Nuttall Consulting

Regulation and business strategy

AER augex model

Assessing the Power and Water Corporation's augex forecast

A report to Power and Water Corporation

Confidential final

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Executive summary

Nuttall consulting has been engaged by Power and Water Corporation (PWC) to undertake an assessment of its augmentation expenditure (augex) forecast. This assessment must use the predictive model the Australian Energy Regulator (AER) has indicated it will use as part of the process it will apply to assess expenditure forecasts. This model is called the AER augex model.

To prepare this model, we have used data that PWC will report in its Reset Regulatory Information Notice. This process has been supported by other data provided by PWC and other comments and advice provided during the course of various meetings with relevant PWC personnel.

To undertake these assessments, we have applied similar principles to those used when undertaking an assessment using the AER's repex model. In this regard, model planning parameters have been calibrated to reflect the four years of PWC's augex (2013/14 to 2016/17 inclusive[1]). As such, the model forecast could be considered a type of indicative intra-company (or business-as-usual) benchmark study[2].

Key assessment findings

Our assessment using the AER's augex model does not support PWC's augex forecast. However, a large portion (56%) of PWC's augex forecast is due to a single zone substation project. If this project was excluded from the assessment then the model would most likely provide stronger support for PWC's forecast.

The augex model predicts the modellable component of PWC's augex over the next regulatory period (2019/20 to 2023/23) to be $32 million (Real 2019) compared to PWC's forecast for this component of $50 million, representing a 64% reduction in the augex forecast.

However, as noted above, $28 million of PWC's augex forecast is due to a single zone substation project, the Wishart zone substation development. This project results in a large increase in forecast augex in the second half of the next regulatory period (2021/22 to 2023/24), and it is this increase that results in the large difference between model forecast and PWC's.

This is shown in Figure E1 below, which compares the model's augex forecast to PWC's. This figure shows both forecasts relative to PWC's recent historical augex (as an average per annum) that has been used to calibrate the augex model. The figure also shows the component of PWC's forecast that is due to the Wishart zone substation development.

[1] Note, unlike the repex model which uses a five year calibration period, a four year period is used for the augex model because of how the AER has defined the data that PWC should report in its Reset RIN.
[2] Note, unlike with the repex model, the AER has not published benchmark parameters that would allow an inter-company benchmark study to be produced.

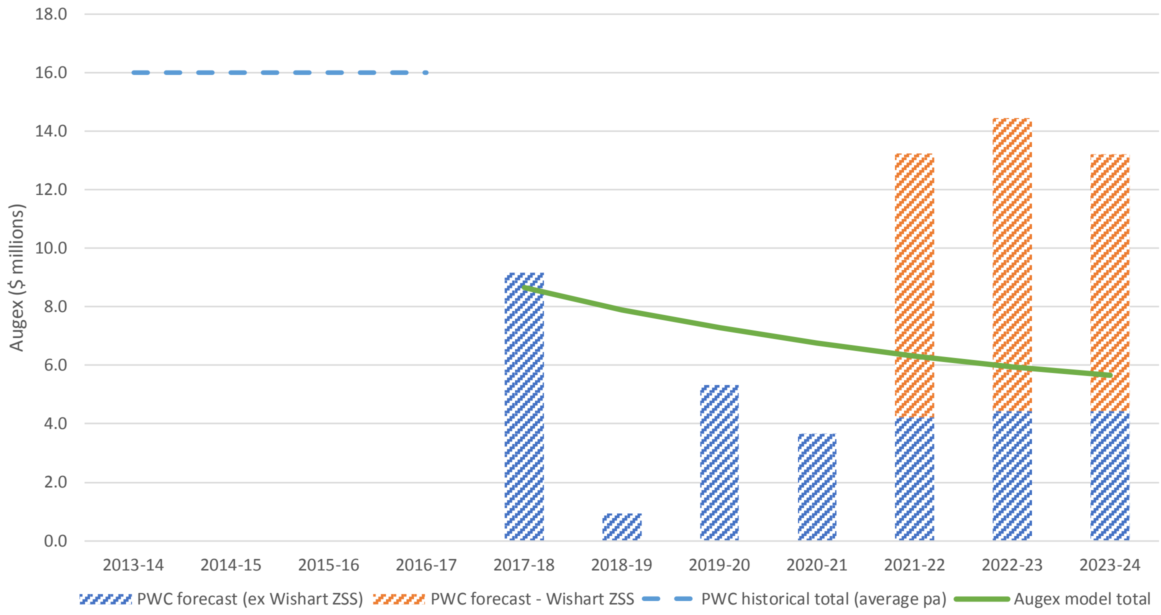

Figure E1 – Assessment results summary

This figure shows that the model's forecast is significantly above the component of PWC's forecast when the augex associated with this project is excluded, with the model's forecast over the next regulatory period of $32 million well above PWC's forecast for this component of $22 million.

It is important to note that this does not mean that the model assessment supports PWC's forecast if the Wishart project is excluded, as this would also require any component of demand growth associated with this development to be excluded from the model along with any related augmentation in the calibration period. We have not conducted this analysis. However, assuming the reduction in demand growth associated with project is significantly less than the relative reduction in augex then it seem reasonable to conclude that such an assessment would most likely provide stronger support to PWC's augex forecast.

It is also important to note that even if the Wishart project could be assessed within the augex model, there could be valid reasons for the findings discussed above, given the form of business-as-usual intra-company benchmark provided by the model. The model assessment finding can be sensitive to individual projects, if their augex dominates the overall forecast. This appears to be the case for PWC.

In these circumstances, the drivers and solutions for this single project – and its augex - could incorporate factors that are not allowed for in this type of intra-company benchmark study. Therefore, these matters would need to be investigated by the AER using its other assessment approaches.

1 Introduction

1.1 Background and scope

Power and Water Corporation (PWC) has engaged us, Nuttall Consulting, to assist in its preparations for its next regulatory decision by the Australian Energy Regulator (AER). This decision will cover the five-year period from 1 July 2019 to 30 June 2024.

As part of this engagement, PWC has requested that we:

- develop a model of PWC's augmentation capex (augex) using the AER's augex model
- use the model to assess PWC's augex forecast, using an approach that could be applied by the AER
- reconcile the model forecast with PWC's own augmentation forecast
- prepare an independent report, which can be used as a supporting document to PWC's building block proposal to the AER, that sets out the forecast and explains how we developed the model and forecast.

This document serves as the report to PWC indicated above.

The following definitions are used in this report:

- **Augmentation capex** (or **augex**) has the meaning given to it by the AER in its recent advice on how it will conduct expenditure forecast assessments, which broadly covers the demand-driven reinforcement, extension or enhancement of the network, excluding similar activities due specifically to the connection of customers.
- We use the term **AER augex model** to mean the generic excel workbook that the AER has advised it will use as an assessment technique in its determinations – and the AER calls the augex model.
- We use the term **PWC augex model** to mean the model we have prepared of PWC's network using the AER augex model. The PWC augex model is used here to produce augex forecasts of the PWC network.
- We use the term **asset** here in a very general sense to reflect the physical unit of network that is accounted for in the AER augex model. This typically reflects an individual line or an individual substation[3].
- When discussing the model and providing results in Section 2 and beyond, we will use the year representation 200*x*, to represent the regulatory year 200*x*-1/200*x*.

[3] Note the difference here to an asset in the repex model – or PWC's systems – which is likely to account for a sub component of the augex model's asset.

In addition, all expenditure and costs shown in this report represent **direct real June 2019 dollars**.

1.2 Nuttall Consulting experience in this task

Nuttall Consulting, using Dr Brian Nuttall (the author of this report), developed the Excel workbook that serves as the basis of the AER's augex model and advised the AER on its possible roles and application in regulatory determinations.

Moreover, we were engaged by the AER to provide advice that informed the AER's past determinations of the Victorian and Tasmanian Distribution Network Service Providers (DNSPs). As part of these engagements, Dr Nuttall developed models and forecasts using the AER's repex model. Although the augex model is aimed at a different expenditure activity (network augmentation, rather than asset replacement) it is broadly based upon similar principles. We have been engaged by a number of DNSPs to assess their augex forecasts using the augex model and an approach that is similar to that used by the AER when applying the repex model to assess repex. This is the same approach we have used here.

1.3 Key information sources

We have used the following key information to develop PWC's augex model:

- the AER augex model and AER augex model handbook, published on the AER website
- asset loading and rating data, provided in the format of the asset status tables in Template 2.4 of the Reset Regulatory Information Notice (RIN); this data covers the two years 2013/14 (2014) and 2017/18 (2018)[4]
- PWC's historical augex covering the period from 2013/14 to 2016/17, and PWC's forecast augex covering the period from 2017/18 (2018) to 2023/24 (2024), as defined in Table 2.4.6 of the Reset RIN
- PWC's forecast augmentation capacity added to its network covering the period from 2017/18 (2018) to 2023/24 (2024), as defined in Table 2.4.6 of the Reset RIN.

We have also held a number of workshops with relevant PWC personnel to clarify data requirements. Where gaps exist, we have made a number of assumptions based on advice from PWC to prepare the models. The critical assumptions and their basis will be discussed in this report.

1.4 Structure

This report is structured as follows:

[4] Note, we understand that the data reporting for each of these two years corresponds to the asset loading and rating entering these years.

- In section 2 we provide an overview of the AER augex model, summarising how it develops a forecast, its inputs and outputs, and how the AER may use it to assess a DNSP's augmentation forecast.
- We discuss the methodology we have used to develop the PWC augex models in Section 3.
- In Section 4 we explain the approach we have used to assess PWC's augex forecast using the augex model.
- Section 5 summarises and discusses the results of this assessment.

2 The AER's augex model

Before explaining the development of PWC's augex model, we first provide an overview of the AER's augex model and its application. This should help provide some context to the results and discussions in the sections that follow.

2.1 Overview of augex model

The AER augex model is an Excel workbook, with a structure, formulas and VBA functions and macros set up by the AER in order that it can be used by the AER to develop a network model of a DNSP and use this to prepare augex forecasts.

The DNSP's network is constructed within the AER augex model as a series of asset populations. The model uses a probabilistic augmentation algorithm to make predictions of augmentation needs for each population. The probabilistic augmentation algorithm assumes that the maximum utilisation that an asset will reach before it must be augmented (called its utilisation threshold in the model) is normally distributed across any asset population represented within the model.

From this, the model predicts future augmentation volumes based upon a current utilisation profile for an asset population represented in the model and forecast growth in demand (which is used as a proxy for the forecast growth in utilisation).

The AER has indicated that it will use this model to make top-down assessments of a DNSP's augex forecast. In this regard, it has indicated that it may use the model in two ways to develop a benchmark forecast:

1. **Intra-company** – it will develop a benchmark forecast within the model that reflects the historical augmentation decisions of the DNSP (this reflects an assumption that these decisions were prudent and efficient)
2. **Inter-company** – it will develop a benchmark forecast within the model that reflects its view of the appropriate augmentation decisions it has determined from the set of DNSPs (this reflects an assumption that the DNSP's decisions may not have been prudent and efficient, and so it has substituted its view on this matter from the augex models of other DNSPs to test this).

It is important to stress that at this stage the AER has not published any of its analysis of the above forms of benchmarking. As such, it is unclear how it may approach the assessment of PWC's augex forecast.

Importantly, it has not published any inter-company benchmark parameters for this model. Therefore, we only discuss **intra-company** benchmarks in this report. As such, the forecast produced by the model in this report only uses planning parameters that reflect PWC's recent historical augmentation and augex decisions, and assumes that these were prudent and efficient decisions.

2.2 AER augex model form, inputs and output

2.2.1 Network specification inputs – network segments and groups

As indicated above, a DNSP's network is defined as a series of distinct asset categories within the augex model. These are called network segments in the AER's documentation and represent the set of network assets that may have similar planning arrangements i.e. lines or substations.

To facilitate analysis and reporting, each network segment defined in the model is assigned to a smaller set of groups. In this way, a model may use a large number of network segments, to improve the accuracy of the analysis, but a much smaller number of groups to provide aggregate forecasts for reporting (and benchmarking) purposes.

2.2.2 Network specification inputs - utilisation profile

A utilisation profile must be provided for each network segment used in the model. This profile represents a snap-shot of the utilisation of the population of assets in that segment for the initial year of the model. That is, the utilisation profile is essentially a vector that holds the volume of assets (measured in capacity units e.g. MVA) at one-percentage increments of utilisation.

The timing of a capacity-related augmentation is typically sensitive to the maximum demand on an asset. That is, it is the amount of the maximum demand that is above various capacity limits of an asset that defines the risks and/or service constraints associated with using the asset. Therefore, within the augex model, the utilisation of any asset (e.g. the utilisation of a line or substation) is defined as:

- *the maximum demand on that asset / the assets capacity limit or rating*.

The model itself does not define exactly how the measures of maximum demand or capacity must be specified. However, the AER has indicated its preference for these measures in an effort to place all DNSPs on a consistent basis[5], where:

- the maximum demand should be weather corrected to represent a 50% probability of exceedance condition (and reflect normal network arrangements)
- the capacity of an asset should reflect its thermal rating, assuming a normal load cycle if applicable (i.e. an asset's normal cyclic rating).

It is important to note that once the units of capacity in a segment are defined, all measures of utilisation, capacity being augmented, or capacity needing to be augmented are reported in the model on that basis.

2.2.3 Network specification inputs – utilisation growth

To predict a network's augmentation *needs*, the model must first predict what the utilisation of the network will be in the future. To do this, the model requires the growth

[5] See discussion in Section 5 of AER augex model manual.

in utilisation (assuming no augmentation) to be input for each network segment. This is essentially the growth in maximum demand for each network segment.

The model represents this growth as a single annual compounded growth rate (percentage growth in one year) that should represent the average annual growth rate over the period being considered (note here that the model does not hold individual growth rates for each year of the forecast period).

2.2.4 Planning parameters inputs

The model uses four planning parameters to define the approach it uses to predict future augmentation *needs*:

- The utilisation threshold, which is represented as a normal probability distribution, is defined by two of these parameters:
  - the mean utilisation threshold
  - the standard deviation of the utilisation threshold.

  The utilisation threshold specifies when existing capacity requires augmentation, and is used to measure this amount from the utilisation profile. In this way, this parameter defines how the *need* for augmentation is measured.

- The capacity factor is the third parameter, reflecting the amount of additional capacity that is added to the network, given the amount of existing capacity that requires augmentation. It is defined as a proportion of the capacity requiring augmentation.

  For example, if the capacity factor is set at 50%, this means that if the model calculates that 100 MVA of the existing capacity will require augmentation in the future then it will assume that 50 MVA of capacity will be added to the network to address that need.

  This parameter relates to the *scale*, in capacity terms, of the augmentation solution that is used to address a *need*.

- The fourth parameter reflects the average augmentation unit cost, where a unit is specified in terms of the relevant unit of capacity for that network segment (i.e. $ / kVA of capacity).

Using these parameters, the capacity added to the network (calculated via the utilisation threshold and capacity factor) multiplied by the augmentation unit cost, produces the expenditure forecast.

2.2.5 Model outputs

The model produces various outputs. These outputs provide various measures of the input utilisation profile, such as average utilisation, average threshold, total quantity of capacity, and total augmentation cost (i.e. quantity x augmentation unit cost).

The model also produces forecasts (by year over a 20-year period), including augmentation capacity volumes, augmentation expenditure and average utilisation.

These outputs are provided at the network segment, segment group and total network level. When averages are calculated at the network group or network level, the model uses a weighted average using the augmentation cost of each asset category as the weighting.

2.3 Calibration

The calibration of a DNSP's model is the critical process that is applied by the AER (and us for this assessment) to produce the intra-company benchmark model.

The calibration process concerns deriving the set of model planning parameters that reflects the actual augmentation outcomes (volumes and expenditure) over the calibration period.

The following process can be used to calibrate the augex model[6].

This process relies on calculating three parameters for each network segment (or segment group) from the available data, namely:

- the augex in that segment (or segment group) over the calibration period
- the capacity added (through augmentation) in that segment (or segment group) over the calibration period
- the capacity that required augmentation in that segment (or segment group) over the calibration period.

2.3.1 Augmentation unit cost

The augmentation unit cost parameters for each segment is simply the augex divided by the capacity added to the segment.

2.3.2 Volume planning parameters

The utilisation threshold parameters (mean and standard deviation) and capacity factor for each segment need to be set to ensure the model reflects the capacity added (through augmentation) over the calibration period.

However, the calculation of these planning parameters is more complicated because:

- we have three parameters to determine and typically only one variable (the total capacity added)
- we are looking at history and not predicting into the future.

[6] The AER augex model manual does not discuss the calibration process in any detail. However, we understand the AER will apply a similar process to the one it has indicated it will use to calibrate its repex model. The process we have defined here should reflect this similar process.

Therefore, the calibration of the utilisation threshold parameters is slightly more involved and involves the following:

- First, in the absence of better information, the need to determine the standard deviation is removed by making it dependent on the mean. We have assumed that the standard deviation is the square root of the mean to reflect a similar assumption the AER has advised it will use for the repex model calibration process.
- Second, the capacity factor is set at a specific value. There are various ways this could be calculated. Here, PWC has estimated this parameter for our assessment by analysing a sample of its recent augmentation projects.
- Third, an augex model is developed to reflect the beginning of the calibration period, with the growth set to represent the growth that occurred over the calibration period. The mean utilisation is determined within this model to ensure that the forecast produced by the model over the calibration period equals actual capacity added due to augmentations during the calibration period.

The above defines the process that will typically be applied.

3 PWC augex model development

3.1 Overview

As discussed in Section 2.3, the process to calibrate a model and prepare a forecast requires the preparation of two augex models:

- The calibration model – This model is developed from the 2013/14 loading and rating data. The planning parameters are calculated within this model to ensure the forecast produced by the model to 2018 (i.e. capacity added and augex) matches what actually occurred.
- The forecast model – This model is developed from the 2017/18 loading and rating data. This model is used to prepare the forecasts over the next period, using the planning parameters developed in the calibration model.

The development of these two models, including the parameter calibration process, is discussed in this section.

3.2 Augex model development

3.2.1 Segmentation

The model produces forecasts for a set of network segments that represent the DNSP's network. As such, each segment defined in the model requires its own set of inputs (i.e. utilisation profile and planning parameters) and the model produces forecasts for each segment.

Segments have been developed that largely reflect those model categories, defined by the AER in its Reset RIN, which are relevant to PWC. However, we have combined all HV feeders in to a single HV feeder segment and all distribution substation types into a single distribution substation segment to simplify the modelling process.

The table below summarises the groups and segments we have developed for the PWC augex models.

Table 1 PWC augex model network segments

Network group	Network segment
Sub-transmission lines	All sub-transmission lines
Transmission and zone substations	Transmission substations Zone substations
HV feeders	All HV feeders
Distribution substations	All distribution substations

3.2.2 Utilisation profiles

Utilisation definition

In the model, the utilisation of an asset (e.g. an HV feeder or zone substation) is defined as:

Utilisation (%) = weather corrected peak demand (MVA) / asset rating (MVA).

For each segment, two utilisation profiles have been prepared reflecting the loading in 2013/14 and 2017/18. These profiles use the following asset ratings defined in the asset status tables of template 2.4 of the Reset RIN.

Table 2 augex model asset rating definitions

Network type	asset rating
Sub-transmission lines	normal cyclic thermal rating
Transmission and zone substations	transformer normal cyclic thermal rating
HV feeders	normal thermal rating
Distribution substations	normal cyclic thermal rating

It is important to note that any capacities referred to in this report as inputs or outputs of the PWC augex model are measured on the above basis. This also includes any references to utilisation and the augmentation unit costs.

Scaling of distribution substation ratings in the augex models

PWC has a material portion of distribution substations with a very high utilisation, which is near or above the model's maximum utilisation input limit (150%). Therefore, to ensure that this limit does not affect our modelling, we have scaled the distribution rating by a factor of two and performed all calibration and modelling using this scaling.

In our experience, there is nothing unusual in applying this scaling to PWC's distribution substations. We have applied similar scaling in the models we have prepared for all other DNSPs. We do not consider that this scaling should have a material effect on the validity or accuracy of the model's forecast.

To avoid confusion, in the tabulated results presented in this report, we show unscaled values in order that they can be readily interpreted by PWC. However, we also present the scaled values in brackets in order that they can be reconciled to the model files.

Summary model inputs

The utilisation profiles need to be viewed through the augex model. However, to aid in the validation of the model, the following table summarises some important parameters associated with this set of profiles.

Table 3 Summary loading, rating and utilisation data in the augex models

Segment	Weather correct peak demand (MVA)		Asset capacity (MVA)		Average utilisation (%)		Asset capacity >100% utilisation (MVA)	
	2014	2018	2014	2018	2014	2018	2014	2018
All sub-transmission lines	**698**	**747**	**2377**	**2579**	**29**	**29**	**0**	**0**
transmission substations	*404*	*437*	*945*	*1090*	*43*	*40*	*0*	*0*
zone substations	*337*	*304*	*710*	*755*	*47*	*40*	*0*	*0*
All transmission and zone substations	**741**	**741**	**1654**	**1844**	**45**	**40**	**0**	**0**
All HV feeders	**509**	**571**	**1439**	**1533**	**35**	**37**	**25**	**18**
All distribution substations[a]	**325**	**409**	**968 (1936)**	**1264 (2529)**	**34 (17)**	**32 (16)**	**38 (75)**	**42 (84)**

a – brackets indicate distribution substation parameters, allowing for the rating scaling that is applied in the model

3.2.3 Load growth

For each segment, the growth in peak demand is an important input that drives the forecast. The growth rate assumptions used in the two augex models (noted in the introduction to this section) have been developed from the *non–coincident summated weather adjusted system annual maximum demand under 50% probability of exceedance conditions* (measured at the zone substation level) as reported in Table 3.4.3 of PWC's RIN.

Based upon this data:

- for the calibration model, the compound annual growth rate from 2013/14 to 2017/18 is 1.7% per annum
- for the forecast model, the compound annual growth rate from 2017/18 to 2023/24 is 1.03 per annum.

To calculate the growth rate to be applied in the model for each segment, the overall growth rate in peak demand can be considered to consist of two components:

- demand growth due to new connections associated with that segment that is driving expenditure that PWC is allocated to the AER's connections expenditure category, which is considered to drive expenditure that is not related to the utilisation of assets in this segment (and so should not be modelled)
- demand growth that is driving expenditure that PWC is allocating to the AER's augmentation expenditure category, which is considered to drive expenditure that is related to the utilisation of assets in this segment (and so can be modelled).

The effects of the first of these components is not assessed through the augex model. The effects of the second component can be assessed through the augex model, and define the growth rates that are used in the augex model. We have estimated this component from data PWC provided on the percentage split of the capacity added for each network group (see the discussion in Section 3.3.2).

Table 5 below summarises the segment group growth rates used in the PWC augex model, calculated using the methodology described above.

Table 4 Augex model growth rates

Segment	Historical	Forecast
All sub-transmission lines	1.70%	1.03%
All transmission and zone substations	1.70%	1.03%
All HV feeders	1.53%	0.93%
All distribution substations	0.51%	0.31%

In appreciating the differences in growth rates between segments, it is worth noting that distribution substations (and to a lesser extent, HV feeders) have a lower growth rate because a large portion of growth in this segment is directly due to new customer connections, and so is not factored into this model.

This should not affect the forecasting in the model because of how the model develops its forecast, and the inherent assumption that this forecast reflects an intra-company benchmark referenced back to PWC's recent history. However, care should be taken in using these growth rates for any other purpose or comparing them to growth rates prepared for other purposes.

3.3 Model calibration

3.3.1 Historical calibration period

The historical calibration period reflects the 4-year period prior to the base year, but inclusive of it. As such, the calibration period covers the commencement of 2013/14 to the commencement of 2017/18. That is, the model is calibrated to reflect the augmentations (i.e. the network-initiated capacity added and augex) that occurred from 2013/14 to 2016/17 inclusive.

3.3.2 Set up of calibration data

As discussed in Section 2.3, the initial phase in calibrating the augex model, involves determining three parameters for each segment. The parameters reflect the augmentations that have occurred over the calibration period, namely:

- the augex
- the incremental capacity added (because of demand-driven augmentations only)
- the capacity factor.

The table below summarises these parameters for each segment in the PWC augex model.

Table 5 Augex model calibration parameters

Segment	capacity added (MVA)	augex $ (millions)	Capacity factor (MVA)
All sub-transmission lines	**182**	**6.3**	**0.50**
transmission substations	*131*	*5.7*	*0.50*
zone substations	*41*	*34.4*	*0.50*
All transmission and zone substations	**171**	**40.1**	**0.50**
All HV feeders	**66**	**16.7**	**0.50**
All distribution substations[a]	**30 (60)**	**0.9**	**0.50**

a – brackets indicate distribution substation parameters, allowing for the rating scaling that is applied in the model

These parameters have been calculated using the following methodology and assumptions.

Capacity added

The capacity added in each segment has been determined by first calculating the total capacity added (for any reason) in each segment. This is calculated as the difference in the total capacity for each segment from 2013/14 to 2017/18 (see segment totals in Table 4).

At the segment group level, we have assumed the proportion of capacity added for different drivers, as shown in Table 6 below. The modellable proportions associated with augex have been used to scale the associated segment total capacity added to produce the capacity added defined in the table above. These assumptions have been discussed with PWC.

Table 6 Capacity added to driver assumptions

Category	demand growth with expenditure allocated to augex (utilisation relation and modellable)	asset replacements, with expenditure allocated to repex (not utilisation related)	greenfield/customer developments with expenditure allocated to connections (not utilisation related)
Sub transmission feeders	**90%**	10%	0%
HV Feeders	**70%**	20%	10%
Zone substations	**90%**	10%	0%
DSS	**10%**	20%	70%

Augex

The augex parameters have been calculated directly from the historical augex defined in Table 2.4.6 of the reset RIN. Where required, the capacity added in a segment has been used to apportion augex defined at the segment group level to individual segments.

Capacity factors

To reduce the burden on PWC, we have assumed the capacity factors for use in each segment group to be 0.5, based upon typical capacity factors we have used for similar modelling exercises.

3.3.3 Determining planning parameters

The calibration of the planning parameters is performed using the calibration model. This model is populated using the 2013/14 utilisation profiles and historical load growth, as explained above. The planning parameters for each segment are calibrated to ensure the calibration model outputs the parameters set out above (in Table 5).

This calibration process can be consider in two steps:

- calculating the unit cost
- calculating the utilisation threshold parameters.

These two steps are discussed in turn below.

3.3.3.1 Calculating the unit cost

We have calculated the augmentation unit costs ($/kVA) for each segment, directly using the parameters shown in Table 6, whereby the unit cost is simply augex / modellable capacity added.

3.3.3.2 Calculating the utilisation threshold parameters

The utilisation threshold for each segment is determined through the calibration model by finding the threshold value that forces the model to forecast the capacity that was known to have been added over the calibration period.

The following process has been used to apply this approach:

1. Input the unit cost and capacity factor planning parameters into the calibration model.
2. Assume the standard deviation of the utilisation threshold, for each segment, is the square root of the mean for that segment.
3. Using the model, determine the mean utilisation threshold parameter that sets the model's forecast of capacity added to the network over the calibration period to be equal to the actual capacity added in the relevant segments. Excel's goal seek function is used for this purpose.

3.3.4 Scenario planning parameters

Table 7 below summarises the segment mean utilisation thresholds and unit costs used in the PWC augex model, calculated using the calibration method described above.

Table 7 Augex model calibrated planning parameters

Segment	mean utilisation threshold (%)	unit cost $/kVA
All sub-transmission lines	**49.4**	**34.9**
transmission substations	*48.2*	*43.8*
zone substations	*69.8*	*848.3*
All transmission and zone substations	**57.8**	**234.4**
All HV feeders	**77.1**	**253.3**
All distribution substations[a]	**74 (37)**	**29.3 (14.6)**

a – brackets indicate distribution substation parameters, allowing for the rating scaling that is applied in the model

4 Augex forecast assessment

In this section we discuss our assessment of PWC's augex forecast. In keeping with the AER's recent approach to the use of its repex model, this assessment is focused on the *aggregate* augex forecast over PWC's next regulatory period, 2019/20 (2020) to 2023/24 (2024).

4.1 Model assessment results

Table 9 summarises the PWC forecast and the comparable augex model forecast. The results are provided as the total augex forecast over the next 5-year regulatory period.

Table 8 Augex model study results summary

Forecast 2019-20 - 2023-24 ($ millions, June-19)	
PWC	Augex model
49.9	31.9

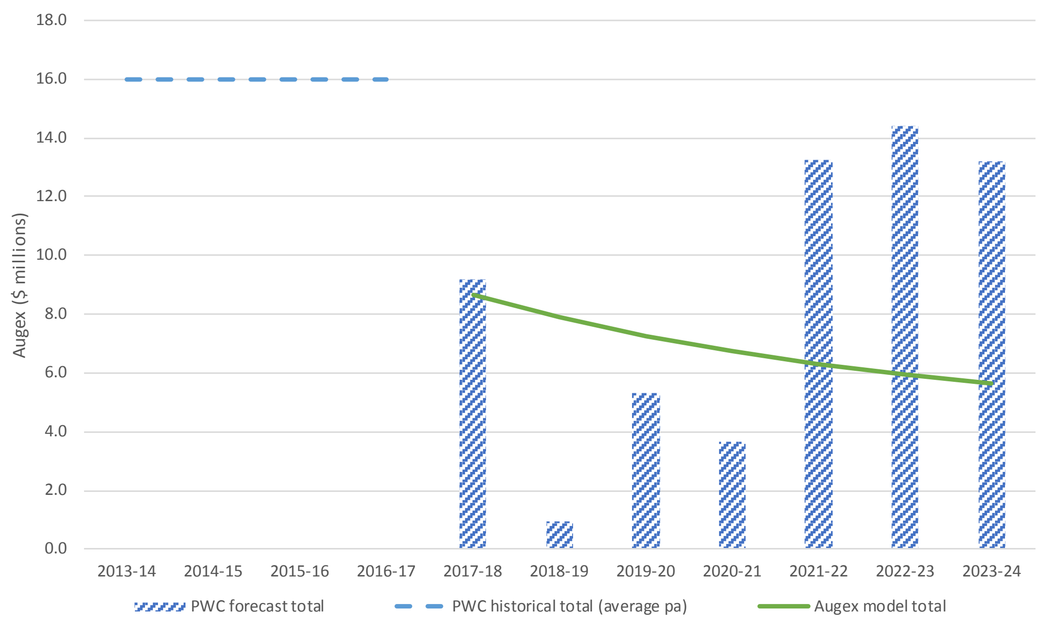

Figure 1 intra-company study results

The profile of PWC's forecast augex compared to the model's forecasts are shown in Figure 1. This figure also shows the average per annum historical augex over the calibration period.

4.2 Assessment discussion and conclusions

Our assessment using the AER's augex model does not support PWC's augex forecast. However, a large portion (56%) of PWC's augex forecast is due to a single zone substation project. If this project was excluded from the assessment then the model would most likely provide stronger support for PWC's forecast.

The augex model predicts the modellable component of PWC's augex over the next regulatory period (2019/20 to 2023/23) to be $31.9 million compared to PWC's forecast of this component of $49.9 million, representing a 64% reduction in the augex forecast.

However, as noted above, $27.8 million of PWC's augex forecast is due to a single zone substation project, the Wishart zone substation development. PWC has advised that this project is required to cater for the forecast demand in the Berrimah, Wishart and East Arm areas, which is one of the areas in the NT where significant growth in demand is forecast.

This project results in a large increase in PWC's forecast augex in the second half of the next regulatory period (2021/22 to 2023/24), and it is this increase that results in the large difference between model forecast and PWC's.

This is shown in Figure 2 and Figure 3 below, which compares the model's forecast to PWC's. These figure shows both forecasts relative to PWC's recent historical augex (as an average per annum) that has been used to calibrate the augex model. The figure also shows the component of PWC's forecast that is due to the Wishart zone substation development. Figure 2 is the equivalent chart to Figure 1 above, showing the overall assessment result. Figure 3 is a similar charts, but showing the results for the model's zone substation segment only.

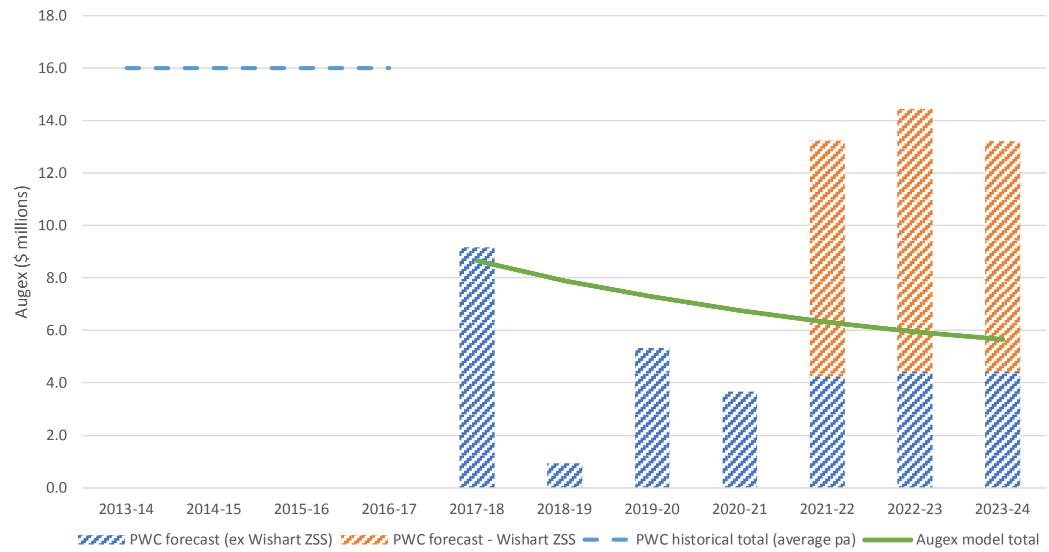

Figure 2 intra-company study results – with Wishart project augex

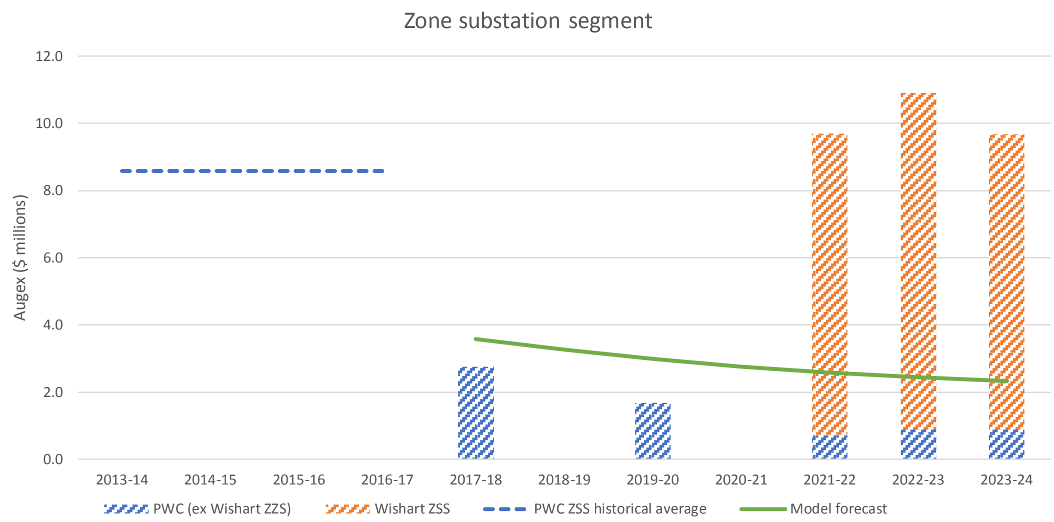

Figure 3 intra-company study results –zone substation segment only

These figures shows that the model's forecast is significantly above the component of PWC's forecast when the augex associated with the Wishart project is excluded. The model's forecast over the next regulatory period of $31.9 million is well above PWC's forecast for this component of $22.1 million.

For the zone substation segment only, the difference between the model's forecast and PWC's is more pronounced. With the Wishart project included, the model's forecast over the next regulatory period is $18.8 million below PWC's forecast, with the model forecasting only $13.1 million compared to PWC's forecast of $32 million. This difference largely reflects the overall assessment difference noted above. However, if the Wishart project augex is excluded, the model forecast for the zone substation segment is significantly higher than PWC's forecast, with the model's forecast remaining at $13.1 million and PWC's forecast dropping down to only $4.2 million.

It is important to note that this does not mean that the model assessment supports PWC's forecast if the Wishart project is excluded, as this would also require any component of demand growth associated with this development to be excluded from the model along with any related augmentation in the calibration period. We have not conducted this analysis. However, assuming the reduction in demand growth associated with project is significantly less than the relative reduction in augex then it seem reasonable to conclude that such an assessment would most likely provide stronger support to PWC's augex forecast.

It is also important to note that even if the Wishart project could be assessed within the augex model, there could be valid reasons for the findings discussed above, given the form of business-as-usual intra-company benchmark provided by the model. The assessment finding can be sensitive to individual projects, if their augex dominates the overall forecast. This appears to be the case for PWC.

In these circumstances, the drivers and solutions for this single project – and its augex - could incorporate factors that are not allowed for in this type of intra-company benchmark study. This could be the case for PWC as it has advised that it deferred this project from an originally proposed date of 2015, by constructing a 12 MVA temporary substation, using the Nomad substation. We have not reviewed the accuracy or reasonableness of this claim, but it could suggest a valid reason for the difference. Therefore, these matters would need to be investigated by the AER using its other assessment approaches, most notably a detailed engineering review.

4.3 Summary and conclusions

Our assessment using the AER's augex model does not support PWC's augex forecast, with the model forecast at 64% of the equivalent PWC augex forecast.

However, the majority of the difference is associated with the modelling of PWC's zone substations, where a large portion (56%) of PWC's augex forecast is due to a single zone substation project – the Wishart zone substation development. If this project was excluded from the assessment then the model would most likely provide stronger support to PWC's forecast.

The reason for this development and its effect on the assessment results could be due to matters that are not allowed for in the assessment method. Therefore, these matters would need to be investigated by the AER using its other assessment approaches (e.g. detailed engineering review of the project).

We consider this assessment to be a reasonable top-down guide to PWC's augmentation needs, of which the results provide a form of independent regulatory challenge to PWC's own augex forecast. However, it is important to stress that the assessment used is only a type of intra-company benchmark, and therefore, it inherently assumes that PWC's historical practices and augex were prudent and efficient. We have not tested the validity of this assumption in our analysis.