functional form and data limitations are multiplied across the industry, it becomes clear that the model is even poorer when used as a benchmark tool across DNSPs. For instance, the average cost of undertaking works on a 132kV sub-transmission network in the Sydney CBD will greatly increase the average cost compared to a DNSP who has no 132kV assets and operates in less congested areas.

B.3 When the model should be used as an informer of efficiency

We consider that the model should only be used under the following criteria:

- The underlying data quality is accurate and reliable.
- Other DNSPs have the same network configurations and design, including similar voltage levels.
- The key driver of augmentation relates to organic growth in the network
- There is sufficient granularity in network segmentation such that asset category types are based on assets that exhibit uniformity in failure modes and similar levels of consequence.
- The assets need to have a known failure / replacement rate which has been stable for over 5 years and is expected to continue for the next 5 or more years with no anticipated changes.
- When assets which have short construction lead and delivery timelines, typically three months or less, this scope includes handover to construction, scheduling of resources, management and delivery of construction phase and closeout of project costs.
- The sample size to determine average expenditure of works is large, and is not highly variable over time or projects completed.

When applying this criteria to the network segments reported in the RIN, we consider that the tool could not be used to benchmark Essential Energy relative to other DNSPs as this would provide misleading indicators of variables such as average unit costs. This means that the augex model has very limited value as a peer comparison.

We also consider that the augex model is by construct a very poor indicator of augex requirements in our circumstances, and should not be used in the AER's regulatory process. We note that for all network segments. In particular, much of our augmentation expenditure is related to pockets of localised growth on the network as a result of spot loads from customer connections or urban infill. The model is not capable of segmenting sufficiently at these localized sections of the network.

We consider that the criteria are partially met for 11kV expenditure, where there is a large sample size, and generally good information on average unit costs. But even here, we consider the tool fails to meet the other criteria, particularly in terms of being able to predict the driver of expenditure at localized levels on the network.

Report commences overleaf.

Networks NSW

AUGEX Model Benchmark Review - Summary

Draft v0.1
March 2014

Amendment Log

Issue Date	Nature Of Change	Page No	Approved By
Draft 17/03	Initial draft	Entire Doc	CO

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AUGEX Model Benchmarking Review

Purpose

The AUGEX model has been developed by Brian Nuttall on behalf of the AER as a tool for review of augmentation capital expenditure programs put forward as part of DNSP's 5-year regulatory proposals. The tool is relatively new, having been developed in 2012 and is yet to be applied in the context of a regulatory determination.

The purpose of the model is to allow the AER to apply high level analysis to a proposal to determine whether the requested capital expenditure is in line with what would be predicted by the model, thus enabling a faster, more hands-off approach to determining a DNSP's capex allowance. The AUGEX model is one of a number of modelling tools the AER has indicated it intends to use in testing the veracity of a DNSP's capital expenditure proposal. The move towards a more mechanistic method for determining capex allowances is driven in part by past difficulties the AER has experienced in conducting sufficiently detailed reviews of forecast capital projects.

According to the AER, the aim of the AUGEX model is to simplify the analysis of complex forecasting methods while still maintaining some ability at the aggregate level to allow for the main drivers of augmentation. The AUGEX model also provides a benchmarking framework that complements the high level assessment approaches the AER can use to assess augmentation expenditure and the more forensic, detailed engineering reviews of expenditure conducted by the AER. The AER will use the AUGEX model initially as a screening tool to identify the sub-categories of expenditure which should be subject to more detailed examination. They may also use the AUGEX model as a reference to set revenue at a future date as they continue to refine it and their assessment methodologies for augmentation capex.

Networks NSW understands the AER's reasons for wanting to apply a more mechanistic approach to examining capex proposals, and acknowledges that such an approach would be less expensive and faster to apply in the context of a determination. Therefore, Networks NSW has applied the AUGEX model to its expenditure proposals to assess its application and robustness and to identify any issues that might need to be addressed in the capital submissions up front.

Unlike the application of the REPEX model, the application of the AUGEX model has been of limited value internally. The issues identified with the application of the model are, we believe, so significant that its application would require significant adjustment outside the model, and ultimately require an examination of detailed planning information to make a decision under the Rules.

The remainder of this report highlights the deficiencies identified in applying the model in practice and in good faith.

Data and model limitations

Models are designed to approximate reality. Models works best when sufficient data points are modelled and deliver results that are statistically representative of the actual results. According to the AER's AUGEX model guidance handbook, to achieve this approximation, "assets are considered as populations rather than individuals. The model does not hold specific limits or attempt to assess specific constraints or solutions. Instead, it assesses aggregate capacity and expenditure levels, based upon aggregate planning parameters that can be used for benchmarking purposes." The model however recognises that different parts of the network have different planning parameters and in an attempt to improve the accuracy "The model allows the network to be constructed from various network segments, each with their own set of planning parameters. This allows some level of disaggregation to capture different augmentation circumstances that could affect benchmarking. For example, where one part of a network (e.g. distribution feeders) could have a significantly different economic loading point or augmentation solution to another part of the network (e.g. sub-transmission lines)."

Disaggregating the network in this way highlights some weaknesses in the model's application to reality. By disaggregating the network into a number of segments, each segment has a smaller sample of data to model and inaccuracies are introduced into the modelled outputs.

Sub-transmission assets

Sub-transmission assets are the highest voltage assets on a distribution network. The augmentation of the sub-transmission network generally occurs as the addition of relatively large amounts of capacity on subtransmission feeders of subtransmission / zone substations however solutions to overcoming capacity constraints are generally unique. They depend on the nature of the constraint and the configuration of the relevant part of the network. Furthermore, the number of constraints and associated augmentation projects at this level of the network is relatively small and there are therefore no 'average' sub-transmission projects. As a result, the AUGEX model outputs for this level of the network are likely to be significantly at variance with the actual expenditure requirements.

Furthermore, because of their size, expenditure on subtransmission network augmentation projects may occur over a number of years, with no relationship between expenditure in a particular year and the capacity added in that year.

The range of costs associated with these projects is wide, as is the amount of capacity added, leading to a large variation in the cost per MVA of capacity added by each project, and in each year. It is considered that modelling of augmentation expenditure at this level of the network will not provide the AER with meaningful benchmarking information with which to assess the expenditure forecast. Because of their unique nature, it is considered that assessment of the forecast for augmentation of the subtransmission network is better carried out by detailed engineering assessment of individual augmentation projects.

11 / 22kV distribution assets

The AUGEX model is considered to apply best in relation to augmentation of the 11 / 22kV distribution network. This is due to the fact that there are many augmentation projects of a similar nature within this asset class. This type of expenditure is reasonably effectively modelled within AUGEX.

The limitation that AUGEX experiences in modelling this level of the network arises from the fact that much of the augmentation of this part of the network is aimed at alleviating constraints other than thermal constraints. In particular, augmentation may be carried out to overcome fault rating exceedances or voltage constraints. Augmentation for fault rating reasons is specifically excluded from modelling within AUGEX as it is not related to increased demand on the network. Augmentation to overcome voltage constraints is to be modelled within AUGEX. However these parts of the network must be modelled in their own network segment.

The difficulty in applying the AUGEX model at the 11/22kV level of the network arises because of the difficulty that many DNSPs do not separate project financial data in a sufficiently detailed manner to enable distinctions to be made between the various types of expenditure and as a result, the accuracy of expenditure modelling is questionable.

For some DNSPs augmentation to overcome voltage constraints represents a major part of their augmentation program. Modelling of these types of augmentation is complex, with capacity factors varying according to the location of the constraint on a feeder. The benchmarked variable of cost per MVA capacity added is highly variable in these situations, rendering benchmarking comparisons invalid.

For these reasons care must be taken by the AER when considering AUGEX outputs for this level of the network.

Low voltage (LV) network

The application of the AUGEX model to the LV network is similar to its application to the 11kV network. At a total level, there are many LV network augmentation projects in any one year, and conceptually, average cost data is available. However, cost data is not available at the level of disaggregation that the AER seeks. This is because the amount of expenditure in each year in augmentation of the low voltage network by DNSPs is generally small relative to the level of expenditure invested at other levels of the network. The benefits that may be obtained from establishing systems that provide detailed cost data for this work are outweighed by the costs associated with maintaining such systems.

DNSPs will generally consider the expenditure requirements for their entire LV network as a whole because making estimates at any lower level of disaggregation requires too many assumptions to be made to have confidence in the accuracy of the estimates. Benchmarking AUGEX outputs at similarly disaggregated levels will also be fraught with such inaccuracies and is not considered to be sufficiently robust to allow the AER to make any determination of the efficient levels of capital investment at the disaggregated level.

Substitutability of assets between asset classes

Another limitation of the model that the AER's guidance handbook has recognised but not provided practical guidance to address is the substitutability of assets in one segment for those in another. This is relevant when determining the most efficient solution to overcome a capacity constraint, and is particularly relevant for assets in the subtransmission segments.

For example, in many instances in NSW load growth on a 33kV network has been addressed by moving to a 132kV network solution which involves construction of new zone substations that bypasses the 33kV network and transforms electricity directly from 132kV to 11kV. Not only do the network assets in each category have a different cost structure but such a move will generally be carried out as part of a long term strategy determined as the most efficient way of meeting the forecast growth in demand in an area over a long time horizon (i.e. 10-20 years). In the timeframe considered by AUGEX, a solution involving establishment of a 132kV zone substation to overcome a constraint at an existing 33kV substation is likely to be highlighted by the model as inefficient expenditure. However, such a finding does not recognise the fact that fewer assets will need to be established in the long term by following this strategy.

Similarly, the AUGEX model does not account for the circumstances in which a network that has typically invested in overhead networks is forced to invest in more underground assets, due to greater urbanised development. The cost difference between these two network types can be as high as ten to one. Where past expenditures have been largely expended on overhead network assets, the AUGEX model is likely to underestimate future expenditure if underground assets are required.

The model's lack of capability in catering for substitution between asset categories limits its most useful application to a 'whole of network' level. Application to the network as a whole removes the necessity to address substitutability of networks asset categories and alleviates the requirement to obtain detailed cost information in favour of general estimates of cost of capacity across the network. What the model may lose in granularity by doing this, it would make up in reasonableness and credibility.

Calibration

The AER originally anticipated that the AUGEX model outputs would be calibrated to historic expenditure levels, similar to the way that the REPEX model is calibrated. The model handbook that the AER published refers to calibration of the model, but no guidance is provided as to how such calibration is to be achieved. In fact, it is not clear that evaluation of augmentation capex forecasts will involve model calibration at all.

Furthermore, it is not clear what value calibration to historic expenditure levels may add to the AER's assessment process. Unlike replacement capex (although there are also issues with calibration of the REPEX model), where asset age, used as a proxy for replacement need, is known in advance, the need for augmentation can change from year to year. The AUGEX model has as one of its inputs the DNSP's global peak demand forecast, but peak demand, when considered on a spatial basis as is required for augmentation decisions, can be volatile from year to year.

The use of historic capital expenditure to forecast expenditure is too simplistic a concept for application in the context of multimillion dollar businesses. The drivers of network augmentation are in most respects outside the control of the network. To assume that the past is a good predictor of the future requires acceptance that the drivers of past expenditure, their strength and timing will be the same in future as it has been in the past. Networks NSW consider that that this is too simplistic an assumption to be reasonably applied at the current time. If expenditure has been deferred in past years due to project delays or a change in relative priorities, expenditure within a period may be lower than it would have been in the absence of those factors. If future expenditure is calibrated to that lower than ideal level of expenditure in the past, future expenditure will also likely to be lower than required as it is based on a level of spend that is too low and unsustainable in the long term.

An example of the type of external influence that renders the use of calibration to historic expenditure levels invalid can be seen in the Design, Reliability and Performance licence conditions imposed on the NSW DNSPs by the NSW government in 2007. These licence conditions imposed a requirement to provide N-1 security on most subtransmission assets by 30 June 2014. Achieving this required significant levels of expenditure. As this level of supply security has now been achieved and this requirement has been removed from our licence conditions from the start of the next regulatory period, augmentation expenditure will be significantly reduced in future compared to the past and calibrating expenditure forecasts to historic levels will produce meaningless results.

Conclusion

The AER's search for a suite of tools to assist them in making consistent and less time consuming regulatory decisions in relation to forecast capital expenditure is understandable and laudable. The NSW DNSPs have applied the model in good faith but have met a number of problems in applying the model.

For good decisions to be made, the models must be based on robust underlying concepts, and utilise appropriate and consistent data. DNSPs do not necessarily have the data required by the model in the level of detail required. A lack of data may lead to modelling inaccuracies and inappropriate decisions if the model outputs are relied on too heavily. It is considered that data capture, or lack thereof, is a significant limitation to robust application of AUGEX.

Experience gained reviewing the model has highlighted the fact that extracting what appear to be the simplest data from the network is more complex on closer inspection. Care must be taken to ensure that data from an individual business is compared on a similar basis to information from other firms, particularly if that firm is to be used as a benchmark, or to create a benchmark for another firm.

The AUGEX model lacks appropriate testing and application in a regulatory context to help inform and improve the model's future application. The lack of clarity around how the model will be applied and/or calibrated severely limits the extent to which the AER can rely on the model to provide an appropriate comparison of a forecast against a benchmark. For a regulator, the model must be applied with care, and any findings from its application treated with scepticism. The tool is not well enough developed to allow the regulator to infer that cuts to a program are required, nor does it allow a regulator to determine the level of forecast expenditure reduction that is appropriate.

Having reviewed the model in detail, Networks NSW considers that AUGEX may usefully be used as a first level test as to the efficiency of the augmentation program as a whole. However, care must be taken to understand the investment context, environmental and political influences, as well as the underlying principles of network design and data capture before a model of this type can be used to substitute for detailed and appropriate expert interrogation of individual projects and their drivers.

Appendix C - NSW DNSP joint analysis on effectiveness of the repex model

C.1 Purpose of repex model

In addition to replacement cost analysis, the AER will also be using the Repex model. It has been described by the AER as a high-level probability based model that forecasts repex for various asset categories based on their condition (using age as a proxy) and unit costs. The AER has used it in determinations to compare NSP forecasts with the repex model outputs to identify and target expenditure that required detailed engineering and business case review. The AER has indicated that it will use the repex model to:

- Assess NSPs' asset life and unit cost trends over time – We note that the AER uses the model in a number of ways including changing functional forms of the age curve, and calibrating the model to reflect past expenditure trends of the DNSP.
- Compare data to other NSP benchmarks – We understand that the AER would be comparing data on average age of replacement, and average costs of expenditure for different asset classes.
- In instances where it consider the analysis shows that a NSP's proposed repex does not conform to the capex criteria, it may be used (in combination with other techniques) to generate a substitute forecast.

The AER has not provided us with sufficient information on how it will apply the repex model as a basis for comparing our forecasts to that predicted by the model. While we have sought to undertake preliminary analysis, we have noted that data limitations and uncertainty on the AER's preferred asset categorisations have limited its use. For this reason our response focuses on the effectiveness of the model from a conceptual point of view.

Our response to the AER's regulatory proposal RIN provides detailed information on variables used to populate the repex model such as capacity, demand and average unit costs. In the RIN, we have detailed our methods and sources we have used to populate the information required for the AER to use its repex model. We will comment further on the results of the populated augex model relative to our proposal, once the AER has released this to stakeholders.

C.2 Testing the validity of the repex model to our circumstances

In preparing our proposal we have sought to test whether the repex model can provide an indicator of the efficiency of our replacement forecasts. We have prepared responses to the questions asked by the AER in the RIN, and undertaken preliminary analysis of the model relative to our forecasts.

We consider that the repex model has fewer deficiencies than the augex model, but still has a number of shortcomings in functional form and data accuracy. The functional form of the augex model should be able to accurately take into account the relevant drivers of expenditure, be of sufficient granularity to provide information on network asset categories, and be able to accurately reflect the future costs of addressing the drivers.

Functional issues with the model

We identified a number of deficiencies in the functional form that limit the validity and robustness of the outcomes of the model:

- The model does not adequately account for all drivers of capex – The repex model uses age as a proxy for identifying the likely need to replace assets in future regulatory periods. This overly simplifies the planning process for identifying needs, which is based on the condition of assets, failure mode analysis, and risk investigations. In some cases, the underlying driver for replacement is that the asset fails to meet modern day safety or environmental standards, and will not be related to the age of the asset.
- The repex model assumes the past is an appropriate proxy for the future – We note that the model relies on historical data on age of replacement and unit costs to develop a prediction of future costs. The model may also be calibrated to compare actual levels of expenditure undertaken in the current period. We consider that this assumption may not necessarily provide a reflection of the level of expenditure needed to maintain the safety and reliability of the network. This is for three reasons:
    - A DNSP may change in planning standards or risk assessments, driving a change in replacement levels compared to the past. Indeed this was the experience encountered by NSW DNSPs in the

mid-2000s when comprehensive reviews identified a need to increase levels of replacement due to under-investment in the past.

  - New standards might be imposed in terms of safety, environmental or worker safety that necessitates an increase in replacement needs.
  - A DNSP may detect a change in failure rates or risks for an asset class prompting the need to develop a proactive replacement program.

> Lumpiness of expenditure – When the assets are large in value and have long delivery time, the expenditure and delivery outcomes can be separated by many years. In this case the expenditure can be realised on the financial registers in partial “lumpy” amounts over a number of earlier years to the final delivery of the overall project where the total network asset is commissioned and therefore technically complete. A key example is switchboard replacement. Typically the switchgear is purchased 1 or 2 years ahead of the installation as it takes 9 to 18 months to deliver. Similar issues arise on most sub-transmission replacement activity such as transmission feeders which is characterised by lumpy investments across a number of years.

> Granularity and clustering issues - The repex model is not sophisticated enough to allow a drop off in expenditure due to achieved programs where a number of asset technologies are clustered together. A good example in this case is when there is a known failure with a particular technology type within an asset class such as Consac cables for low voltage feeders. In this case, clustering the assets together would provide a false picture of the typical age of replacement for all low voltage feeders, as the actual age of Consac would be significantly lower than other asset types which would exceed the average age.

Accuracy and reliability of data

Similar to the augex model, the underlying data on age of assets, replacement ages and expenditure costs can be highly unreliable and accurate for certain asset categories. The data quality issues are expanded on in our response to the RIN. In some areas, the information is so inaccurate that we believe the outcomes of the model should not be relied on at all. We also note that average costs of replacement is a highly unreliable measure of costs when there are small sample sizes and significant variation in costs, such as for sub-transmission assets.

When the deficiencies in functional form and data limitations are multiplied across the industry, it becomes clear that the model is even poorer when used as a benchmark tool across DNSPs. This is clear from previous applications of the repex model to Victorian DNSPs. For example, the Powercor and SP AusNet replacement ages generated by Nuttall for underground cable assets are approximately 43 years whereas for Jemena and United Energy, replacement ages are 60 years. Our more detailed analysis indicates that the 40 year asset is most likely driven by failing LV cables such as the Consac type which are becoming known to regulators worldwide as a problem. On the other hand the 60 year asset age is most likely representative of older HV paper insulated cables with more typical replacement ages for underground cables.

C.3 When the model should be used as an informer of efficiency

Taking these issues into account, we consider that the repex model can only be used for a very limited range of asset types and should only be used to benchmark the DNSP to its own performance. We consider that the repex model will likely work best under the following conditions:

> The underlying data quality is accurate and reliable

> There is sufficient granularity in technology types such that asset category types are based on assets that exhibit uniformity in failure modes and similar levels of consequence.

> The assets need to have a known failure / replacement rate which has been stable for over five years and is expected to continue for the next 5 or more years with no anticipated changes.

> When assets which have short construction lead and delivery timelines, typically three months or less, this scope includes handover to construction, scheduling of resources, management and delivery of construction phase and closeout of project costs.

> The sample size to determine average expenditure of works is large, and is not highly variable over time or projects completed.

The analysis which the NSW distributors have carried out shows that the pole data would be an asset type that would best meet some of these criteria. However, even in this case there are still issues with the underlying data quality and inability to properly dis-aggregate technology types. In this case, we consider the repex model might be an effective test of a DNSP's forecast, and if issues are identified, could lead the AER to undertake a further review of the investment proposal for this category of investment. Importantly, it should not be used as a form of substitute, as the outcomes of the model would still be highly unreliable. Further we note that benchmarking data across industry peers is likely to provide a misleading picture, unless the AER undertakes detailed analysis on the quality of that data. Our experience for instance is that the data quality for Ausgrid and Endeavour Energy's poles are of a much more robust quality compared to Essential Energy.

In other cases, we consider the repex model should not be used at all. For instance, there are only a small sample of sub-transmission works that are completed by DNSPs. In these cases, metrics such as average age and costs would not be statistically reliable to perform further analysis. In these cases, we have applied caution in implying any conclusions from the repex analysis.

Report commences overleaf.

Networks NSW

Report - REPEX Model Review

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About this report

The purpose of this report is to set out the joint findings of the NSW DNSPs (Networks NSW) on the repex model that the AER intends to use to assess the proposed replacement capex of Ausgrid, Endeavour Energy and Essential Energy in the 2014-19 regulatory determinations.

In its Forecast Assessment Expenditure Guidelines, the AER has indicated that the model will be used as part of its assessment of the proposed replacement capex of the DNSPs. The model predicts the likely expenditure on network asset categories, based on the age profile, replacement age and average expenditure.

The report tests the conceptual effectiveness of the repex model, and consequently the role and weight that should be attached to the outcomes of the model when the AER makes its regulatory determination.

The AER has not provided sufficient time to enable us to compare our replacement expenditure forecasts to those predicted by the repex model. The AER issued a final RIN on 7 March 2014, which was the first time the AER had identified the asset categories that would be used to populate the repex model. We consider that the AER should release the findings of its repex model prior to finalising its draft determination to enable us to properly respond to its findings.

The key finding of this report is that the repex model should be used with extreme caution by the AER, and only as a complement to other types of in-depth assessment of a DNSP's proposal and supporting documents. We have made the following observations when reviewing the model:

- The repex model has severe limitations and deficiencies - The repex model is a very high level tool that cannot be used as a substitute for detailed planning analysis due to its construct, data and application limitations.

- The repex model could be used to target a further, more detailed review of a DNSP's program - We consider that the repex model may play a role in the AER's assessment of our capex. However, due to its limitations, the model should never be used to reject or substitute proposed forecasts. Rather, the model could be used effectively to target programs or projects for further detailed review, particularly in areas where a DNSPs forecasts appear to be significantly higher or lower than predicted by the model.

- The repex model should be disregarded for certain sub-categories - The reliability of the repex model will vary depending on the underlying characteristics of the asset group being reviewed. In some cases, the data and model limitations may lead to very inaccurate results. For example, due to the small sample size of large sub-transmission assets, the repex model will be highly inaccurate. In other cases, the repex model may provide a meaningful comparator to help target the AER's detailed review. For instance, the model may be more effective for certain distribution assets where there are large populations, homogeneity in technology, failure modes and costs, and consistency in replacement levels and costs over time.

1. Description and use of repex model

In this section, we identify the purpose of the repex model, how it works, and the AER's intended application of the model to its review of NSW DNSP's proposed capex.

1.1 Purpose and background of model

In its Forecast Assessment Expenditure Guidelines, the AER noted that the repex model will be used as part of its assessment of the proposed replacement capex of the DNSPs. The AER first applied the repex model to the 2011-15 regulatory determinations for Victoria and has also used it for the 2012-17 regulatory determination for Aurora Energy (Tasmanian DNSP).

The repex model marks a shift in the AER's assessment methods, where it increasingly relies on high level tools to guide its decision making, compared to detailed engineering reviews of forecasts. The model is a type of benchmarking tool as it meets the Productivity Commission's definition of a "method for comparing a firm to other businesses, to itself over time (or between its various divisions) or to an ideal firm."[1]

1.2 Description of model and key variables

The AER's repex handbook provides a description of the underlying premise and workings of the model. The model is contained in a series of Microsoft spreadsheets that require input data to predict the likely replacement capex on network assets over a 20 year period. The AER can re-calibrate the model to use recent historical expenditure and the benchmark data of peer DNSPs.

Premise of model

The underlying premise of the model is that age is a proxy for the many factors that drive individual asset replacements. The AER notes that with time, network assets age and deteriorate. This can affect their condition, which in turn can impose risks associated with the asset's failure such as network performance, safety, environmental damage and operational risks.

The model simplistically predicts the volume of replacement based on the age of system assets on a distributor's network. To do this, the model requires information on the age of assets, and the likely age of replacement. As a final step, the model predicts the total expenditure by multiplying volumes by the average cost of replacing an asset in that group.

The AER acknowledges that network planners do not solely rely on asset age to forecast replacement needs in the future[2]:

> "It should be recognised that the managers of capital assets will frequently rely on alternative techniques to determine their asset replacement strategies. A particular approach may include critical impact, condition based or risk based techniques or a mix of these or other techniques. They are all valid approaches and may give superior estimates of replacement need in particular circumstances."

[1] Productivity Commission, *Electricity Network Regulatory Frameworks*, 26 June 2013, p147.
[2] Australian Energy Regulator, *Replacement Expenditure Model Handbook – Electricity Network Service Providers*, November 2013.

In the section on model and data limitations, we highlight how the fundamental premise of the model cannot adequately account for all the drivers of replacement, and that using age as a proxy for replacement may provide a misleading picture of replacement needs.

'Base case' of the model

The repex model can be manipulated in a number of ways to test the replacement capex proposed by the DNSP. In the first instance, the AER uses the information provided in a DNSP's RIN to derive results for the model (termed the 'base case'). The steps involved in the 'base case' are explained in the AER's handbook and are summarised below.

1. Asset categorisation and grouping - The model requires the NSP's network asset base to be broken down into a number of discrete asset categories. This categorisation is required to reflect variations in asset lives and unit costs between different asset types. The AER's regulatory proposal RINs for NSW DNSPs mandate high level categories, but provide the ability for DNSPs to include lower level sub-categories.

2. Inputs – The key inputs required by the repex model relate to the age profile of each sub-category of assets, the mean age of replacement, and the unit replacement costs of assets within this group. These are collected by the AER as part of the RIN and are described below.

    - Age profile - Reflects the volume of the existing assets at the various ages within the asset category at a static point in time. The model allows the installation dates to go backwards up to 90 years from the current date of the age profile.

    - Mean age and standard life - These two parameters define the probability distribution of the replacement life for the asset category. The AER assume a normal distribution around the mean.

    - Unit replacement cost - This parameter defines the average unit cost to replace one unit within the asset category. This unit cost must reflect the volume unit used within the age profile.

3. Outputs - The model takes these inputs and produces the following outputs for each asset categories:

    - Age and asset value statistics and charts of the age profile - The model provides summary information of the age profile. This is presented at the asset category and asset group level. This covers information such as total volumes and replacement costs, proportions of the total network, average ages and lives, and proportions of aged assets.

    - 20-year replacement forecasts - Based upon the input data, the model produces year-by-year forecasts of asset replacement for the following 20 years. The forecasts prepared include individual asset category forecasts and aggregated asset group forecasts.

The 20 year replacement forecasts are based on a function within the model that provides a probabilistic estimate that an asset in the group will be replaced at a specific age. The model assumes that the probability is normally distributed around the mean age, taking into account the standard deviation.

Calibration

In addition to the 'base case', the AER also undertakes a calibration exercise to' fit' the function of the model to historical replacement volumes and costs of the DNSP. This involves:

- Using historical replacement volumes over the most recent 5 years of actual data to adjust the mean replacement life until the forecast volume of replaced assets in the first year of the forecast period equals the average actual volume.
- Adjusting the unit replacement cost to reflect most recent data on the costs of replacing assets.
- Re-calibrating the model (ie: refreshing the outcomes) to allow for the new data.

The AER also note that as part of its calibration technique, it may use other scenarios such as using asset life and unit costs of other DNSPs that it has collected through the benchmarking process.

1.3 Application of repex model by AER in decision making

In its Forecast Expenditure Assessment Guidelines (FAEG), the AER has indicated that it will use the repex model as part of its overall assessment on a DNSP's repex forecast. In addition to the repex model the AER will assess the forecasting approach, consider benchmarks and trend analysis of past expenditure, and performing detailed project reviews. It notes that:

> "When a NSP's forecast repex shows a significant divergence from the historic trend or our expenditure modelling we will assess the information supporting the NSP's forecasting approach and move to conducting more detailed project reviews."

The AER has stated that in instances where it consider the analysis shows that a NSP's proposed repex does not conform to the capex criteria, it may be used (in combination with other techniques) to generate a substitute forecast.

The AER has been less clear about the weight it applies to the 'base case' form of the model, relative to calibrations of the model that rely on historical levels of replacement by the DNSP or benchmark data from other DNSPs.

As noted in section 4, we consider this lack of clarity raises issues on whether the model can be used in a neutral manner, and the ability of the AER to choose a substitute level of capex from a range of model outcomes.

2. Limitations and deficiencies of the repex model

In preparing our proposal we have sought to test whether the repex model can provide an indicator of the efficiency of our replacement forecasts.

We have not been able to undertake a detailed review of the model outcomes relative to our forecasts, as we have not been provided the populated model the AER intends to use. For this reason our review has been limited to a high level conceptual examination of the model. In doing so, we have examined the AER's repex handbook, undertaken preliminary analysis on template models, and reviewed the AER's determinations for Victorian and Tasmanian DNSPs.

Based on this review, we consider that the repex model is less structurally flawed than the augex model, but still has a number of shortcomings. These include weaknesses in the model construct, the underlying data quality and statistical validity, and the application of the model by the AER. These deficiencies are explained in greater detail below.

2.1 Deficiencies with model construction

It is important to recognise that a model is an abstract reflection of complex reality, and will therefore never be perfect. Modelling is a key tool used to predict the future, and is therefore used by a prudent network planner to varying degrees in developing forecasts of volumes and unit costs.

The key question is whether the construction of the repex model can lead to an accurate prediction of the replacement level that a prudent and efficient DNSP would incur in their circumstances.[3] In addressing this question, we have identified 3 central weaknesses with the model that limit its effectiveness to replicate the real world circumstances of a DNSP.

Cannot account for the real world drivers of replacement

As noted in section 1, a key premise of the repex model is that age asset is an accurate proxy for the likely time that an asset is replaced. There is little doubt that an asset's condition deteriorates with time, and will exhibit a higher probability of failure towards the end of its life.

However, we consider there is a high degree of variability around a 'mean' age of replacement that limits the accuracy of its use in predicting volumes of replacement. Even with technologies that experience uniformity in failure mode, there are cases where a prudent DNSP will replace an asset much before, or after, the mean age of replacement. These natural variations in 'wear and tear' of the asset relate to:

- Innate differences in the manufacturing quality of the asset and the installation process and complexity.

[3] In turn, this leads to deeper questions such as the risk tolerance threshold that a prudent DNSP would adopt. For instance, how many safety and reliability incidents that a prudent DNSP is willing to accept from asset failures. It also raises issues such as whether early replacement is an efficient response to ensuring sustainable rates of replacement. The repex model largely ignores these types of considerations by assuming that the average age of replacement is efficient and that a DNSP would not look to long term efficiency considerations such as early replacement of assets to enable steady and sustainable levels of investment over time.

- Operating and topological differences when the asset is used over time, for instance an asset installed in coastal regions may likely be exposed to salt water corrosion.
- Differences in maintenance of similar assets over time. For example, Ausgrid's assets were previously owned by local councils, each which had a different approach to maintenance. Obviously, assets that were well maintained over time will exhibit longer lives even if there is uniformity in failure modes.

The likely age of replacement will also depend on the consequences of failure. A prudent DNSP will often undertake proactive replacement programs that strive to replace assets before they fail in service, particularly to mitigate high safety or reliability consequences. For instance, an asset located close to the general public is more likely to be replaced that one in an isolated area when there is a chance of explosive failure. This means that assets which have uniform failure modes may have very different replacement ages.

Using age as a proxy also fails to take into account other drivers of capex such as duty of care programs. In these cases, age (ie: deterioration in condition) is not the primary driver of replacement but rather the need to ensure our assets meet modern day safety or environmental standards. A key example is clearance heights for feeders, which may not meet a required standard for public safety.

It is for this reason that a prudent network planner uses a greater variety of tools and information to determine than age based modelling to forecast replacement programs. For instance, for large and costly assets on the sub-transmission network, the prudent planner would look to conditional data of the individual asset, and undertake granular risk-consequence analysis.

For categories of assets that contain a high population, the planner may use more high level tools such as models. However, the model would be configured to best reflect the individual circumstances of the DNSP and the condition of the asset base. While age based analysis may feature in such analysis, it is likely that a prudent planner would also use other data sources to guide its forecasts including conditional data from inspections, failure mode analysis, trends in failure rates, and consequence of failure analysis.

Sub-categories may not be sufficiently granular to reflect replacement age

A key assumption of the repex model is that individual assets in a population share common characteristics, and accordingly that there can be a level of accuracy in predicting replacement costs and age. [4] The repex model allows DNSPs to identify sub-categories of assets under the AER's major categories of assets. For example, a DNSP can provide data on feeder by voltage and/ or technology type so as to group assets with common failure modes and likely similar replacement ages.

However, there are a diverse range of technologies on a DNSP's network, which means that sub-groups will rarely contain assets with similar failure modes. In some cases, this issue arises due to a lack of quality data on asset age profiles and replacement lives for assets, which mean that

[4] As noted above, even if these conditions are present, age will never be able to accurately account for the real world drivers of replacement.

technologies need to be clustered together. This means that even at a sub-category level, the mean age of replacement will be imprecise.

Our preliminary examination of data to be used in the repex model suggests that the sub-categories we have provided as part of our RIN contain multiple technologies. As such, the outcomes of the repex model are likely to be inaccurate even at the sub-group level.

Average unit costs do not provide a realistic estimate of costs

The repex model uses 'average' unit costs for sub-categories of assets to predict the likely levels of expenditure of a DNSP. We consider that this is a problematic assumption and does not provide a realistic expectation of unit costs. Each replacement job is likely to be different due to site specific factors, even when there is sufficient uniformity in the asset being replaced.

On the sub-transmission parts of the network, costs become very site specific and may be impacted by the type of job being undertaken. For instance, the replacement of underground cables in Sydney Harbour will be far more expensive than replacing the same asset in a land area. It is for this reason that network planners consider site specific costs of major projects, rather than relying on average costs as a basis of a forecast.

On the 11kV and distribution network, an averaging approach may provide a more accurate indication of future costs. In these cases, there is a greater population of assets and potentially less variation in scope differences. Even in these cases, there is likely to be significant variation in the types of jobs being undertaken and the complexity of the task.

A prudent network planner may not be able to accurately forecast the cost of each individual project but would seek to identify whether there are differences in the type of project being constructed and account for this with different unit rates for particular jobs. In contrast, the repex model is limited in its inability to account for variations and distributions around the mean, and may be impacted by outliers in costs.

A further limitation with using average costs is when the asset has a long delivery time as is the case with sub-transmission major projects. In these cases, the expenditure and commissioning of the asset can be separated by many years, leading to a mismatch in average unit costs for a particular year.

A key example is switchboard replacement. Typically the switchgear is purchased 1 or 2 years ahead of the installation as it takes 9 to 18 months to deliver. Similar issues arise on most sub-transmission replacement activity such as transmission feeders which is characterised by lumpy investments across a number of years. It should be noted that lumpy projects generally relate to sub-categories where there is a paucity of sample data, exacerbating the inaccuracy of the repex model.

2.2 Problems with data quality and statistical validity

An axiom of modelling is that underlying data should be accurate and reliable, and should meet the key principles underlying statistical validity. In the sections below we note that the repex model fails to meet these conditions.

Data quality and accuracy

Similar to the augex model, the underlying data on age of assets, replacement ages and expenditure costs can be highly unreliable and accurate for certain asset categories. The data quality issues are expanded on in our response to the RIN. We note that the AER's RIN has required this information to be provided despite Ausgrid raising issues in the past with the quality of information available to us. At the time, the AER noted that they still require us to provide the information even if it is in the form of a best estimate.

As explained in our response to the RIN, in some areas the information is so unreliable that we believe the outcomes of the model should not be used at all. We also note that average costs of replacement is a highly unreliable measure of costs when there are small sample sizes and significant variation in costs, such as for sub-transmission assets.

Statistical validity

We note that the AER's repex model handbook does not identify a quantitative statistical test for evaluating the effectiveness of the repex model. We consider that the results of the repex model for each sub-category may fail to meet one or more of the following principles underlying statistical validity:

- Sample size – We consider that for many sub-categories (for example, sub-transmission assets) there are insufficient samples to be confident in the outputs of the model.

- Sample representative of population – For the reasons noted in Section 2.1, we consider that the underlying data for each sub-category is unlikely to contain asset technologies with different failure characteristics and therefore cannot be used accurately to predict replacement age.

- Algorithm is sound – An algorithm sets out the calculation steps involved in developing the function that is used to predict the outputs. We note that the AER has generally used information on the mean and standard deviation to 'fit' a normal distribution. This is a very broad assumption, and reflects the lack of samples to derive a more precise algorithm. The algorithm would likely be different for each sub-category, and this means that the replacement density curve is likely to be very imprecise.

- Model outcomes holds outside data range - In many cases, there is insufficient data to know when the asset is likely to be replaced. In some cases, the technology may only be first exhibiting signs of failure, which we know will increase rapidly in the forthcoming regulatory period based on inspection of the equipment.

2.3 Application of the model

All models involve an element of subjectivity and judgement in application. A key concern of the NSW DNSPs is that the AER's handbook lists a number of uses of the model from the 'base case', to calibration with past data, to benchmarking with other DNSPs.

We consider that with so many outputs at its disposal, the AER may be misled into thinking there is a potential inefficiency. At worst, the use of multiple models may result in 'cherry picking' outcomes that are used to provide weight to reject a DNSP's forecast. In the sections below, we discuss the limitations with the various ways the repex model can be manipulated to provide alternative output values.

Aggregation

The AER has suggested that aggregation of sub-category assets may be used to draw conclusions, particularly when benchmarking with peer DNSPs. For instance, the AER may sum together the values of all replacement capex for feeders, including all the different voltages and technologies.

We consider that aggregation of individual sub-categories is likely to lead to errors in the predictive values. This is due to the errors and limitations of certain sub-categories of expenditure included under a major category. For example, the AER may use data for a sub-category where the DNSP has explicitly stated that data is estimated due to lack of information.

Calibration

In previous determinations, the AER has used 'calibration' functions when the base case suggests that a far higher level of expenditure is warranted. In these cases, the AER has used most recent historical data or substituted benchmarking data to 'refit' the model to derive alternative outcomes. When the AER has re-calibrated the models they have found that DNSP's proposed forecasts exceed the predicted values of the model.

In our view this raises significant concerns with the validity of the model given that the 'base case' could produce results that the AER considered were invalid. In these cases, it would be incorrect to use a flawed model with different input data (either benchmark of past expenditure) to derive a conclusion that the AER considered was not anomalous. In our view, this is a type of backsolve to validate the use of the model.

In any case, we have identified flaws in relying on such information for the purposes of re-fitting the model.

Substituting base case data with recent historical estimates

The model may also be calibrated to compare actual levels of expenditure undertaken in the current period. We consider that this assumption may not necessarily provide a reflection of the level of expenditure needed to maintain the safety and reliability of the network. This is for 3 reasons:

- A DNSP may change in planning standards or risk assessments, driving a change in replacement levels compared to the past. Indeed this was the experience encountered by NSW DNSPs in the mid 2000s when comprehensive reviews identified a need to increase levels of replacement due to under-investment in the past.
- New standards might be imposed in terms of safety, environmental or worker safety that necessitates an increase in replacement needs.
- A DNSP may detect a change in failure rates or risks for an asset class prompting the need to develop a proactive replacement program.

Benchmarking

When the deficiencies in functional form and data limitations are multiplied across the industry, it becomes clear that the model is even poorer when used as a benchmark tool across DNSPs. For benchmarking to be valid, the regulator would need to ensure that the quality of data is sound at a sub-category level, and that the data is comparable. This assumption does not hold due to the following factors:

- Data may not be comparable as DNSPs have different technologies on their networks which are likely to exhibit different failure modes. For example, the Powercor and SP AusNet replacement ages generated by Nuttall Consulting[5] for underground cable assets are approximately 43 years whereas for Jemena and United Energy, replacement ages are 60 years. Our more detailed analysis indicates that the 40 year asset is most likely driven by failing LV cables such as the Consac type which are becoming known to regulators world wide as a problem.

- Data quality is unlikely to be of a consistent quality across all DNSPs. We note that where sub-categories are different, benchmarking could only be used at an aggregate level. However this would contain data sets where the information is of a poor quality, and may also relate to different technologies installed on the network.

- Each DNSP is likely to have different unit costs due to inherent differences in design and construction, and different cost accounting methods, for instance allocation of overheads.

[5] Nuttall Consulting, "Report – Capital Expenditure" June 2010, p33

3. Application and weight to be applied to repex model

We note that the AER intends to use the repex model as part of its overall assessment on the replacement capex proposed by a DNSP.

3.1 How the model should be used by the AER

Despite the limitations identified in Section 2, we consider that the repex model can play a role as a partial indicator of the efficiency of elements of the replacement capex. The NSW DNSPs have applied 2 principles that should be considered when applying benchmarking tools such as the repex model:

- Testing the relative effectiveness of the tool to provide insights into efficiency.
- Using the information in a way that enables the decision maker to identify whether there is a potential inefficiency in the forecasts.

Effectiveness of the repex model

The NSW DNSPs note that the Productivity Commission undertook a comprehensive review of the use of benchmarking in a regulatory setting. A key finding was that poorly designed tools or misapplication can mislead the decision maker, resulting in outcomes that do not meet the long term interests of customers. For this reason, the Productivity Commission recommended that benchmarking techniques need to meet 6 criteria.

Using the available explanatory information provided by the AER we have sought to analyse the repex model in relation to the 6 criteria. This is set out in Attachment A. The key findings of our analysis are:

- The underlying model and data limitations mean that the repex model does not sufficiently satisfy the criteria of an effective benchmark.

- The relative effectiveness of the repex model largely depends on the underlying characteristics of the asset group. This means that in some cases, the model should be disregarded entirely and not used as part of the AER's assessment approach. In other cases, the model does provide the regulator with information that can help guide its detailed review of replacement programs that are higher or lower than the model's predictions.

- The lack of clarity on how the AER will use the multiple forms of the model (base case, calibrated forms) to target its detailed reviews of programs and projects raises issues on subjectivity in the application of the outcomes.

- Multiple forms of the model may lead the AER into error, particularly where it has used data from other DNSPs to calibrate the model.

Use of model in decision making

For these reasons we consider that limited reliance should be placed on the model's outcomes when assessing the replacement capex of the DNSPs. In particular, he model should not be used to reject a DNSP's proposal without further assessing the detailed forecast methods, investment plans and costings underlying the proposed capex. Further, the outcomes of the model should not be used as a basis for substituting an alternative estimate of replacement capex.

In our view, the most effective way to use the repex model is to:

- Only use the repex model for sub-categories that meet the conditions identified in Section 3.2 below. In other cases, the AER should not use the model outcomes at all to guide decision making

- For sub-categories that meet the conditions, the AER would use the repex model to target programs where a DNSP is outside a reasonable range (either higher or lower in costs). The AER could use the different forms of the model to perform this check, but must give consideration as to whether deviations in outcomes are driven by deficiencies in the model specifications.

- The AER would undertake a detailed review of the programs which the repex model considers sit outside the range predicted by the repex models. The AER would undertake a neutral review of the underlying strategies and policies, the forecasting methods, other trend analysis, and the detailed basis underlying the proposed expenditure.

- Where the AER finds an issue, it would seek explanation and reasons from the business prior to forming a conclusion. This ensures that relevant material has not been disregarded in the AER's assessment.

- If having reviewed the material in light of the capex criteria, the AER considers that the proposed expenditure should be rejected, the AER should base a substitute on the identified issues rather than rely on the outcomes of the repex model.

3.2 What asset categories could the repex model be used for?

Taking these issues into account, we consider that the repex model can only be used for a very limited range of sub-categories, and should not be calibrated using the data of other DNSPs unless data quality is sound. We consider that the repex model will likely work best when the following factors are present:

- The underlying data quality is accurate and reliable. This includes appropriate checks on any benchmarking material provided by other DNSPs to ensure the data can be relied on, and is comparable.

- There is sufficient granularity in technology types such that asset category types are based on assets that exhibit uniformity in failure modes and similar safety or reliability consequences.

- The assets need to have a known failure / replacement rate which has been stable for over 5 years and is expected to continue for the next 5 or more years with no anticipated changes.

- When assets which have short construction lead and delivery timelines, typically 3 months or less, this scope includes handover to construction, scheduling of resources, management and delivery of construction phase and closeout of project costs.

- The sample size to determine average expenditure of works is large, and is not highly variable over time.

In our view, this type of assessment needs to be taken by the AER on each sub-group category in the model. In this regard we note that the AER's high level groupings are based on the type of asset, for instance poles, feeders, switchgear and transformers.

We consider that the effectiveness of the repex model is more dependent on where the individual asset type sits in the network (ie: sub-transmission, 11kV or the lower voltage distribution network). For example, the model may be more suitable for low voltage underground feeders, compared to 132kV feeders due to greater sample sizes and therefore more confidence in variability of costs. For this reason, we have reviewed the effectiveness of the model in relation to the elements of the network.

Sub-transmission assets

We consider the model will be highly ineffective at predicting the forecast capex for sub-transmission assets, and should not be used at all in the AER's assessment. This is based on how the asset performs against the factors we have outlined.

While the underlying data quality is likely to be far more accurate than other elements of the network, the key weakness with sub-transmission assets is the limited sample size upon which to base analysis. This means that inputs such as average age of replacement and unit costs are based on a few assets and therefore cannot be relied on for analytical purposes. The issue becomes worse when the underlying technologies in the population are substantially different and exhibit varying failure modes, meaning that the replacement age of assets is likely to vary significantly.

A further weakness is that sub-transmission assets are marked by high variability in costs due to site specific factors. For example, replacing sub-transmission cables under the harbour will have a significant cost premium relative to replacing a cable in a less dense suburb. It is for this reason that DNSPs generally undertake detailed costings on major equipment rather than rely on averages of the past. In addition, these projects can take many years to build meaning that financial data may not provide an accurate picture of the average cost of replacing the asset.

Given these deficiencies, we consider that a preferred method of assessment should be to undertake a detailed review of underlying asset management strategies, forecast methods, investment cases, and costing estimate data.

11kV (High voltage) assets

We consider the repex model may have some merit as a high level assessment tool for 11kV replacement, but that the outcomes have a high degree of error. There are a large population of 11kV feeders, which means that an experienced network planner may use models as part of a prudent long term forecasting approach. However, the planner's model would likely be more complex than the repex model to cater for information such as failure rate trends and variations in costs.

When looked at on the surface, 11kV assets meet many of the factors identified above for using repex as an assessment tool. For instance, there is a greater sample size to undertake analysis, and less apparent variability in scope of works to replace an 11kV asset. Further, construction times would not span longer than a year. For this reason, we consider that it may have some merit in being applied.

At the same time, there are a number of complexities that need to be considered prior to using the repex model for assessment purposes:

- While there are greater numbers of 11kV assets in service than sub-transmission assets, there is a diverse range of technologies that are installed across our networks. These are likely to have different failure modes, and consequently asset lives. At a sub-category level this issue may be addressed through providing data in a granular manner, however there is limited data quality at more granular levels.

- Similarly, the type and location of an 11kV asset will greatly impact the complexity of replacing an 11kV asset, and therefore we would expect there to be variability in costs. For this reason the average unit cost may not be a reliable estimate, unless the sub-categories relate to the complexity of the project.

- There is very little replacement being undertaken on the 11kV networks across the 3 businesses, and therefore a paucity of samples to use when estimating the average life.

For these reasons, we think the outcomes of the repex model for testing the forecast of 11kV investment should be used with caution.

We also note benchmarking data of peer DNSPs is very problematic and should not be applied by the AER. The costs of conducting 11kV will greatly depend on the underlying area where works are taking place. For instance, replacing an 11kV asset in a highly dense urban area creates additional costs, such as multi-way ductlines in the Sydney CBD . We also note that DNSPs such as Victoria use a 22kV voltage configuration which means that peer comparisons cannot be used.

Distribution assets

Distribution assets such as substations and low voltage feeders are perhaps the most amenable for applying the repex model. Distribution assets are numerous in volume and therefore an experienced planner may use similar types of models to identify long term forecasts. In this respect, distribution assets meet many of the conditions for using repex as an assessment tool.

For instance, there is generally a large sample size at a sub-category level, which means that assets can be designated to common technologies that exhibit similar failure modes. For instance LV Consac cables have common failure modes, and there is a sufficient population to draw inferences on the appropriate replacement age. However the model will only be accurate if there is sufficient granularity of assets in the model. For instance Consac cables are part of the underground cable category in the model, which comprise many construction types including HSL, HDPE, and XLPE, each of which have a variety of failure modes and therefore expected replacement lives.

The weakness with distribution assets is that data quality is likely to be poor, particularly age profiles and historic replacement ages. This means that the predictive value of the model is likely to be imprecise. We consider the issue of data quality becomes even more of a problem when our replacement ages and unit costs are compared to other DNSPs. Our understanding is that other DNSPs also have very poor quality data at the distribution level of the network, and therefore the application of benchmarking data will result in errors when reviewing the outcomes of the model.

Benchmarking unit costs and asset ages to peer distributors adds a further complexity, and is very likely to result in misleading outcomes. At the distribution level, there are network specific drivers that explain cost differentials and the average age of replacement. For example, the cost of replacing a Sydney CBD substation (which comprise three 1000kVA transformers and switchgear) is far higher than a rural substation of equivalent voltage(comprising one 50kVA transformer and High Voltage Dropout fuses).

Attachment A – Assessment of repex model compared to Productivity Commission criteria

Productivity Commission criteria	Productivity Commission's description of criteria	NSW DNSPs' assessment of repex model relative to Productivity Commission criteria
Validity	A valid benchmark should relate to efficiency (or conversely inefficiency) in one or more meaningful dimensions. A valid benchmark should reflect the way that the businesses are run. In particular, comparing the costs between businesses in different jurisdictions without accounting for factors outside the control of the business could provide misleading indicators of managerial efficiency.	For the reasons identified in Section 2.1 of this document, we consider the repex model does not adequately reflect the drivers of replacement.
Accuracy and reliability	Accuracy is the degree to which a benchmark provides an unbiased estimate of efficiency, while the reliability (used here in the normal sense of reproducibility) is about the variance of the measure.	For the reasons identified in section 2.2 we consider that the underlying data on replacement age and average costs is not accurate for each asset sub-category in the model. This means that the predictive values are only accurate and reliable for certain sub-categories inputted by the DNSP.
Robustness	This is a subset of accuracy and reliability, but worth emphasizing in its own right. A particularly useful robust measure is one that provides information about the efficiency of an enterprise regardless of its operating environment.	We consider that the model is not robust as the average age of replacement and unit costs are impacted by a number of factors not considered in the model. We refer the AER to Section 2 of this document
Manipulation and gaming of data	Manipulation and gaming of data - As in all systems where rewards and punishments depend on incomplete measures of performance, the measured party has incentives to 'look' like a highly performing entity. Accordingly, the regulator should consider the capacity of any particular benchmarking measure to create unforeseen business behaviours.	As noted in section 2.3, we consider that the AER's use of calibrations and benchmarking data may lead to cherry picking of the data series to draw inaccurate conclusions.
Parsimony	Parsimony - A good model should be no more complex than required. This is important in assisting interpretability, avoiding data mining, achieving robust results, reducing data collection costs and allowing greater comparability of results across countries.	The model is relatively simple, but contains complexity due to the number of manipulations and forms that can be applied by the AER in drawing conclusions.
Fit for purpose	Benchmarking has multiple purposes. Some require great accuracy, reliability and robustness. This is particularly important where benchmarking is used to determine a business's revenue allowance. Such benchmark estimates should be highly reliable across time, business types and jurisdictions. The concerns are less where benchmarking is indicative — used to identify areas for possible future investigation, or to reach some prima facie judgment.	We consider that the model is only fit for purpose when the AER applies it in the manner set out in section 3.1.