Attachment 6.4

Estimation of value of customer reliability for Western Power's network

Access Arrangement Information

2 October 2017

Access Arrangement Information (AAI) for the period
1 July 2017 to 30 June 2022

westernpower

Synergies
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Estimation of value of customer reliability for Western Power's network

A report prepared for Western Power's Access Arrangement (4) for the 2017-18 to 2021-22 regulatory period

September 2017

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Executive Summary

Synergies has developed proxy values of customer reliability (VCRs) for Western Power using CPI-indexed values of the Australian Energy Market Operator's (AEMO's) 2014 VCR estimates for the National Electricity Market and individual jurisdictions and customers within them.

In dollar terms, a VCR represents an individual customer's or customer classes' willingness to pay for the reliable supply of electricity.

Purpose of VCRs

The primary purpose of the VCRs we have developed are to set the reliability incentive rates to be used in Western Power's service standard incentive scheme in its upcoming Access Arrangement (AA4) for the period from 1 July 2017 to 30 June 2022. We also expect the VCR estimates to be used by Western Power in the future in its distribution and transmission network planning.

VCR estimation methodology

The method employed by Synergies to derive the proxy VCR estimates for Western Power involved two steps:

- Step 1 – determine the residential and business customer class VCRs at the (WA) State-wide level using AEMO's 2014 residential and business customer class VCR estimates; and
- Step 2 – convert these customer class VCRs into Western Power's network segment VCRs (CBD, Urban, Short Rural, Long Rural) using the composition of its customers and their relative energy loads at each of these segments.

The methodology we adopted to develop the VCRs utilised Western Power's data on outage frequency and their associated probabilities, as well as customer class energy loads. This allowed us to tailor AEMO's VCR estimates to reflect the outage frequency and customer class load profiles existing on Western Power's network.

We have also escalated the VCR estimates for movements in CPI since 2014 to maintain the real value of the estimates.

Step 1 – Customer class VCRs

Given AEMO's VCR estimation work did not extend to Western Australia (WA) and no comparable customer survey of the value that WA electricity consumers place on a reliable electricity supply exists, we have developed proxy VCR estimates for WA using AEMO's VCRs.

Table 1 presents our VCR estimates for Western Power developed using AEMO's underlying South Australia (SA) and NSW VCR estimates as proxies for WA. We consider SA and NSW to be the closest comparators to WA in terms of the likely key drivers of electricity demand in the State and hence value that electricity customers are likely to place on reliable electricity supply.

Table 1 VCR estimates by customer class (June $2017/kWh)

	Residential	Commercial	Industrial	Direct Connect Customers (DCC)	Aggregate (ex DCC)	Aggregate (incl DCC)
Western Power tailored option – SA seasonal	28.8	50.5	55.3	9.7	43.3	37.1
Western Power tailored option – NSW seasonal	30.0	50.5	55.3	9.7	43.7	37.5

Source: Synergies' VCR Model using Western Power and AEMO input data

The tailored nature of the two VCR options we have estimated for Western Power using SA and NSW data is based on jurisdictional time of day (TOD) and seasonal (summer and winter) VCRs developed by AEMO based on underlying five year outage frequency and electricity consumption data and presented in June $2017. We consider the TOD and seasonal VCR estimates are likely to be more reflective of consumer electricity consumption preferences than VCR estimates that do not reflect these factors.

Step 2 – Network segment VCRs

Based on the aggregate customer class-specific VCR values for residential, commercial and industrial customers produced in Step 1, weighted average aggregate values for each of Western Power's network segments have been derived.

The weights used to calculate these network segment values are based on the electricity consumption of each customer group in each segment using five year average electricity consumption data.

We recommend that the proxy VCR estimates for Western Power utilising AEMO's SA TOD/seasonal VCR estimates escalated to current dollars be used to calculate the network component incentive rates. We consider SA to be the closest comparator to WA in terms of their respective consumers' electricity demand characteristics given similar climatic conditions, including comparable number of extreme hot weather days annually.

Our recommended network segment VCRs are presented in Table 2 in June $2017 based on the Australian Energy Regulator's (AER's) major event day definition applied to Western Power's outage frequency data.[1]

Table 2 VCR estimates by customer class (June $2017/kWh)

Network component	CBD	Urban	Short rural	Long rural
VCR estimate ($/kWh)	51.0	43.2	41.9	43.1

Source: Synergies' VCR Model using Western Power and AEMO data

[1] Major event days are where supply interruptions on that day are not regarded as representative of daily operation, usually due to weather conditions. These interruptions are removed from the outage data.

Contents

Figures and Tables

1 Introduction

The purpose of this report is to present and explain the calculation of contemporary values of customer reliability (VCRs) for Western Power's distribution and transmission networks.

1.1 Purpose and estimation of VCRs

In dollar terms, a VCR represents an individual customer or customer classes' willingness to pay for the reliable supply of electricity.

In general, different customers could be expected to place different values on having a reliable electricity supply depending on their circumstances. These circumstances include whether they are a residential or business customer, the nature of their use of electricity, their location and the current level of electricity supply reliability that they experience.

In light of this, VCRs are usually derived based on customer surveys using a representative sample of the total customer base, including logical customer groupings within it.

Between November 2013 and July 2014, the Australian Energy Market Operator (AEMO) surveyed almost 3,000 residential and business customers of various sizes and industries across eastern and south-eastern Australia. The survey was the first of its type across the whole of the National Electricity Market (NEM), covering Queensland, New South Wales, the Australian Capital Territory, Victoria, South Australia, and Tasmania.

No comparable authoritative customer survey has been undertaken in Western Australia yet. Consequently, we have been required to use AEMO's VCR estimates for customers in the NEM jurisdictions as a proxy for the VCR estimates we have calculated for Western Power. In doing so, we have attempted to choose a proxy that we consider bears the most resemblance to WA energy customers.

1.2 Role of VCRs developed in this report

We understand the VCRs we have calculated will be used by Western Power to calculate the reliability incentive rates to be used in Western Power's service standard incentive scheme in its upcoming AA4 for the regulatory period from 1 July 2017 to 30 June 2022. Specifically, estimates of VCR have been derived for the CBD, Urban, Rural Short and Rural Long segments of Western Power's distribution network.

The remainder of this report is structured as follows:

- Section 2 identifies data sources used in calculating the VCRs;

- Section 3 discusses the basis of our choice of residential and non-residential VCR proxies for Western Power;
- Section 4 sets out our estimation methodology used to develop proxy VCRs for Western Power;
- Section 5 identifies the key features of the Synergies' VCR model;
- Section 6 presents the recommended VCR estimates for Western Power's distribution network and for Direct Connect Customers (who are connected to the transmission network); and
- Appendix A presents the full set of AEMO VCR data we used to develop the recommended VCRs for Western Power
- Appendix B presents results of how changes in electricity consumption across customer classes has impacted on the energy weights applied in calculating our network component VCR estimates.

2 Data sources

We have relied on both Western Power's customer outage frequency data and AEMO's customer class VCR estimates as our inputs to derive Western Power's VCRs.

Each of these data sources is explained in turn below.

2.1 AEMO data

The key AEMO data inputs are as follows

- Base VCR values are those estimated by AEMO as at September 2014, which we have escalated in line with CPI movements.[2] These estimates include customer level VCRs by outage duration and timing of occurrence.
  - For residential customers, the VCR data is available by NEM jurisdiction.
  - For non-residential customers, each customer class is broken down by the following sizes but not by jurisdiction (ie these are NEM-wide estimates):
    - Small
    - Medium
    - Large.
- AEMO also developed Direct Connect Customer VCRs by industry class for the largest energy-consuming customers connected to the transmission (rather than distribution) network as follows:
  - Wood paper and pulp
  - Minerals
  - Mining.

The full list of AEMO's 2014 VCR values by residential and business customer classes for the NEM and by jurisdiction are presented in Appendix A to this report.

2.2 Western Power data

The key Western Power data inputs are as follows:

- Historic outage frequency data by customer class was provided by Western Power.[3] The frequency data covered the five year period from 2012-13 to 2016-17 for

[2] AEMO recommends that its VCR estimates be escalated in line with CPI until the next VCR Survey is undertaken.

[3] Source: '170920 VCR Input data up to and incl 201617.xlxs' received by Synergies via email on 21 September 2017

residential, commercial and industrial customers by the following outage durations used by AEMO in developing its 2014 VCR estimates:

  – 0 – 1 hr
  – 1 – 3 hrs
  – 3 – 6 hrs
  – 6 – 12 hrs
  – 12+ hrs

- The outage frequency data was also broken down by network component:
  – CBD
  – Urban
  – Rural Short
  – Rural Long
- The outage frequency data also included number of outage events and total customers interrupted.
- To ensure consistency with the basis of the AEMO VCR estimates, the outage frequency data provided by Western Power was filtered by excluding the effect of:
  – planned outages
  – outages of less than 5 minutes in duration
  – outages affecting less than 50 people.[4]
- Historic energy consumption by customer class and network component for the period 2012-13 to 2016-17 was provided by Western Power.[5]
  – this data included total GWh consumed across the total distribution network and Direct Connect Customer data for large customers connected directly to the transmission network, specifically customers in the metals and mining sectors.[6]

[4] These filters effectively establish the scope of the outage data for which meaningful VCR estimates can be estimated. Removal of planned outages is appropriate on the assumption that consumers can plan for and adjust their electricity consumption prior to the planned outage. Removal of outages of less than five minutes and that affect less than 50 people establish the lowest possible threshold below which AEMO considers that electricity consumer's valuation of reliability cannot meaningfully be estimated. For example, AEMO is assuming that the value to a consumer in avoiding an outage below five minutes cannot be distinguished from that consumer avoiding a five minute outage.

[5] Source: '170920 VCR Input data up to and incl 201617.xlxs' received on 21 September 2017.

[6] Source: '170920 VCR Input data up to and incl 201617.xlx' received on 21 September 2017.

2.3 Supplementary data

A range of other publicly available Australian Bureau of Statistics data was used to compare Western Power's network and customer base with the NEM jurisdictions, particularly in terms of residential loads and climatic conditions.

We used this data to identify an appropriate individual NEM jurisdiction's residential VCR proxy for Western Australia given the lack of jurisdictional-specific customer survey data for the latter.

3 Choice of residential and non-residential VCR proxies for Western Power

This section discusses the basis of our choice of residential and non-residential VCR proxies for Western Power.

3.1 Residential VCR proxy

Given the AEMO residential VCR estimates were calculated both at the NEM-wide (averaged) and individual jurisdictional levels, we need to determine our preferred VCR proxy for Western Australia.

Regional differences in VCRs occur due to several factors including:

- Access to alternative non-electricity grid energy sources i.e. domestic gas, solar PV.
- Climatic differences, including summer and winter extreme temperatures.
- Demographic differences, including household income.
- Existing level of electricity prices.

This list reflects well-accepted drivers of residential electricity demand, which in turn is likely to influence the value of a reliable electricity supply to customers. Our list is not exhaustive but includes what we consider are likely to be the most important underlying drivers of VCR estimates.

Given our view that regional differences influence VCR estimates, we have chosen not to use AEMO's NEM-wide residential VCR estimates as a proxy for Western Power. This is consistent with AEMO's approach of also estimating residential VCR values for each of the NEM jurisdictions.

Hence, we have based the choice of a residential proxy VCR for Western Power on identifying an individual NEM jurisdiction that has similar underlying drivers of residential consumption behaviour to Western Australia. On these grounds, it could reasonably be assumed that residential customers in Western Australia and its most comparable NEM jurisdiction will place a similar value on a reliable supply of electricity.

Hence, to select a proxy for Western Power's residential VCR values we analysed the similarities between WA and the other NEM jurisdictions based on the factors identified above.

3.1.1 Alternative energy sources

In respect of domestic gas usage, WA in total consumes approximately 40% of all gas consumed in Australia. However, only around 5% of gas consumption in WA is used by households.

As indicated on Table 3, according to the ABS Household Energy Consumption Survey, total dwelling energy use in WA was $36/week with 72% of total energy usage spent on electricity and 28% spent on gas.

Table 3 Dwelling energy sources - Average weekly expenditure ($2012)

	NSW	VIC	QLD	SA	WA	TAS	ACT
Electricity	31	27	27	31	26	40	28
Gas	7	18	3	9	10	2	21
Total	38	45	30	40	36	44	49

Source: ABS Publication 4670.0 Household Energy Consumption Survey 2012 Sept 2013

The jurisdictions most comparable to WA in terms of total household energy use and gas usage are NSW (72% of total energy usage spent on electricity) and SA (77.5% of total energy usage spent on electricity). This suggests that reliable electricity supply is likely to be comparably important in these jurisdictions because gas is an alternative (but not strong alternative) energy source for residential customers.

The reliance on gas in other jurisdictions is either significantly greater e.g. 40% of Victorian energy use in the home is gas-related, or much less significant e.g. less than 5% is gas-related in Tasmania and the ACT and around 10% in Queensland. This implies for these jurisdictions that either an important alternative energy source (natural gas) is available, or no alternative is available. Hence, residential customers' value of a reliable electricity supply will likely differ from those in WA, SA and NSW.

In addition to gas supply, small-scale solar PV has become an increasingly important complementary (rather than fully substitutable) energy source to grid-supplied electricity for residential customers. In practice, it has reduced the amount of electricity sourced from the grid and may have affected solar PV-owning residential customers' views about the value of a reliable supply of electricity from the grid, particularly during sunlight hours.

Table 4 indicates small scale solar PV penetration rates across Australia.

Table 4 Number and proportion of solar PV installations across Australia

State/Territory	Total number of solar PV systems installed (up to March 2016)	Proportion of households with solar PV
Queensland	470,953	24.12%
New South Wales & ACT	348,033[7]	10.25%
Victoria	282,295	11.09%
Western Australia	199,662	18.70%
South Australia	194,927	25.13%
Tasmania	26,660	10.72%
Northern Territory	5,334	6.09%
Australia	1,527,864	15.22%

Note: the two sources of data used in this table are taken from different sources, although both are based on data reported by the Clean Energy Regulator.

Source: http://reneweconomy.com.au/australias-top-solar-states-and-suburbs-23048/; and Australian Energy Council (2016), Renewable Energy in Australia, How Do We Compare? p 4

Table 4 indicates that the number of installed small scale solar PV units and associated penetration rates in WA and SA are comparable and relatively high by Australian standards, implying that the impact of solar PV on residential VCR estimates could be similar.

3.1.2 Climatic differences

There is a strong relationship between weather and electricity use. Hence, VCR values for residential customers will likely vary due to climatic differences, particularly temperature which drives heating and cooling needs.

With respect to climatic conditions, we compared historical data of maximum temperatures for WA, SA and NSW major cities using the temperatures registered by weather stations located at their main airports.

The following Bureau of Meteorology (BOM) data in Table 5 compares average daily temperatures for all mainland capitals except Darwin and Canberra over the period from 1981 to 2000. While we acknowledge that there will be significant variability within jurisdictions, the majority of residential customers are located in capital cities so the following comparison will be relevant for most residential customers.

[7] NSW = 331,378 installations and ACT = 16,655 installations.

Table 5 Average temperatures by State capital

	Perth	Sydney	Brisbane[a]	Adelaide	Melbourne
Mean Max Temp – Annual	24.8°	22.5°	25.3°	22.3°	20.4°
Mean Min Temp – Annual	12.4°	14.5°	15.7°	12.2°	11.4°
Mean Max Temp – June	19.2°	18.0°	20.9°	16.1°	14.8°
Mean Min Temp – June	9.0°	9.8°	10.7°	8.1°	7.9°
Mean Max Temp – Dec	29.2°	25.5°	28.4°	26.9°	24.4°
Mean Min Temp – Dec	15.2°	18.3°	19.7°	15.5°	14.1°
Mean No. of Days > 30°C	79.0	15.7	33.4	55.4	32.1
Mean No. of Days > 35°C	28.2	3.4	1.0	20.2	10.8
Mean No. of Days > 40°C	4.5	0.3	0.0	3.3	1.7

a Brisbane data is available only from 1981 to 2000

Note: All temperatures are measured from 1981-2010, except for Brisbane. Weather stations used: Perth – Perth Airport; Sydney – Sydney (Observatory Hill); Brisbane – Brisbane Airport; Adelaide – Adelaide (Kent Town); Melbourne – Melbourne Regional Office

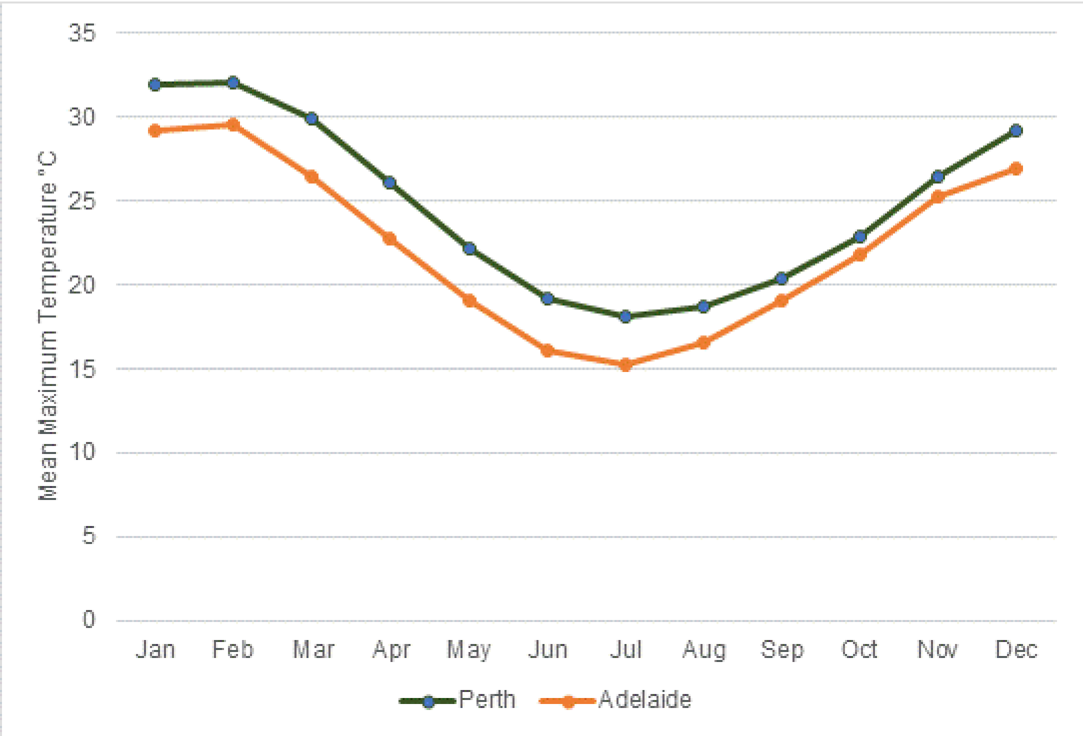
Source: Australian Government Bureau of Meteorology

Recognising that cooling and heating needs will be driven by hot and cold temperature extremes, including air conditioning demand, Table 5 indicates that the average number of days with temperatures in excess of 30°C annually in Perth and Adelaide is relatively high and similar (79 days and 55.4 days respectively). The next closest cities are Brisbane and Melbourne (33.4 days and 32.1 days respectively). Sydney averages only 15.7 extreme hot days annually. This suggests cooling-driven peak electricity demand in Perth and Adelaide is likely to be relatively closely aligned.

Table 5 also indicates that average winter minimum temperatures (in June) across all capital cities are very similar, indicating what is likely to be broadly comparable electricity heating demand (although Melbourne's heating demand is primarily gas-based).

Taking a broader picture of temperatures across a year, Figure 1 depicts long-term (1981-2010) reported mean maximum temperatures registered at Perth and Adelaide airports from January to December, which are the closest comparator cities from an extreme weather perspective.

Figure 1 Mean maximum temperatures – Perth and Adelaide



Note: This figure shows mean maximum temperatures from 1944 to 2016 for Perth and from 1955 to 2016 for Adelaide
Data source: Australian Government Bureau of Meteorology

In terms of average maximum temperatures, Figure 1 indicates Perth is hotter than Adelaide through the year with the summer average peak for both high, which suggests a similar dependence on electricity used for cooling purposes.

Overall, when accounting for climatic conditions, the above weather data suggests SA is likely to be the most suitable comparator for WA as an indicator of electricity demand and the value that consumers place on a reliable electricity supply, because its extreme hot summer days and summer maximum temperatures are more closely aligned than for any of the other jurisdiction.

3.1.3 Demographic factors

A range of other factors may impact on the value that residential customers place on electricity supply reliability. Each of the potentially important ones are discussed briefly in the sections below.

Household income

One such factor is average household income because there is research evidence to suggest electricity demand is positively related to the incomes of customers.[8]

According to the ABS Household Income and Wealth Survey, the weekly value of WA's disposable income and equivalised disposable income was $2,029 and $1,180 respectively.[9] Table 6 shows that both SA and NSW register lower income indicators than WA, however, NSW values are closer.

Table 6 Disposable income and equivalised disposable income – Mean weekly value ($2013-14)

	ACT	WA	NSW	VIC	QLD	SA	TAS
Disposable Income	2,048	2,029	1,739	1,619	1,618	1,423	1,321
Equivalised Disposable Income	1,209	1,180	1,014	959	962	878	826

Source: ABS Publication 6523.0 Household Income and Wealth, Australia, 2013 – 2014. Dec 2015

Household characteristics

Other demographic indicators based on household characteristics summarised in Table 7 below, suggest that NSW households are likely to be more like WA households in terms of composition and distribution of income than SA households. This, together with higher disposable incomes in WA and NSW, could indicate similar relatively high consumption patterns and a higher average customer valuation of a reliable supply of electricity.

Table 7 Household characteristic indicators

	ACT	WA	NSW	VIC	QLD	SA	TAS
Total average number of people in household (no)	2.6	2.7	2.6	2.6	2.6	2.4	2.4
Average number of employed persons in	1.5	1.4	1.3	1.3	1.3	1.2	1.1

8 For example, refer to Alan M. Rai, Luke Reedman and Paul Graham, 'Price and income elasticities of residential electricity demand: the Australian evidence' for analysis of price and income elasticities of demand over the period from 1970 and 2011.

9 Equivalised disposable income is total household income adjusted by the application of an equivalence scale to facilitate comparison of income levels between households of differing size and composition, reflecting the requirement of a larger household to have a higher level of income to achieve the same standard of living as a smaller household.

	ACT	WA	NSW	VIC	QLD	SA	TAS
household (no)							
Employee income contribution to household income (%) (1)	69.8	66.1	60.1	60	60.9	54.1	52.3
Percentage of households with two or more people employed (%)	49.9	44	41.9	42.6	42.5	38.4	34.6

Note: (1) As percentage of total household income.
Source: ABS Publication 6523.0 Household Income and Wealth, Australia, 2013 – 2014. Dec 2015

Notwithstanding the above data, AEMO's residential VCR estimates for the NEM and by individual jurisdiction suggest that household income is not a significant contributing factor to VCRs. Table 8 shows AEMO's residential VCR estimates by jurisdiction. The highest residential VCR estimate is for Tasmania. SA and NSW have the next highest and very similar residential VCR estimates.[10]

Table 8 Aggregate residential VCRs ($2014/kWh)

	NEM	NSW	VIC	QLD	SA	TAS
Residential VCR	25.95	26.53	24.76	25.42	26.88	28.58

Source: AEMO Value of Customer Reliability – Application Guide, Final Report, p 4

As a result, we have placed a low weight on the household income statistics as a guide to developing proxy residential VCR estimates for Western Power.

3.1.4 Level of electricity prices

The level of electricity prices may influence customers' value of reliable electricity supply, including due to traditional consumer perceptions about the link between the price and quality of goods/services ie the higher the price the better expected quality of goods/services and vice versa.

Evidence gathered by Australian electricity distribution networks over recent years indicates that residential customers across NEM jurisdictions are broadly satisfied with existing reliability levels and appear unwilling to trade-off material reductions in

10 The ACT does not have its own jurisdictional VCR, it is subsumed within NSW.

reliability of supply for lower electricity prices.[11] This is consistent with customer feedback received from Western Power's recent customer engagement activities.[12]

This customer view about current electricity levels prevails regardless of the differences in residential electricity price levels across NEM jurisdictions. In addition, AEMO found a generally poor understanding of electricity prices and bills in general, as well as the purpose of the VCR survey.[13]

Given this evidence, we have not considered the impact of different levels of electricity prices across Australia on our choice of residential VCR proxy estimates for Western Power.

3.1.5 Residential VCR proxy conclusion

Given the results of the above analysis of relevant factors that are likely to determine regional differences and similarities between VCR values across Australia, on balance, we consider SA is the most suitable proxy to determine residential VCR values for Western Power. This is primarily because of comparable energy usage by household types and number of extreme weather days each year in WA and SA, the factors that we consider are the most likely to drive residential VCRs. Consequently, they are likely to indicate residential customers in each jurisdiction have broadly comparable values of electricity supply reliability.

However, given the closeness of SA and NSW as potential VCR proxies, we also calculate residential VCR estimates for Western Power using AEMO's NSW VCR values in section 4 of this paper. This provides a useful cross-check for our VCR estimates calculated using the SA residential proxy.

In developing residential VCR estimates for Western Power, we have escalated AEMO's VCR estimates for subsequent movements in CPI to maintain their real value, as recommended by AEMO.[14]

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11 References include: Energex (2014), Appendix 4, Customer Engagement Research Synopsis, p4; Essential Energy (2014), Attachment 2.2, How customer engagement informed our proposal, p5; (2013): SA Power Networks, Attachment 6.5, Deloitte: SA Power Networks Stage 1 Online Consumer Survey Report, pp34-37

12 https://www.westernpower.com.au/about/reports-publications/customer-insights-feedback-report/

13 AEMO (2014), AEMO Value of Customer Reliability Review – Final Report, p 36

14 AEMO (2014), Value of Customer Reliability Review, Application Guide, Final Report, pp 22-24

3.2 Non-residential customer VCR proxy ($/kWh)

As noted in section 2.1 above, AEMO's VCR estimates for non-residential customers are not differentiated by jurisdiction. Consequently, we do not need to identify a State-based non-residential customer proxy for Western Power.

Of note, AEMO found that its latest business VCR values for the commercial and agricultural sectors were notably lower than its 2007–08 values, including due to the implementation of energy efficiency savings by businesses in these sectors in response to higher electricity prices.[15]

AEMO's non-residential VCR estimates are presented in Table 9 below, including for large customers that are directly connected to the transmission network.

Table 9 Aggregate non-residential VCRs ($2014/kWh)

Sector	Agriculture	Commercial	Industrial	Direct connection to transmission network
Sector average	47.67	44.72	44.06	6.05
Small size	54.87	57.13	69.66	n/a
Medium size	51.81	57.28	64.44	n/a
Large size	46.41	42.13	39.13	n/a

Source: AEMO Value of Customer Reliability – Application Guide, Final Report, p 4

We have escalated AEMO's non-residential VCR estimates for subsequent movements in CPI in calculating non-residential VCR estimates for Western Power, consistent with our calculation of residential VCR estimates.

3.2.1 Non-residential customer VCR proxy conclusion

For non-residential customers, we have simply adopted AEMO's VCR estimates by customer class size and escalated them for subsequent CPI movements up to June 2017, while noting we have not calculated a VCR for Western Power's agricultural class because of internal data limitations.

[15] AEMO (2014), AEMO Value of Customer Reliability Review – Final Report, p 1

4 VCR estimation methodology

The method employed by Synergies to derive the VCR estimates for Western Power involved two steps:

- Step 1 – determination of the customer class proxy VCRs at the (WA) State-wide level using the underlying AEMO VCR estimates; and
- Step 2 – conversion of these customer class VCRs into Western Power's network segment VCRs (CBD, Urban, Short Rural, Long Rural).

Each of these steps is discussed below.

4.1 Step 1 – Determination of customer class VCRs

Our customer class VCR estimates are based on AEMO's underlying VCR estimates for 24 different outage scenarios, which we have applied to Western Power's outage frequency data broken down in accordance with the scenarios. We have made no changes to AEMO's VCR estimates.

We consider this approach preserves the integrity of the AEMO VCR estimates while recognising the outage frequency profile on Western Power's network and hence WA energy customers' likely willingness to pay for a reliable electricity supply.

4.1.1 Summary of AEMO's underlying data

AEMO's 2014 review resulted in 24 different outage scenarios and associated VCRs for each of the following customer classes:[16]

- Residential
- Agricultural
- Commercial
- Industrial.

The outage scenarios comprised the following four hours in the day outage frequency classes:

- 0 – 1 hr
- 1 – 3 hrs

[16] AEMO (2014), Value of Customer Reliability Review, Final Report, (September) page x

- 3 – 6 hrs
- 6 – 12 hrs

and the following six peak and off-peak seasonal scenarios:

- Off-Peak weekday winter
- Peak weekday winter
- Off-Peak weekday summer
- Peak weekday summer
- Off-Peak weekend winter
- Off-Peak weekend summer.

This breakdown of customer class by outage scenario on a seasonal hours-in-the-day basis represents AEMO's view about the feasible limits of a statistically robust disaggregation of VCR estimates. In other words, AEMO considered that it could not develop robust VCR estimates at a more disaggregated level than the above 24 outage scenarios.

AEMO notes that the approximate confidence interval for a VCR estimate produced in its study is +/-30%, which it considers to be an acceptable range for the choice modelling survey data that underpins its VCR estimates.[17] This cautions against false precision being placed on the 2014 VCR estimates developed by AEMO.

4.1.2 Western Power's data limitations

Ideally, frequency data for each of AEMO's 24 outage scenarios would be provided by Western Power to utilise the complete VCR data set produced by AEMO for all customer classes i.e. residential, agricultural, commercial and industrial by outage scenario.

However, the following data deficiencies (compared to the AEMO data set) reduced the granularity of the VCR estimates we could calculate for Western Power as follows:

- No reliable agricultural class classification was available for non-residential customers.
- Around 10% of total outages were not classified by customer class and hence could not be used in the analysis.[18]

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17 AEMO (2014), Value of Customer Reliability Review, Final Report, September, p 31

18 The impact of these data deficiencies on our VCR estimates is discussed in section 5.4 of our report.

The impact of these data deficiencies on our VCR estimates is discussed in section 5 of our report.

Due to the data deficiencies, our VCR model in broad terms allows two approaches to be adopted to derive customer class and network segment VCRs for Western Power:

(a) Apply AEMO's NEM-wide VCRs

(b) Apply AEMO's jurisdictional-specific VCRs.

Each approach is discussed in turn below.

4.1.3 NEM-wide approach

This approach uses AEMO's NEM-wide VCR estimates and applies them to Western Power's detailed outage frequency data for residential, size-based commercial and industrial customers.

Applying this approach assumes that Western Power's VCRs are most closely aligned to the NEM-wide average VCRs. In other words, customers on Western Power's network place a value on electricity supply reliability which is aligned to the average value of customer reliability observed in the NEM. In our view, this is unlikely to be a realistic assumption given jurisdictional differences in electricity usage, existing levels of network reliability, climate and household and business characteristic differences.

However, as discussed in chapter 3 of our report, AEMO's non-residential VCR estimates are only available as NEM-wide estimates, whereas its residential VCRs are based on individual NEM jurisdiction values.

Consequently, we have paid close attention to AEMO's State-based residential customer class VCR estimates, which we consider allow identification of a proxy more closely related to Western Australia's residential customers' circumstances and hence their likely value of electricity supply reliability. In contrast, we have no choice but to use AEMO's NEM-wide VCR estimates for our non-residential customer class proxy VCRs for Western Power.

4.1.4 Jurisdictional-specific approach

This approach applies one or more of AEMO's jurisdiction-based VCR estimates by outage duration and customer class to Western Power's detailed outage frequency data for residential customers. As noted above, AEMO's VCR estimates for non-residential customers are not differentiated by jurisdiction.

Using the AEMO VCR estimates, we derived VCRs on a probability-weighted basis using the outage frequency by duration data provided by Western Power to derive aggregate customer class VCRs at a (WA) State-wide level using the following two-stage process.[19]

- Stage 1: Using actual historical outage data of the Western Power network, we calculate the outage probabilities for each AEMO-specified customer class and based on its specified times of day, weekday and season.
  - Table 10 shows the probabilities for Western Power's residential customer class.

Table 10 Western Power's outage probabilities for its residential customer class

Outage duration (hours)	Off-peak weekday winter	Peak weekday winter	Off-peak weekend winter	Off-peak weekday summer	Peak weekday summer	Off-peak weekend summer
0 to 1	6.3%	3.3%	2.1%	5.8%	2.8%	2.1%
1 to 3	10.4%	6.4%	3.5%	9.4%	5.5%	3.4%
3 to 6	5.8%	3.3%	1.9%	5.3%	3.1%	1.8%
6 to 12	4.6%	1.9%	1.7%	5.2%	2.2%	2.1%

Source: Western Power data

- Stage 2: The probability of each outage duration and time of day/season is then multiplied by the corresponding AEMO VCR values. The result of this multiplication process is a probability-weighted residential VCR value for Western Power based on a probability-weighted SA residential VCR estimate developed by AEMO.
  - Table 11 shows the VCR values for the SA residential customer class.

Table 11 AEMO's VCR by event estimates for SA residential customer class ($/kWh)

Outage duration (hours)	Off-peak weekday winter	Peak weekday winter	Off-peak weekend winter	Off-peak weekday summer	Peak weekday summer	Off-peak weekend summer
0 to 1	14.36	41.49	14.36	14.36	41.49	14.36
1 to 3	33.25	36.20	33.25	33.25	36.20	33.25
3 to 6	29.32	28.07	29.32	29.32	28.07	29.32
6 to 12	19.84	18.11	19.84	19.84	18.11	19.84

Source: AEMO Value of Customer Reliability – Appendix, p 6

AEMO characterises the Step 2 multiplication calculation as follows:[20]

$$Weighted\,VCR = \sum Pij * Qij$$

[19] In practical terms, this is a 'top down' rather than individual network feeder 'ground up' estimation approach.

[20] AEMO (2014), AEMO Value of Customer Reliability – Application Guide, December, p 28

Where:

P is the array of outage probabilities (refer Table 10)

Q is the array of VCR values (refer Table 11)

i is the number of event classes in the P and Q vectors (eg Peak weekday summer)

j is the number of outage durations in the P and Q vectors (eg 1 to 3 hours).

This two-stage process is repeated for all customer classes to develop the proxy customer class VCR estimates for Western Power.

The critical issue is to identify an appropriate proxy or proxies for Western Power's VCR estimates, which we discussed in section 3 of our report. Our preferred residential customer VCR proxy jurisdiction is South Australia, primarily because the energy consumption profile and likely value that customers place on a reliable supply of electricity in SA bears the most resemblance to WA customers.

4.2 Step 2 – Conversion of customer class VCRs into network segment VCRs

Using the aggregate customer class-specific VCR values for residential, commercial and industrial customers produced in Step 1, weighted average aggregate VCR values for each of Western Power's network segments are then derived using energy load weights by customer class within each segment. To calculate these network segment VCR values, we adopt a two-stage process set out in the section below.

4.2.1 Stage 1: Determine energy weights

First, we determine the volume of energy consumed by each customer class (ie residential, commercial, industrial) in each network segment (ie CBD, Urban, Short Rural, Long Rural), which is also summed to develop a total energy consumed value.

Individual energy load weights are calculated for each customer group in each network segment based on their consumption relative to total energy consumed. We have used a five year averaging period to 2017 to develop the energy weights to smooth any annual variations in the data. It is possible to use shorter averaging periods for the energy weights. Our reasons for choosing a five year averaging period are explained in section 6.3 of our report.

The energy weights by customer class and network segment are presented in Table 12.

Table 12 VCR weights by customer class for Western Power (%)

Network segment	Residential	Commercial	Industrial
CBD	3.2	72.1	24.7
Urban	38.7	38.7	22.7
Short rural	44.5	33.1	22.4
Long rural	36.7	52.3	11.0
Total network (excl Direct Connect Customers)	38.2	40.0	21.8

Source: Synergies using Western Power data

4.2.2 Stage 2: Convert customer class VCRs into network segment VCRs

Second, having calculated the network segment by customer class energy weights, we then apply the weights to each of the aggregate customer class VCR estimates we have developed to determine each of the network segment VCR estimates.

The equation used for this calculation for the CBD network segment is as follows:

$$\sum (Residential\ VCR\ estimate\ *\ CBD\ Residential\ Customer\ Energy\ Weight) + (Commercial\ VCR\ estimate\ *\ CBD\ Commercial\ Energy\ Weight) + (Industrial\ VCR\ estimate\ *\ CBD\ Industrial\ Energy\ Weight).$$

The relevant VCR values and energy weights are as follows:

- Residential VCR = $27.7/kWh
- Commercial VCR =$48.6/kWh
- Industrial VCR = $53.4/kWh
- Residential VCR energy weight = 3.3%
- Commercial VCR energy weight = 70.9%
- Industrial VCR energy weight = 25.8%

Inserting these values and weights into the above equation generates the CBD network VCR estimate:

$$\sum (\$27.7\ *\ 0.033)\ +\ (\$48.6\ *\ 0.709)\ +\ (\$53.4\ *\ 0.258)$$

$$=\ \sum (\$0.91\ +\ \$34.46\ +\$13.78)$$

$$=\ \$49.15/kWh.$$

Our estimation methodology for customer class and network segment VCRs set out in this section was incorporated into a VCR Model we developed for Western Power, which is discussed in the next section of our report.

5 VCR Model

The VCR methodology discussed in Section 4 of this report has been incorporated into a Microsoft Excel VCR Model to enable Western Power to calculate proxy VCR estimates for its network using the NEM-wide and jurisdictional-specific approaches adopted by AEMO.

The VCR Model has the functionality for Western Power to escalate for inflation the value of the VCR estimates it generates over time, a practice recommended by AEMO.[21]

5.1 Model structure

The model is comprised of a small set of data input and output sheets, including two Operator sheets for the User to select their VCR preferences for a base case and alternative scenario from the available menu of options (refer to sheets named *'VCR Preferences|Base Case'* and *'VCR Preferences|Scenario'*).[22] The menu of options reflects AEMO's 24 outage scenarios identified in section 4.1.1 of our report.

Each of the key sheets in the model is identified below.[23]

5.1.1 Calculation sheets – *'Input|VCR Calc|Base Case'* and *Input|VCR Calc|Scenario'*

These sheets calculate VCR estimates for Western Power by customer type and network component based on the User's chosen VCR preferences for the Operator's chosen base case and alternative scenario.

It uses AEMO's VCR estimates and Western Power's outage frequency and energy load data - each of these data inputs has its own sheet in the model.

5.1.2 Input sheet – *'Input|AEMO VCR data'*

This sheet incorporates AEMO's estimated customer class VCR values ($2014/kWh) presented by outage duration, time of day (peak or off peak), day of week (weekday or weekend) and season (summer or winter) across the residential and agricultural, commercial, industrial and transmission-network connected customer types. The transmission network connected customers are referred to as Direct Connect Customers (DCCs). This data reflects AEMO's 24 outage scenarios identified in section 4.1.1 of our report.

21 AEMO (2014), Value of Customer Reliability – Application Guide, December, p 22

22 The model also includes 'Title', 'Log' and 'Contents' sheets.

23 The VCR Model has 'Title', 'Contents' and 'Log' work sheets that are not explained below.

AEMO's aggregated NEM-Wide and State VCR estimates are also presented in this sheet.

As discussed in section 4 of our report, the VCR proxy estimates by customer type that the model calculates for Western Power are a direct function of the disaggregation of AEMO's VCR values by customer type and its 24 outage scenarios.

The AEMO VCR values were not estimated on a network segment basis so the VCR Model has been set up to convert the customer class VCRs into network segment VCRs (using the methodology explained in section 4.2.2 of our report). This transformation is undertaken in the *'Output|VCR Results|Base Case'* and *'Output|VCR Results|Scenario'* sheets of the VCR Model.

It is important to note that all values in this sheet are taken from AEMO's 2014 VCR report and do not require any periodic updates.[24]

5.1.3 Input and calculation sheets – *'Input|WP Outage Freq data|AA3'* and *'Input|WP Outage Freq data|AA4'*

These sheets incorporate Western Power's outage data by duration, time of day (peak or off peak), day of week (weekday or weekend) and season (summer or winter), reflecting the 24 outage scenarios developed by AEMO.

The VCR Model can calculate VCR estimates based on Western Power's outage frequency data derived using either the Economic Regulation Authority's major event day definition (AA3) or the Australian Energy Regulator's (AER's) major event day definition (AA4).[25] The Operator nominates which definition it prefers in the *'VCR Preferences|Base Case'* and *'VCR Preferences|Scenario'* sheets of the model.

This disaggregation of outage data is aligned to AEMO's estimated customer class VCR values (refer section 5.1.2 above), which allows the model to calculate proxy VCR estimates for each of Western Power's customer class segments.

5.1.4 Input and calculation sheet – *'Input|WP Load data'*

This sheet incorporates Western Power's energy data by customer class and network segment. This is the primary data input sheet in the VCR Model.

[24] The only time these values would need to be updated is if AEMO were to undertake a new customer survey which results in revised VCR estimates.

[25] The VCR estimates in our report are based on Western Power's outage frequency data derived using the AER's major event day definition (AA4).

5.1.5 Calculation sheet – *'Calc|VCR Weights calc'*

This sheet calculates energy weights by customer class and network segment, which the model uses to develop weights to convert the Western Power customer class VCR estimates into Western Power's proxy network segment VCR estimates.

The calculations are based on Western Power's energy load data incorporated in the 'Input/WP Load data' sheet (see previous section).

5.1.6 Input sheet – *'Input|CPI index'*

This sheet presents the Australian Bureau of Statistics' CPI annual index (All Groups, Australia) that is used to express the VCR values in the Operator's preferred dollar terms. The index can be updated annually by the Operator when the June quarter CPI data is released.[26]

5.1.7 Output/results sheet – '*Output|VCR Results|Base Case' and 'Output|VCR Results|Scenario'*

These sheets present the VCR proxy values for Western Power by customer class and network segment based on the Operator's chosen VCR preferences for the base case and alternative scenario. These sheets use the calculated customer class VCR estimates and transforms them into network segment VCR estimates using the energy weights by customer class and network segment calculated in sheet

The VCR Model automatically generates these results based on the Operator's nominated VCR preferences (see next section).

5.1.8 Operator sheet – *'VCR Preferences|Base Case' and 'VCR Preferences|Scenario'*

The following features have been developed to provide Western Power with reasonable flexibility in determining base case and alternative scenario VCRs for its network:

- Granularity in terms of the VCRs used in the determination of network-wide and jurisdictional-specific customer class VCRs has been provided:
  - for the Residential VCR estimates the model allows the use of the NEM-wide residential VCR, a specified non-Time Of Day (TOD) and non-seasonal (composite) jurisdictional VCR or a specified jurisdictional TOD/seasonal VCR.

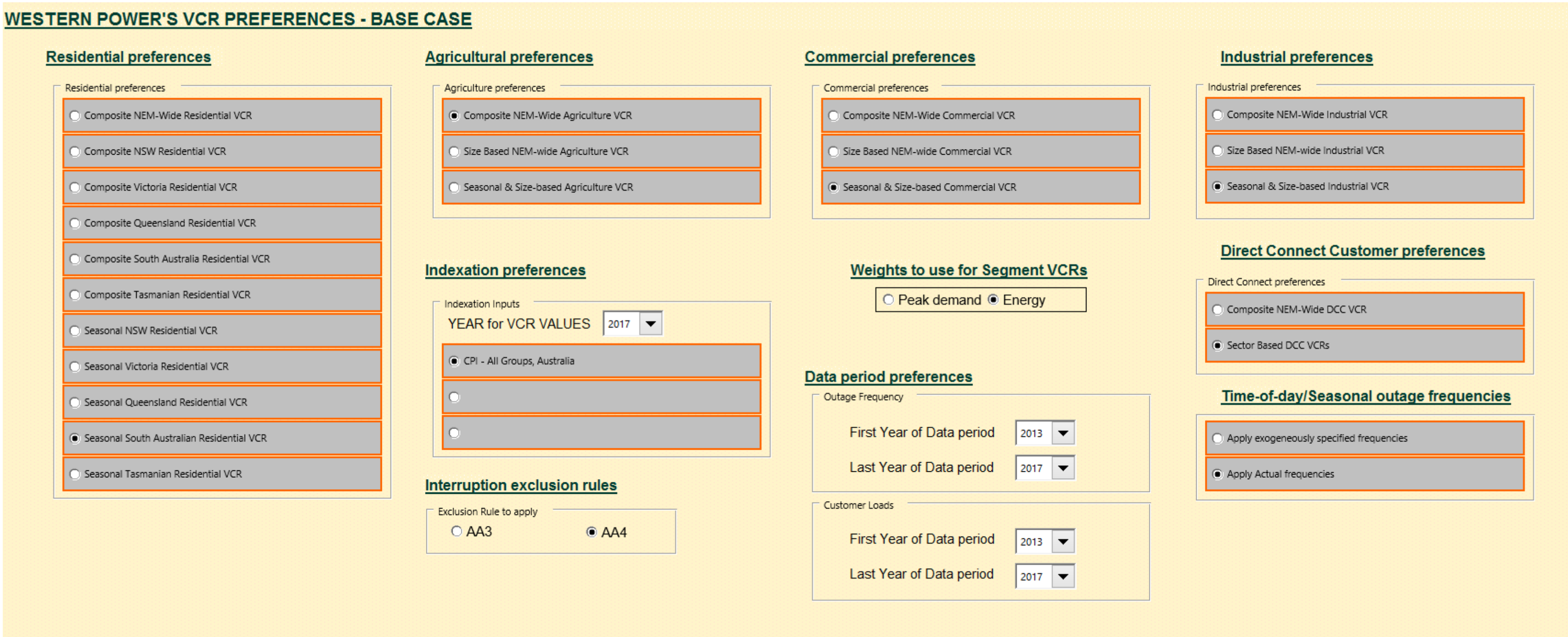
[26] Forecast annual CPI in this sheet is 2.5% based on the mid-point of the Reserve Bank of Australia's inflation target band.

   - for the non-residential VCRs, a similar approach has been employed except that there is no jurisdictional variable, only business size and TOD/Seasonal variation is available (reflecting the VCR estimates determined by AEMO).

- The length of the period used to calculate the outage frequency and load weights can be varied for each separately.
   - The range of data is from 2013 to 2017 and any continuous period across that range can be selected. For example, five year average data could be used for the outage frequency weights and a single year of data could be used for the load weights.

- The 2014 VCR values provided by AEMO (assumed to be in $2014) can be escalated to be expressed in the dollar values of subsequent years. Indexed values are expressed as at 30 June in the year selected.

The '*VCR Preferences|Base Case*' sheet of the model reflecting the above features is shown in the screen print over page.


WESTERN POWER'S VCR PREFERENCES - BASE CASE
Residential preferences
Residential preferences
Composite NEM-Wide Residential VCR
Composite NSW Residential VCR
Composite Victoria Residential VCR
Composite Queensland Residential VCR
Composite South Australia Residential VCR
Composite Tasmanian Residential VCR
Seasonal NSW Residential VCR
Seasonal Victoria Residential VCR
Seasonal Queensland Residential VCR
Seasonal South Australian Residential VCR
Seasonal Tasmanian Residential VCR
Agricultural preferences
Agriculture preferences
Composite NEM-Wide Agriculture VCR
Size Based NEM-wide Agriculture VCR
Seasonal & Size-based Agriculture VCR
Indexation preferences
Indexation Inputs
YEAR for VCR VALUES
2017
CPI - All Groups, Australia
Interruption exclusion rules
Exclusion Rule to apply
AA3
AA4
Commercial preferences
Commercial preferences
Composite NEM-Wide Commercial VCR
Size Based NEM-wide Commercial VCR
Seasonal & Size-based Commercial VCR
Weights to use for Segment VCRs
Peak demand
Energy
Data period preferences
Outage Frequency
First Year of Data period
2013
Last Year of Data period
2017
Customer Loads
First Year of Data period
2013
Last Year of Data period
2017
Industrial preferences
Industrial preferences
Composite NEM-Wide Industrial VCR
Size Based NEM-wide Industrial VCR
Seasonal & Size-based Industrial VCR
Direct Connect Customer preferences
Direct Connect preferences
Composite NEM-Wide DCC VCR
Sector Based DCC VCRs
Time-of-day/Seasonal outage frequencies
Apply exogeneously specified frequencies
Apply Actual frequencies

6 Results and recommendations

We have used the VCR model to generate VCR residential and non-residential estimates based on the approaches discussed in Sections 4 and 5 of our report.

All VCR estimates have been calculated using the most recent available actual outage frequency and energy throughput data from 2012-13 to 2016-17, which have been provided by Western Power.

6.1 Western Power tailored option 1 (SA proxy)

Key model inputs for this approach are:

- Residential VCR – SA TOD/seasonal VCRs[27]
- Commercial VCR – TOD/seasonal VCRs with small, medium and large customer size variation
- Industrial VCR – TOD/seasonal VCRs with all customers classified as large size
- Direct Connect Customers – Industry sector based VCRs for customers connected to the transmission network

6.2 Western Power tailored option 2 (NSW proxy)

Key model inputs for this approach are:

- Residential VCR – NSW TOD/seasonal VCR
- Commercial VCR – TOD/seasonal VCR with small, medium and large customer size variation
- Industrial VCR – TOD/seasonal VCR with all customers classified as large size
- Direct Connect Customers – Industry sector based VCRs for customers connected to the transmission network

6.3 VCR proxy estimates

6.3.1 Customer class VCRs

Table 13 presents our proxy VCR estimates for Western Power by customer class.

[27] Refer section 4.1.4 of our report

Table 13 VCR estimates by customer class (June $2017/kWh)

	Residential	Commercial	Industrial	Direct Connect Customers	Aggregate (ex DCC)	Aggregate (incl DCC)
1. Western Power tailored option – SA TOD/seasonal	28.8	50.5	55.3	9.7	43.3	37.1
2. Western Power tailored option – NSW TOD/seasonal	30.0	50.5	55.3	9.7	43.7	37.5

Source: Synergies' VCR Model using Western Power and AEMO input data

Box 1 shows the instructions required to replicate the VCR estimates in Table 13 using the VCR Model. The relevant Excel tab in the model to apply the chosen preferences is named 'Operator's VCR preferences'. The resulting VCR estimates are presented in the Excel tab named 'VCR results/scenarios'.

Box 1 Operator instructions for Table 13

Excel tab; 'Operator's VCR preferences'

1. Western Power tailored option – SA TOD/Seasonal

- Residential preferences: Seasonal SA Residential VCR
- Agricultural preferences: Composite NEM-wide Agriculture VCR
- Commercial preferences: Seasonal and Size-based Commercial VCR
- Industrial preferences: Seasonal and Size-based Industrial VCR
- Direct Connect Customer preferences: Sector based DCC VCRs
- Time of Day/Seasonal outage frequencies: Apply actual frequencies
- Indexation preferences: June 2017
- Interruption Exclusion Rules: AA4
- Weights to use for Segment VCRs: Energy
- Date period preferences:
  - Outage frequencies

    First year of data period: FY2013
    Last year of data period: FY2017
  - Customer Load

    First year of data period: FY2013
    Last year of data period: FY2017

2. Western Power tailored option – NSW TOD/Seasonal

Apply same preferences as for Western Power tailored option – SA TOD/Seasonal (refer above), with the following single exception:

- Residential preferences: Seasonal NSW Residential VCR

Source: Synergies' VCR Model

Table 13 indicates that our derived VCR estimates based on AEMO's underlying SA and NSW VCR estimates are comparable.

Based on these results, there appear no grounds to change our view that SA is the appropriate proxy for Western Power's customer class VCR estimates. However, we subjected these estimates to sensitivity testing in relation to the energy load and outage frequency data used in our calculations to gain further confidence about the robustness of the estimates.

Sensitivity testing of customer class VCR estimates

There is the potential for the VCR estimates we have calculated to be sensitive to the energy load by customer class and outage frequency data used as underlying weighting factors in the model calculations. Both energy load (at the customer class level) and outage frequency data can vary across years, including due to extreme weather events, which will affect the VCR estimates.

Changing energy load profiles across customer classes and network components over time are more important than total energy load movements in the VCR estimation methodology because it is the relative consumption profiles that drive the energy load weights used to generate the customer class and network component VCRs.

Consequently, we tested the sensitivity of the customer class VCR estimates to energy load and outage frequency data based on the following periods:

- Five-year average (2013-17 for energy and outage frequency data)
- Three-year average (2015-17 for energy and outage frequency data)
- One year average (2017 for energy and outage frequency data)

The results of our sensitivity testing on our preferred SA-based VCR proxy estimates are presented in Table 14.

Table 14 Sensitivity of customer class VCR estimates (June $2017/kWh)

Customer class	VCRs based on 5-year average data	VCRs based on 3-year average data	VCRs based on 1 year average (2017) data
Residential	28.8	28.7	28.6
Commercial	50.5	50.2	50.3
Industrial	55.3	55.3	58.9
Direct Connect Customers (DCCs)	9.7	9.5	9.3
Aggregate (ex DCCs)	43.3	43.4	43.9
Aggregate (incl DCCs)	37.1	36.9	37.3

Source: Synergies' VCR Model using Western Power and AEMO input data

Table 14 indicates limited variation in VCR estimates across the different averaging periods. In general, the VCR estimates based on five year and three year average outage frequency and energy load data are most comparable. Further, the Industrial customer VCR estimate using one year average data is the only estimate materially different to estimates calculated using five year and three year average data.

Box 2 shows the instructions required to replicate the VCR estimates in Table 14 using the VCR Model. The relevant Excel tab in the model to apply the chosen preferences is named 'Operator's VCR preferences'. The resulting VCR estimates are presented in the Excel tab named 'VCR results/scenarios'.

Box 2 Operator instructions for Table 14

Excel tab: 'Operator's VCR preferences'

All customer classes – VCRs based on 5-year average data

- Residential preferences: Seasonal SA Residential VCR
- Agricultural preferences: Composite NEM-wide Agriculture VCR
- Commercial preferences: Seasonal and Size-based Commercial VCR
- Industrial preferences: Seasonal and Size-based Industrial VCR
- Direct Connect Customer preferences: Sector based DCC VCRs
- Time of Day/Seasonal outage frequencies: Apply actual frequencies
- Indexation preferences: June 2017
- Interruption Exclusion Rules: AA4
- Weights to use for Segment VCRs: Energy
- Date period preferences:
  - Outage frequencies

    First year of data period: FY2013
    Last year of data period: FY2017
  - Customer Load

    First year of data period: FY2013
    Last year of data period: FY2017

All customer classes – VCRs based on 3-year average data

Apply same preferences as for all customer classes 5-year average data (refer above), with the following single exceptions:

- Date period preferences:
  - Outage frequencies

    First year of data period: FY2015
    Last year of data period: FY2017
  - Customer Load

    First year of data period: FY2015
    Last year of data period: FY2017

All customer classes – VCRs based on 1-year average data

Apply same preferences as for all customer classes 5-year average data (refer above), with the following single exceptions:

- Date period preferences:
  - Outage frequencies

    First year of data period: FY2017
    Last year of data period: FY2017
  - Customer Load

    First year of data period: FY2017
    Last year of data period: FY2017

Source: Synergies' VCR Model

Further to the Table 14 outcomes, our view is that the VCR estimates should be based on underlying three or five year average outage/energy load data to smooth atypical annual movements in these variables, particularly outage frequency, which is potentially variable across years. This is because consumers' willingness to pay for a reliable supply of electricity is more likely to reflect several years of experience of receiving that supply rather than a single year's bad or good (relative to the average year's) experience. For this reason, we do not favour the use of one year average outage/energy load data.

6.3.2 Network component VCRs

Consistent with the customer class VCR estimates, it is evident from Table 15 that there is very little difference in the VCR estimates generated by applying either the SA or NSW TOD/seasonal data.

Table 15 VCR estimates by network component (June $2017/kWh)

	CBD	Urban	Short rural	Long rural
1. Western Power tailored option – SA TOD/seasonal	51.0	43.2	41.9	43.1
2. Western Power tailored option – NSW TOD/seasonal	51.0	43.7	42.5	43.5

Source: Synergies' VCR Model using Western Power and AEMO input data

This outcome reflects the similarity of the SA and NSW VCR customer class estimates, which underpin the network component VCR estimates. As previously noted, we convert the customer class VCRs into network component VCRs using energy consumed by each of the four network components.

Box 3 shows the instructions required to replicate the VCR estimates in Table 15 using the VCR Model. The relevant Excel tab in the model to apply the chosen preferences is named 'Operator's VCR preferences'. The resulting VCR estimates are presented in the Excel tab named 'VCR results/scenarios'.

Box 3 Operator instructions for Table 15

Excel tab; 'Operator's VCR preferences'

1. Western Power tailored option – SA TOD/Seasonal

- Residential preferences: Seasonal SA Residential VCR
- Agricultural preferences: Composite NEM-wide Agriculture VCR
- Commercial preferences: Seasonal and Size-based Commercial VCR
- Industrial preferences: Seasonal and Size-based Industrial VCR
- Direct Connect Customer preferences: Sector based DCC VCRs
- Time of Day/Seasonal outage frequencies: Apply actual frequencies
- Indexation preferences: June 2017
- Interruption Exclusion Rules: AA4
- Weights to use for Segment VCRs: Energy
- Date period preferences:
  - Outage frequencies

    First year of data period: FY2013
    Last year of data period: FY2017
  - Customer Load

    First year of data period: FY2013
    Last year of data period: FY2017

2. Western Power tailored option – NSW TOD/Seasonal

Apply same preferences as for Western Power tailored option – SA TOD/Seasonal (refer above), with the following single exception:

- Residential preferences: Seasonal NSW Residential VCR

Source: Synergies VCR Model

Sensitivity testing of network component VCR estimates

We also tested our network component VCR estimates using the different energy load and outage frequency data assumptions applied in our customer class VCR sensitivity testing.

The results of our sensitivity testing on the SA-based VCR proxy estimates for Western Power's network components are presented in Table 16.

Table 16 Sensitivity of network component VCR estimates (June $2017/kWh)

Network component	VCR based on 5-year average data	VCR based on 3-year average data	VCR based on 1-year average data
CBD	51.0	50.9	51.8
Urban	43.2	43.3	44.0
Short Rural	41.9	42.2	43.2
Long Rural	43.1	43.0	42.0

Source: Synergies' VCR Model using Western Power and AEMO input data

Table 16 indicates limited variation in VCR estimates across the different averaging periods.

Consistent with the sensitivity analysis undertaken on our customer class VCR estimates, Table 16 indicates that the network component VCR estimates are relatively stable across different averaging periods. Moreover, it is evident there is less variation in the network component VCR estimates than the customer class VCR estimates presented in Table 14. The network component VCR estimates based on one year average outage frequency and energy load data are generally slightly higher than the VCR estimates based on three and five year average data.

Box 4 shows the instructions required to replicate the VCR estimates in Table 16 using the VCR Model. The relevant Excel tab in the model to apply the chosen preferences is named 'Operator's VCR preferences'. The resulting VCR estimates are presented in the Excel tab named 'VCR results/scenarios'.

Box 4 Operator instructions for Table 16

Excel tab: 'Operator's VCR preferences'

All customer classes – VCRs based on 5-year average data

- Residential preferences: Seasonal SA Residential VCR
- Agricultural preferences: Composite NEM-wide Agriculture VCR
- Commercial preferences: Seasonal and Size-based Commercial VCR
- Industrial preferences: Seasonal and Size-based Industrial VCR
- Direct Connect Customer preferences: Sector based DCC VCRs
- Time of Day/Seasonal outage frequencies: Apply actual frequencies
- Indexation preferences: June 2017
- Interruption Exclusion Rules: AA4
- Weights to use for Segment VCRs: Energy
- Date period preferences:
  - Outage frequencies

    First year of data period: FY2013
    Last year of data period: FY2017
  - Customer Load

    First year of data period: FY2013
    Last year of data period: FY2017

All customer classes – VCRs based on 3-year average data

Apply same preferences as for all customer classes 5-year average data (refer above), with the following single exceptions:

- Date period preferences:
  - Outage frequencies

    First year of data period: FY2015
    Last year of data period: FY2017
  - Customer Load

First year of data period: FY2015 Last year of data period: FY2017
All customer classes – VCRs based on 1-year average data Apply same preferences as for all customer classes 5-year average data (refer above), with the following single exceptions: • Date period preferences: - Outage frequencies First year of data period: FY2017 Last year of data period: FY2017 - Customer Load First year of data period: FY2016 Last year of data period: FY2017

Source: Synergies' VCR Model

We consider that where network component VCR estimates are used to calculate the incentive rates in service performance incentive schemes (such as the Service Standards Adjustment Mechanism (SSAM)), then aligning the length of period used to set the performance targets (ie one or multiple years) with the outage frequency data used to calculate the VCR estimates is appropriate. This alignment occurs under the AER's service target performance incentives schemes for distribution and transmission under the national electricity regulatory framework. Five year average service performance data is the default approach applied under these schemes to set the performance targets.

This length of averaging period is consistent with Western Power's internal practice of using five year or longer data sets to develop its electricity usage and demand forecasts. It is also consistent with the proposed service standard benchmark (SSB) and SSAM targets (SST) performance targets over the AA4 period (5 years to set both distribution and transmission).

Given our VCR Model allows for a decoupling of the length of period that can be used for the outage frequency and energy load weights, we conducted one further sensitivity test involving different energy load weightings. This included use of five year average outage frequency data and one, three and five year average energy load data.

Compared to outage frequency data, energy load data is likely to be less subject to variability annually, although changing patterns of energy consumption across different customer classes will affect the energy load weightings used to calculate the VCR estimates. Potentially important energy trends in recent years include declining residential consumption due to increasing small-scale solar PV penetration.

Table 17 shows the sensitivity of our VCR estimates to the different load weightings.[28]

[28] Outage frequency data is based on the five year average to 2016-2017 under each load weighting.

Table 17 Sensitivity of network component VCR estimates to energy load weightings (June $2017/kWh)

Network component	VCR based on 5-year average energy load data	VCR based on 3-year average energy load data	VCR based on 1-year average energy load data
CBD	51.0	51.1	51.0
Urban	43.2	43.4	43.3
Short Rural	41.9	42.3	42.4
Long Rural	43.1	43.1	41.8

Source: Synergies' VCR Model using Western Power and AEMO input data

It is evident from Table 17 that the network component VCR estimates are relatively insensitive to the length of period used for the energy load weights. This stability reflects the relatively large volume of total energy consumed by the Urban network component (around 67%), which in relative terms has moved very little over the past five years.

In contrast, energy consumed by the Long Rural network component has declined sharply in relative terms primarily due to lower commercial customer class load, but it only accounts for around 8% of total energy consumed.

Box 5 Operator instructions for Table 17

Excel tab: 'Operator's VCR preferences'

All customer classes – VCRs based on 5-year average data

- Residential preferences: Seasonal SA Residential VCR
- Agricultural preferences: Composite NEM-wide Agriculture VCR
- Commercial preferences: Seasonal and Size-based Commercial VCR
- Industrial preferences: Seasonal and Size-based Industrial VCR
- Direct Connect Customer preferences: Sector based DCC VCRs
- Time of Day/Seasonal outage frequencies: Apply actual frequencies
- Indexation preferences: June 2017
- Interruption Exclusion Rules: AA4
- Weights to use for Segment VCRs: Energy
- Date period preferences:
  - Outage frequencies

    First year of data period: FY2013
    Last year of data period: FY2017

  - Customer Load

    First year of data period: FY2013
    Last year of data period: FY2017

All customer classes – VCRs based on 3-year average data

Apply same preferences as for all customer classes 5-year average data (refer above), with the following single exceptions:

- Date period preferences:
  - Outage frequencies

First year of data period: FY2013 Last year of data period: FY2017 - Customer Load First year of data period: FY2013 Last year of data period: FY2017
All customer classes – VCRs based on 1-year average data Apply same preferences as for all customer classes 5-year average data (refer above), with the following single exceptions: • Date period preferences: - Outage frequencies First year of data period: 2017 Last year of data period: 2017 - Customer Load First year of data period: 2017 Last year of data period: 2017

Source: Synergies' VCR Model

Attachment B indicates how relative changes in customer class energy consumption over the past five years has affected the energy load weights used in the VCR estimation methodology.

6.3.3 Electricity Network Access Code requirements

The *Electricity Networks Access Code 2004* (the Code) has no detailed guidance regarding the choice of averaging period to be used in Western Power's SSAM.

Section 6.31 of the Code requires that an SSAM must be (a) sufficiently detailed and complete to enable ERA to apply it at the next access arrangement review; and (b) consistent with the Code objective. The Code objective is an efficiency-based objective in regards to the promotion of investment in, operation and use of networks and their services to promote competition in upstream and downstream markets.

We consider the proxy VCR estimates we have generated in this report are sufficiently detailed and complete to enable ERA to apply the SSAM in AA4. We also consider these VCR estimates will contribute to achievement of the Code objective through the creation of robust incentive rates in the SSAM, a regulatory scheme intended to create financial incentives for Western Power to maintain its service performance for the long-term benefit of its customers.

6.3.4 Conclusion on sensitivity results

The sensitivity testing of our customer class and network segment VCR estimates indicates they are stable in regards to the length of averaging period used to calculate the outage frequency and energy load weights ie there is not a significant difference in the VCR estimates whether a single, three or five year average data set is used.

However, we recommend that the VCR estimates should be based on five year average outage frequency and energy load weights to smooth any potential large variations in outage frequency or energy load data over time. A five year averaging period is also consistent with Western Power's proposed approach to using 5 years of data to set the AA4 SSBs and SSTs and better aligned with Western Power's internal demand and energy use forecasting methodologies and the AER's service target performance incentive schemes for distribution and transmission networks.

In our view, choice of a five year averaging period in Western Power's SSAM for AA4 is likely to be best aligned with achievement of the Code objective by providing stable underlying outage frequency and energy load data used in the calculation of proxy VCR estimates.

6.4 Impact on results of data gaps

The main gaps in the Western Power data used to derive Table 4 are:

- The unavailability of agricultural customer outage data
- Constrained non-residential commercial customer size-based outage frequency data
- Existence of unusable outage data
- No data on customer peak demand

6.4.1 Agricultural Data

Western Power does not have access to reliable outage data on its agricultural customers.[29] Consequently, agricultural customers are likely to be subsumed within the commercial or industrial customer classes depending on their size.

AEMO's sectoral NEM-wide VCRs vary from 26.0/kWh for residential up to 44.7/kWh for the commercial sector. The sector-wide VCR for the agricultural sector calculated by AEMO is 47.7/kWh. Hence, if we were to calculate aggregate customer class VCR

[29] Western Power has advised that its tariff classes (as per its Price List) relate to "Commercial", "Industrial" and "Residential" customer types. There is no tariff class for agricultural customers. Western Power has a field in its metering system (MBS) that classifies the property type of the customer as: "Residential"; "Farm"; (ie "Agricultural"); "Commercial"; or "Industrial". However, information is entered at time of connection based on the information provided by electricity retailers. There is no formal process to proactively upkeep and QA this data over time. As a consequence, the "customer type" data based on the property type in MBS is considered unreliable and it is more appropriate to use the tariff classes to determine the customer class data.

estimates for Western Power using NEM-wide VCRs, it would under-estimate the actual VCR of its customers to the extent there is a material number of agricultural customers with higher VCRs than other non-residential customers using the network.

In terms of the TOD/seasonal VCRs results shown in Table 10 of our report, the assessment is much less straight forward. The AEMO VCR estimates vary considerably from sector to sector and across events. For example, the highest agricultural-based VCR estimate is 91.5/kWh for all events in the small customer class, while the highest VCR in the commercial sector is 96.9/kWh which was recorded by medium sized customers in the off-peak, summer period. The highest industrial VCR is 149.0/kWh recorded by small size firms in this class in the summer peak period. Hence, the impact of excluding agricultural customers in this analysis will depend on the load weighs and outage frequencies/duration probabilities used.

6.4.2 Unusable outage data

Around 10% of outage data could not be used to generate the proxy VCR estimates because it was not classified by customer class.

Notwithstanding this unusable data, the sample size of Western Power's outage data provided to Synergies is large enough to provide a representative outage profile (frequency and duration) for the network such that robust VCR estimates can be developed.[30]

6.4.3 No data on customer peak demand

The lack of customer data reflecting their contribution to peak demand has affected our calculation of the network component VCRs (CBD, Urban etc). Rather than using peak demand as the weighting variable for the conversion of the customer class VCRs to network segment VCRs, electricity consumption data has been used.

To the extent that energy consumption data across customer classes is unrepresentative of their respective peak demands, the VCR estimates will be less precise. Peak demand is a better weighting variable given network capacity is built to meet network and locational peak demand not average demand (consumption).

This is potentially most significant for residential customers given their electricity usage is, in general, peakier than non-residential customers. The practical impact of using electricity consumption as the weighting variable rather than peak demand is likely to be lower network segment VCRs than would otherwise be the case, particularly for the

[30] The outage data was reported for five years from 2012-2013 to 2016-2017.

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Urban network segment where residential customers are the largest customer class in electricity consumption terms.

The other network segment VCR estimates are likely to be less directly affected given the greater influence of non-residential customers with flatter demand profiles in these segments. (We recognise there would be an indirect downward effect on the VCR estimates of these network segments if the Urban network segment VCR were higher due to the use of peak demand weights.)

6.4.4 Conclusion

Of the omissions, it would be reasonable to conclude that the lack of outage data on Western Power's agricultural customers results in a somewhat less reliable VCR estimate for these customers than if it was possible to adopt AEMO's Agricultural VCR estimates for this customer class to estimate a proxy for Western Power.

We do not consider the unavailability of 10% of total outage data to be material.

It is difficult to assess the likely effect of using electricity consumption rather than peak electricity demand data to convert the customer class VCRs into network segment VCRs, beyond noting that the Urban network segment VCR is likely to be most affected given residential customers relatively peaky electricity demand.

Overall, we consider the customer class and network segment VCR proxies we have calculated for Western Power are robust and have not been materially compromised by the gaps in Western Power's underlying data identified in our report.

6.5 Recommendation

It is recommended that the VCR estimates in Table 18 (expressed in June $2017) be used by Western Power to calculate the network component incentive rates in the distribution component of its SSAM for AA4. These estimates are based on five year average outage frequency and energy load weights.

Table 18 VCR estimates by network component (June $2017/kWh)

	CBD	Urban	Short rural	Long rural
VCR estimate	51.0	43.2	41.9	43.1

Source: Synergies' VCR Model using Western Power and AEMO data

These VCR estimates are based on the SA TOD/seasonal estimates presented in Table 13 of this report.

Given the relatively minor gaps in Western Power's outage data identified in section 5.4 of our report, we consider that our proxy VCR estimates generated using underlying AEMO VCR data are robust and can be relied upon for AA4.

A AEMO's VCR estimates

Table A.1 AEMO 2014 VCR estimates for residential customers, NEM-wide and by State ($2014/kWh)

Outage category	NEM	New South Wales	Victoria	Queensland	South Australia	Tasmania
Composite VCR excl DCCs	39.0	38.4	39.5	39.7	38.1	39.4
Composite VCR incl DCCs	33.5	34.2	32.6	34.9	34.1	25.6
Composite Residential	26.0	26.5	24.8	25.4	26.9	28.6
Residential O/P wday win - 0-1 hrs		16.3	8.7	11.8	14.4	11.5
Residential O/P wday win - 1-3 hrs		35.0	36.8	37.4	33.3	43.5
Residential O/P wday win - 3-6 hrs		29.2	26.2	34.9	29.3	34.1
Residential O/P wday win - 6-12 hrs		21.0	18.8	21.6	19.8	22.8
Residential P wday win - 0-1 hrs		42.9	28.1	42.8	41.5	45.3
Residential P wday win - 1-3 hrs		37.5	36.0	40.5	36.2	46.3
Residential P wday win - 3-6 hrs		28.0	24.1	33.0	28.1	32.9
Residential P wday win - 6-12 hrs		19.0	16.5	19.8	18.1	21.0
Residential O/P wend win - 0-1 hrs		16.3	8.7	11.8	14.4	11.5
Residential O/P wend win - 1-3 hrs		35.0	36.8	37.4	33.3	43.5
Residential O/P wend win - 3-6 hrs		29.2	26.2	34.9	29.3	34.1
Residential O/P wend win - 6-12 hrs		21.0	18.8	21.6	19.8	22.8
Residential O/P wday sum - 0-1 hrs		16.3	8.7	11.8	14.4	11.5
Residential O/P wday sum - 1-3 hrs		35.0	36.8	37.4	33.3	43.5
Residential O/P wday sum - 3-6 hrs		29.2	26.2	34.9	29.3	34.1
Residential O/P wday sum - 6-12 hrs		21.0	18.8	21.6	19.8	22.8
Residential P wday sum - 0-1 hrs		42.9	28.1	42.8	41.5	45.3
Residential P wday sum - 1-3 hrs		37.5	36.0	40.5	36.2	46.3
Residential P wday sum - 3-6 hrs		28.0	24.1	33.0	28.1	32.9
Residential P wday sum - 6-12 hrs		19.0	16.5	19.8	18.1	21.0
Residential O/P wend sum - 0-1 hrs		16.3	8.7	11.8	14.4	11.5
Residential O/P wend sum - 1-3 hrs		35.0	36.8	37.4	33.3	43.5
Residential O/P wend sum - 3-6 hrs		29.2	26.2	34.9	29.3	34.1
Residential O/P wend sum - 6-12 hrs		21.0	18.8	21.6	19.8	22.8

Note: For this table, some words have been shortened; 'wday' is weekday, 'win' is winter, 'wend' is weekend, 'hrs' is hours and 'sum' is summer.

Source: AEMO (2014), Value of Customer Reliability Review, Appendix, September

Table A.2 AEMO 2014 VCR estimates by non-residential customer class, NEM-wide ($2014/kWh)

Outage category	VCR estimate
Composite NEM-wide Agriculture	47.7
Small NEM-wide Agriculture	54.9
Sml Agriculture O/P wday win - 0-1 hours	91.5
Sml Agriculture O/P wday win - 1-3 hours	45.7
Sml Agriculture O/P wday win - 3-6 hours	26.1
Sml Agriculture O/P wday win - 6-12 hours	13.1
Sml Agriculture P wday win - 0-1 hours	91.5
Sml Agriculture P wday win - 1-3 hours	45.7
Sml Agriculture P wday win - 3-6 hours	26.1
Sml Agriculture P wday win - 6-12 hours	13.1
Sml Agriculture O/P wend win - 0-1 hours	91.5
Sml Agriculture O/P wend win - 1-3 hours	45.7
Sml Agriculture O/P wend win - 3-6 hours	26.1
Sml Agriculture O/P wend win - 6-12 hours	13.1
Sml Agriculture O/P wday sum - 0-1 hours	91.5
Sml Agriculture O/P wday sum - 1-3 hours	45.7
Sml Agriculture O/P wday sum - 3-6 hours	26.1
Sml Agriculture O/P wday sum - 6-12 hours	13.1
Sml Agriculture P wday sum - 0-1 hours	91.5
Sml Agriculture P wday sum - 1-3 hours	45.7
Sml Agriculture P wday sum - 3-6 hours	26.1
Sml Agriculture P wday sum - 6-12 hours	13.1
Sml Agriculture O/P wend sum - 0-1 hours	91.5
Sml Agriculture O/P wend sum - 1-3 hours	45.7
Sml Agriculture O/P wend sum - 3-6 hours	26.1
Sml Agriculture O/P wend sum - 6-12 hours	13.1
Medium NEM-wide Agriculture	51.8
Med Agriculture O/P wday win - 0-1 hours	86.4
Med Agriculture O/P wday win - 1-3 hours	43.2
Med Agriculture O/P wday win - 3-6 hours	24.6
Med Agriculture O/P wday win - 6-12 hours	12.4
Med Agriculture P wday win - 0-1 hours	86.4

Outage category	VCR estimate
Med Agriculture P wday win - 1-3 hours	43.2
Med Agriculture P wday win - 3-6 hours	24.6
Med Agriculture P wday win - 6-12 hours	12.4
Med Agriculture O/P wend win - 0-1 hours	86.4
Med Agriculture O/P wend win - 1-3 hours	43.2
Med Agriculture O/P wend win - 3-6 hours	24.6
Med Agriculture O/P wend win - 6-12 hours	12.4
Med Agriculture O/P wday sum - 0-1 hours	86.4
Med Agriculture O/P wday sum - 1-3 hours	43.2
Med Agriculture O/P wday sum - 3-6 hours	24.6
Med Agriculture O/P wday sum - 6-12 hours	12.4
Med Agriculture P wday sum - 0-1 hours	86.4
Med Agriculture P wday sum - 1-3 hours	43.2
Med Agriculture P wday sum - 3-6 hours	24.6
Med Agriculture P wday sum - 6-12 hours	12.4
Med Agriculture O/P wend sum - 0-1 hours	86.4
Med Agriculture O/P wend sum - 1-3 hours	43.2
Med Agriculture O/P wend sum - 3-6 hours	24.6
Med Agriculture O/P wend sum - 6-12 hours	12.4
Large NEM-wide Agriculture	46.4
Lge Agriculture O/P wday win - 0-1 hours	77.4
Lge Agriculture O/P wday win - 1-3 hours	38.7
Lge Agriculture O/P wday win - 3-6 hours	22.1
Lge Agriculture O/P wday win - 6-12 hours	11.1
Lge Agriculture P wday win - 0-1 hours	77.4
Lge Agriculture P wday win - 1-3 hours	38.7
Lge Agriculture P wday win - 3-6 hours	22.1
Lge Agriculture P wday win - 6-12 hours	11.1
Lge Agriculture O/P wend win - 0-1 hours	77.4
Lge Agriculture O/P wend win - 1-3 hours	38.7
Lge Agriculture O/P wend win - 3-6 hours	22.1
Lge Agriculture O/P wend win - 6-12 hours	11.1
Lge Agriculture O/P wday sum - 0-1 hours	77.4
Lge Agriculture O/P wday sum - 1-3 hours	38.7

Outage category	VCR estimate
Lge Agriculture O/P wday sum - 3-6 hours	22.1
Lge Agriculture O/P wday sum - 6-12 hours	11.1
Lge Agriculture P wday sum - 0-1 hours	77.4
Lge Agriculture P wday sum - 1-3 hours	38.7
Lge Agriculture P wday sum - 3-6 hours	22.1
Lge Agriculture P wday sum - 6-12 hours	11.1
Lge Agriculture O/P wend sum - 0-1 hours	77.4
Lge Agriculture O/P wend sum - 1-3 hours	38.7
Lge Agriculture O/P wend sum - 3-6 hours	22.1
Lge Agriculture O/P wend sum - 6-12 hours	11.1
Composite NEM-Wide Commercial	44.7
Small NEM-Wide Commercial	57.1
Sml Commercial O/P wday win - 0-1 hours	96.7
Sml Commercial O/P wday win - 1-3 hours	54.2
Sml Commercial O/P wday win - 3-6 hours	31.7
Sml Commercial O/P wday win - 6-12 hours	19.7
Sml Commercial P wday win - 0-1 hours	94.8
Sml Commercial P wday win - 1-3 hours	48.9
Sml Commercial P wday win - 3-6 hours	28.0
Sml Commercial P wday win - 6-12 hours	17.0
Sml Commercial O/P wend win - 0-1 hours	76.9
Sml Commercial O/P wend win - 1-3 hours	55.8
Sml Commercial O/P wend win - 3-6 hours	34.2
Sml Commercial O/P wend win - 6-12 hours	22.4
Sml Commercial O/P wday sum - 0-1 hours	96.7
Sml Commercial O/P wday sum - 1-3 hours	54.2
Sml Commercial O/P wday sum - 3-6 hours	31.7
Sml Commercial O/P wday sum - 6-12 hours	19.7
Sml Commercial P wday sum - 0-1 hours	94.8
Sml Commercial P wday sum - 1-3 hours	48.9
Sml Commercial P wday sum - 3-6 hours	28.0
Sml Commercial P wday sum - 6-12 hours	17.0
Sml Commercial O/P wend sum - 0-1 hours	76.9
Sml Commercial O/P wend sum - 1-3 hours	55.8

Outage category	VCR estimate
Sml Commercial O/P wend sum - 3-6 hours	34.2
Sml Commercial O/P wend sum - 6-12 hours	22.4
Medium NEM-Wide Commercial	57.3
Med Commercial O/P wday win - 0-1 hours	96.9
Med Commercial O/P wday win - 1-3 hours	54.3
Med Commercial O/P wday win - 3-6 hours	31.8
Med Commercial O/P wday win - 6-12 hours	19.7
Med Commercial P wday win - 0-1 hours	95.1
Med Commercial P wday win - 1-3 hours	49.0
Med Commercial P wday win - 3-6 hours	28.1
Med Commercial P wday win - 6-12 hours	17.1
Med Commercial O/P wend win - 0-1 hours	77.1
Med Commercial O/P wend win - 1-3 hours	56.0
Med Commercial O/P wend win - 3-6 hours	34.3
Med Commercial O/P wend win - 6-12 hours	22.4
Med Commercial O/P wday sum - 0-1 hours	96.9
Med Commercial O/P wday sum - 1-3 hours	54.3
Med Commercial O/P wday sum - 3-6 hours	31.8
Med Commercial O/P wday sum - 6-12 hours	19.7
Med Commercial P wday sum - 0-1 hours	95.1
Med Commercial P wday sum - 1-3 hours	49.0
Med Commercial P wday sum - 3-6 hours	28.1
Med Commercial P wday sum - 6-12 hours	17.1
Med Commercial O/P wend sum - 0-1 hours	77.1
Med Commercial O/P wend sum - 1-3 hours	56.0
Med Commercial O/P wend sum - 3-6 hours	34.3
Med Commercial O/P wend sum - 6-12 hours	22.4
Large NEM-Wide Commercial	42.1
Lge Commercial O/P wday win - 0-1 hours	71.3
Lge Commercial O/P wday win - 1-3 hours	40.0
Lge Commercial O/P wday win - 3-6 hours	23.4
Lge Commercial O/P wday win - 6-12 hours	14.5
Lge Commercial P wday win - 0-1 hours	69.9
Lge Commercial P wday win - 1-3 hours	36.0

Outage category	VCR estimate
Lge Commercial P wday win - 3-6 hours	20.7
Lge Commercial P wday win - 6-12 hours	12.6
Lge Commercial O/P wend win - 0-1 hours	56.7
Lge Commercial O/P wend win - 1-3 hours	41.2
Lge Commercial O/P wend win - 3-6 hours	25.2
Lge Commercial O/P wend win - 6-12 hours	16.5
Lge Commercial O/P wday sum - 0-1 hours	71.3
Lge Commercial O/P wday sum - 1-3 hours	40.0
Lge Commercial O/P wday sum - 3-6 hours	23.4
Lge Commercial O/P wday sum - 6-12 hours	14.5
Lge Commercial P wday sum - 0-1 hours	69.9
Lge Commercial P wday sum - 1-3 hours	36.0
Lge Commercial P wday sum - 3-6 hours	20.7
Lge Commercial P wday sum - 6-12 hours	12.6
Lge Commercial O/P wend sum - 0-1 hours	56.7
Lge Commercial O/P wend sum - 1-3 hours	41.2
Lge Commercial O/P wend sum - 3-6 hours	25.2
Lge Commercial O/P wend sum - 6-12 hours	16.5
Composite NEM-Wide Industrial	44.1
Small NEM-Wide Industrial	69.7
Sml Industrial O/P wday win - 0-1 hours	121.8
Sml Industrial O/P wday win - 1-3 hours	63.3
Sml Industrial O/P wday win - 3-6 hours	36.2
Sml Industrial O/P wday win - 6-12 hours	19.8
Sml Industrial P wday win - 0-1 hours	149.0
Sml Industrial P wday win - 1-3 hours	72.3
Sml Industrial P wday win - 3-6 hours	40.7
Sml Industrial P wday win - 6-12 hours	22.1
Sml Industrial O/P wend win - 0-1 hours	104.5
Sml Industrial O/P wend win - 1-3 hours	66.0
Sml Industrial O/P wend win - 3-6 hours	39.2
Sml Industrial O/P wend win - 6-12 hours	22.0
Sml Industrial O/P wday sum - 0-1 hours	121.8
Sml Industrial O/P wday sum - 1-3 hours	63.3

Outage category	VCR estimate
Sml Industrial O/P wday sum - 3-6 hours	36.2
Sml Industrial O/P wday sum - 6-12 hours	19.8
Sml Industrial P wday sum - 0-1 hour	149.0
Sml Industrial P wday sum - 1-3 hours	72.3
Sml Industrial P wday sum - 3-6 hours	40.7
Sml Industrial P wday sum - 6-12 hours	22.1
Sml Industrial O/P wend sum - 0-1 hours	104.5
Sml Industrial O/P wend sum - 1-3 hours	66.0
Sml Industrial O/P wend sum - 3-6 hours	39.2
Sml Industrial O/P wend sum - 6-12 hours	22.0
Medium NEM-Wide Industrial	64.4
Med Industrial O/P wday win - 0-1 hours	112.7
Med Industrial O/P wday win - 1-3 hours	58.5
Med Industrial O/P wday win - 3-6 hours	33.4
Med Industrial O/P wday win - 6-12 hours	18.3
Med Industrial P wday win - 0-1 hours	137.9
Med Industrial P wday win - 1-3 hours	66.9
Med Industrial P wday win - 3-6 hours	37.6
Med Industrial P wday win - 6-12 hours	20.4
Med Industrial O/P wend win - 0-1 hours	96.6
Med Industrial O/P wend win - 1-3 hours	61.0
Med Industrial O/P wend win - 3-6 hours	36.3
Med Industrial O/P wend win - 6-12 hours	20.3
Med Industrial O/P wday sum - 0-1 hours	112.7
Med Industrial O/P wday sum - 1-3 hours	58.5
Med Industrial O/P wday sum - 3-6 hours	33.4
Med Industrial O/P wday sum - 6-12 hours	18.3
Med Industrial P wday sum - 0-1 hours	137.9
Med Industrial P wday sum - 1-3 hours	66.9
Med Industrial P wday sum - 3-6 hours	37.6
Med Industrial P wday sum - 6-12 hours	20.4
Med Industrial O/P wend sum - 0-1 hours	96.6
Med Industrial O/P wend sum - 1-3 hours	61.0
Med Industrial O/P wend sum - 3-6 hours	36.3

Outage category	VCR estimate
Med Industrial O/P wend sum - 6-12 hours	20.3
Large NEM-Wide Industrial	39.1
Lge Industrial O/P wday win - 0-1 hours	68.4
Lge Industrial O/P wday win - 1-3 hours	35.5
Lge Industrial O/P wday win - 3-6 hours	20.3
Lge Industrial O/P wday win - 6-12 hours	11.1
Lge Industrial P wday win - 0-1 hours	83.7
Lge Industrial P wday win - 1-3 hours	40.6
Lge Industrial P wday win - 3-6 hours	22.9
Lge Industrial P wday win - 6-12 hours	12.4
Lge Industrial O/P wend win - 0-1 hours	58.7
Lge Industrial O/P wend win - 1-3 hours	37.1
Lge Industrial O/P wend win - 3-6 hours	22.0
Lge Industrial O/P wend win - 6-12 hours	12.3

Note: For this table, some words have been shortened; ‘wday’ is weekday, ‘win’ is winter, ‘wend’ is weekend, and ‘sum’ is summer.

Source: AEMO (2014), Value of Customer Reliability Review, Appendix, September

B Testing energy load weights used in VCR estimation

This attachment show how changing energy load profiles across customer classes has impacted on the energy weights applied in calculating the CBD, Urban, Short and Long Rural network component VCR estimates.[31]

Table B1 below indicates in the CBD network component over the past five years, there has been relatively little change in the residential consumption share, but a decline in the commercial consumption share accounted for by an increasing industrial consumption share.

Table B.1 CBD VCR estimates energy load weights

Energy load data set	Residential	Commercial	Industrial
One year average	3.4%	70.4%	26.2%
Three year average	3.0%	70.3%	26.7%
Five year average	3.2%	72.1%	24.7%

Source: Synergies based on Western Power data

Table B2 below indicates over the past five years in the Urban network component there has been relatively stable consumption shares across customer classes.

Table B.2 Urban VCR estimates energy load weights

Energy load data set	Residential	Commercial	Industrial
One year average	38.5%	38.7%	23.3%
Three year average	37.7%	39.7%	22.6%
Five year average	38.7%	38.1%	22.7%

Source: Synergies based on Western Power data

Table B3 below indicates a decline in the commercial consumption share in the Short Rural component over the past five years, primarily accounted for by a rising share of industrial consumption.

Table B.3 Short Rural VCR estimates energy load weights

Energy load data set	Residential	Commercial	Industrial
One year average	43.3%	29.7%	26.9%
Three year average	43.0%	32.8%	24.2%
Five year average	44.5%	33.1%	22.4%

Source: Synergies based on Western Power data

31 Western Power's energy data is available from 2012-13 to 2016-17.

Table B4 below indicates a relatively large decline in the commercial customer consumption share in the Long Rural network component over the past five years, accounted for by a comparably large increase in the residential consumption share.

Table B.4 Long Rural VCR estimates weights

Energy load data set	Residential	Commercial	Industrial
One year average	42.3%	47.2%	10.5%
Three year average	36.7%	50.7%	12.6%
Five year average	36.7%	52.3%	11.0%

Source: Synergies based on Western Power data