Values of customer reliability

Final report on VCR values

December 2024

AUSTRALIAN ENERGY REGULATOR

Important notice

The information in this publication is for general guidance only. It does not constitute legal or other professional advice. You should seek legal advice or other professional advice in relation to your particular circumstances.

The AER has made every reasonable effort to provide current and accurate information, but it does not warrant or make any guarantees about the accuracy, currency or completeness of information in this publication.

Parties who wish to re-publish or otherwise use the information in this publication should check the information for currency and accuracy prior to publication.

Inquiries about this publication should be addressed to:

Australian Energy Regulator
GPO Box 3131
Canberra ACT 2601
Email: aerinquiry@aer.gov.au
Tel: 1300 585 165

AER reference: 17455427

Contents

1 Executive summary

The purpose of our 2024 values of customer reliability (VCR) review is to review the VCR methodology and update the VCR. We completed the first stage of this review on 30 August 2024 when we published our final determination on the VCR methodology. This final report addresses the second stage of our review by setting out the updated VCR and explaining how we have implemented the methodology we finalised in stage 1.[1]

What are the VCR?

VCR seek to reflect the value that different types of customers place on reliable electricity supply under different conditions and are usually expressed in dollars per kilowatt hour ($/kWh) of unserved energy. VCR are a collection of numerical values that cover different customer segments, including residential, business and very large business customers. VCR vary across customer segments and outage scenarios (when the outage occurs and how long it lasts). As there is no separate market for electricity reliability, VCR are difficult to observe directly and must be estimated.

VCR play an important role in ensuring customers pay no more than necessary for reliable energy by enabling electricity businesses and the Australian Energy Regulator (AER) to identify the appropriate level of investment to deliver reliable energy services to customers given the information available at the time. VCR link efficiency and reliability, playing a pivotal role in network planning and investment and informing the design of wholesale electricity market standards and settings and network reliability incentives.

Most outages customers experience in the National Electricity Market (NEM) and the Northern Territory (NT) originate in distribution networks.[2] Most of these outages are less than 12 hours in duration and typically relate to powerline damage caused by lightning, car accidents, weather and debris such as falling branches, and animals. VCR for unplanned outages up to 12 hours (standard outages) are important because they can be applied to the uses of VCR we have identified, including as an input for cost-benefit assessments, such as those applied in regulatory tests that assess network investment proposals.[3] It is VCR for these outages that are the subject of this five year review and update.

While prolonged outages are outside the scope of our 2024 VCR review, our separate value of network resilience review established an initial value of network resilience (VNR) for these longer outages. Prolonged outages are less frequent than other outages but may have a significant impact on affected electricity customers and the broader economy. The storm-related outages in Queensland (December 2023 to January 2024), Victoria (February 2024)

---

1 Further information about our 2024 VCR review and update can be found on the VCR 2024 webpage. We will monitor the use of the published VCR to check they are being applied correctly. We encourage those using VCR values to contact us to support the correct application.

2 Around 95% of the interruptions to supply experienced by electricity consumers are due to issues in the local distribution network – see AER, State of the energy market 2024, Australian Energy Regulator, 7 November 2024, p. 56.

3 See the Final Determination on the 2024 VCR methodology for identified VCR uses.

and Broken Hill (October 2024) are recent examples where some customers experienced prolonged outages.[4]

Our VCR role

Developing the VCR methodology has been an iterative process since AEMO developed the first VCR methodology for the NEM in 2014.

Under the National Electricity Rules (NER), since 2018 we have been responsible for developing and reviewing the VCR methodology and calculating and updating the VCR using that methodology. In 2019, we developed the VCR methodology for standard outages and calculated the VCR using that methodology. We have annually adjusted the published 2019 VCR in accordance with the annual adjustment mechanism in the 2019 VCR methodology. Consistent with the NER, we have reviewed the VCR methodology as part of our 2024 review and we have updated the VCR by 18 December 2024.

In addition to setting out the framework for developing the VCR methodology and publishing the VCR, the NER also establish a VCR objective.[5] The VCR objective requires the VCR methodology and VCR to be fit for purpose for any current or potential uses of VCR that the AER considers to be relevant. We consider the VCR have the following uses:

- as an input into the cost-benefit analysis for network planning (such as regulatory investment tests and integrated system plans) and the assessment of future network expenditure for capital projects
- setting transmission and distribution reliability standards and targets
- informing reviews of the wholesale market reliability standard and settings
- informing reviews of the system restart standard
- informing reliability and emergency reserve trader procurement
- informing the assessment of requests to declare certain risks as protected events
- as the key measure for linking outcome performance with service target performance incentive schemes incentives.[6]

We calculate and publish VCR for different customer groups (residential, businesses and very large businesses) and for different segments within each customer group. We also report more granular values for different outage scenarios (based on outage duration and timing).

---

4 The initial values of network resilience which are the values attributable to the benefit network customers receive from a resilient network, either in reduced outage probability and/or duration, where network resilience is defined as a network's ability to withstand and recover from an extreme hazard event that is likely to lead to a prolonged outage (an outage of over 12 hours in duration). More information on these values is available on our VNR webpage.

5 NER, rule 8.12.

6 See the *Final Determination on the 2024 VCR methodology* for identified VCR uses.

Consistent with our advice in various guidelines and guidance notes, when applying the VCR, the value used should be reflective of the customer composition on the network and the reliability preferences of the customers who are affected by a proposed investment.

1.1 Implementing the 2024 VCR methodology

We used a survey-based methodology to update the VCR in 2024, which was very similar to the methodology we used to calculate the previous VCR in 2019. Keeping the methodology consistent between 2019 and 2024 allowed us to compare the 2024 and 2019 VCR outcomes, and to further consider the annual adjusted VCR in that context.

Our decision to use the survey-based methodology for residential customers and businesses (other than very large businesses) was based on factors including that this methodology is objective and rigorous, directly engages with customers (as required under the NER) and allows us to achieve good granularity with respect to customer types, outage types and location. This level of granularity means the resulting VCR can be applied to the uses we have identified. Separately, we again conducted a direct cost survey of very large businesses, as we did in 2019, following on from AEMO in 2014.

While the methodology was consistent between 2019 and 2024, we used a different data source to estimate residential unserved energy in 2024 because the data source we relied on in 2019 has been discontinued. The level of unserved energy is one of the key inputs we use, along with the residential survey results and outage frequencies, to calculate the residential VCR.

After engaging with stakeholders, we chose the Australian Energy Market Operator's (AEMO's) Market Settlement and Transfer Solutions (MSATS) dataset as new input data to estimate residential unserved energy. It is a more reliable and authoritative data source based on a much more comprehensive sample which can be used to inform all our residential unserved energy estimates. This dataset is also likely to remain available for future VCR updates.

We note that because we have used a new data source to estimate residential unserved energy for 2024, the differences between the 2019 residential unserved energy estimates and the 2024 unserved energy estimates may be a result of either this change or changes in residential consumption over time. With that in mind, we undertook some further analysis to better understand the 2024 figures. This included both comparing our unserved energy estimates across different segments for 2019 and 2024 and reviewing other information sources on residential consumption between 2019 and 2024 as a sense check (notably, the AER's Economic Benchmarking Regulatory Information Notice (RIN) data[7] and the ACCC's Inquiry into the NEM insights[8]).

We observed that the differences between our 2019 and 2024 residential unserved energy estimates are not uniform and vary across customer segments both in direction and magnitude. However, while other data sources we examined do not allow for a 'like for like'

7 RIN data can be accessed on our performance reporting webpage.

8 ACCC, *Inquiry into the National Electricity Market report - June 2024*, Australian Competition and Consumer Commission, 28 June 2024.

comparison, they show similar patterns of residential unserved energy changes between 2019 and 2024.

1.2 2024 results

This section provides an overview of the 2024 results, with more detailed results and analysis provided in chapter 5.

There are 3 key inputs to the residential, business and very large business VCR calculations:

1. **Dollar value associated with each outage scenario.** For residential and business VCR, this is based on a willingness to pay to avoid the outages, measured through responses to the residential and business surveys. For very large business customers, it is derived from the costs associated with the relevant outage scenarios, reported through direct cost surveys.
2. **Unserved energy estimates for each outage scenario**. These are based on consumption data from the survey responses, AEMO metering data and other information on electricity consumption.
3. **Outage frequencies for each outage scenario**. These are based on reported historical network outage data.

Key findings

The key findings from our survey results are the following, noting that the specific VCR outcomes for each segment are a combination of movements in all the underlying calculation components (willingness to pay, unserved energy and outage frequencies) across a range of different outage scenarios.

- The 2024 residential VCR are higher than the 2019 VCR survey (across the NEM, state and territory aggregate VCR, with one exception at the climate zone level). The main drivers of this change are an increase in residential willingness to pay and a decrease in residential unserved energy.

- The 2024 business (less than10 megavolt amperes (MVA)) VCR are significantly lower than the 2019 VCR survey. This change has been driven primarily by changes in business customers' willingness to pay as a proportion of the customer bill, which declined between 2024 and 2019.[9] While we had a larger sample size in 2024 than in 2019, changes in the sampling composition may have potentially shifted the results.

The 2024 very large business VCR are significantly lower than the 2019 VCR survey, with the exception of the services segment VCR increasing between 2019 and 2024. This change has been driven by several factors. While we have a similar sample size in 2024 to the 2019 sample size, the sample composition for each segment in 2024 is substantially different from 2019. The reported outage costs and consumption levels have also changed, including for the respondents that participated in both 2019 and 2024 surveys. Changes in our estimates

9 There is much more heterogeneity in business customers' energy consumption levels and profiles compared with residential customers. To capture this in our willingness to pay estimates – and also to make the survey questions meaningful to respondents – we focused on the willingness to pay as a proportion of customer bill, rather than a dollar per month amount.

of outage frequencies also contributed somewhat to the differences, as the relative frequency weights of 3-hour and 6-hour outages are higher and the relative weight of 1-hour outages is lower in 2024 than in 2019.

Residential customers

Table 1 Residential VCR values by jurisdiction

Jurisdiction	2024 VCR ($/kWh)	2019 VCR ($/kWh)	2019 VCR, real* ($/kWh)
New South Wales (NSW)	38.53	25.85	31.16
Victoria	49.23	21.43	25.84
Queensland (Qld)	36.09	23.76	28.64
South Australia (SA)	48.52	30.31	36.53
Tasmania (Tas)	35.69	16.96	20.45
Australian Capital Territory (ACT)	50.70	21.38	25.77
Northern Territory	30.69	18.31	22.07
NEM	41.48	24.08	29.02

Note: The 2019 VCR, real ($2024), have been calculated consistent with our annual adjustment mechanism (nominal 2019 VCR multiplied by a ratio of CPI for September 2024 and CPI for September 2019).

Business customers

Table 2 Business VCR values

Customer segment	2024 VCR ($/kWh)	2019 VCR ($/kWh)	2019 VCR, real* ($/kWh)
Agriculture	22.25	37.87	45.65
Commercial	34.39	44.52	53.66
Industrial	33.49	63.79	76.89

Note: The 2019 VCR, real ($2024), have been calculated consistent with our annual adjustment mechanism (nominal 2019 VCR multiplied by a ratio of CPI for September 2024 and CPI for September 2019).

Very large business customers

Table 3 Very large business VCR values

Customer segment	2024 VCR ($/kWh)	2019 VCR ($/kWh)	2019 VCR, real* ($/kWh)
Services	33.10	10.54	12.70
Industrial	12.22	117.99	142.22
Mines	10.63	35.16	42.38
Metals	5.38	19.86	23.94

Note: The 2019 VCR, real ($2024), have been calculated consistent with our annual adjustment mechanism (nominal 2019 VCR multiplied by a ratio of CPI for September 2024 and CPI for September 2019).

1.3 2024 VCR and the VCR annual adjustment mechanism

Our VCR methodology must include a mechanism for annually adjusting the VCR between VCR updates.[10] As this mechanism forms part of the VCR methodology, we must review it and, if required, update it before we update the VCR.[11] This means we had to finalise the annual adjustment mechanism for the 2024 VCR before we had the opportunity to consider the 2024 VCR outcomes and compare the movements in the VCR between 2019 and 2024.

As part of our 2024 review of the VCR methodology we considered alternative annual adjustment approaches, taking into account stakeholder feedback. We did not identify a feasible alternative, so we decided to use the same annual adjustment mechanism as was in the 2019 VCR methodology. However, in the 2024 VCR methodology, we removed the X factor rather than setting it at 0.[12] This mechanism involves adjusting the published VCR values on an annual basis by the Consumer Price Index (CPI).

Our rationale for adjusting the VCR by CPI was that it ensures, in economic terms, that the real values of VCR are maintained between VCR reviews. However, the construction of annual adjustment mechanism in this way means it will not capture other changes that may drive movements in the VCR over time.

As we have largely kept our 2019 methodology unchanged for the 2024 VCR update, we can now make observations on how the updated 2024 VCR for different customer categories compare with the 2019 VCR. These include:

- for residential customers, the 2024 VCR by segment are all higher than the 2019 CPI adjusted result, with one exception (Climate Zone 3 and 4 – Regional)

---

10 NER, Rule 8.12.

11 NER, Rule 8.12.

12 AER, *Values of customer reliability methodology - final determination*, Australian Energy Regulator, 2024, p. 28.

- for business customers, the 2024 VCR are significantly lower than the 2019 CPI adjusted result for each subgroup
- for very large business customers, the 2024 results are all significantly lower than 2019 CPI adjusted, with the exception of the services segment.

This means that while the annual adjustment maintained the value of these aggregate 2019 VCR, the 2024 VCR results show that business and very large business customers' actual aggregate VCR have fallen in real terms over that time period.

While such ex-post analysis does not imply that the same dynamics would reoccur in the future, it does highlight challenges with annual adjustment in the face of incomplete information about changes in the components of the VCR.

In early 2025, we intend to engage with stakeholders to reflect on the learnings from our 2024 update and to identify some key themes for future research. These themes may include exploring the trends in unserved energy over time and the use of different annual adjustment mechanisms for different components of the VCR (for example, willingness to pay and unserved energy). Once we have developed our understanding further and explored this issue with stakeholders, we will consider the implications for our forward VCR work program, including the timing of the next VCR review.

1.4 Next steps

Our reliability and resilience work will continue following the completion of the 2024 VCR review and the 2024 VNR Review (which focused on a subset of prolonged outages that fall outside the scope of the VCR).

The estimates we have published are the best available that are consistent with largely maintaining the methodology between the two reviews in 2024 and 2019. We are now in a better position to review how the methodology could be improved to be more robust over time, particularly given the significant changes underway in wider trends in electricity consumption and the opportunities to install backup power in the form of onsite generation and storage. We expect that changes in consumer attitudes and preferences are also changing, with respect to the value of grid supplied electricity. There is also greater attention being paid to estimation techniques, given the importance of efficient investment during the energy transition. In 2025 we will commence further work on the VCR and this work will focus on:

- examining the learnings from our 2024 VCR review, including the impacts of changes in sampling composition in the business surveys
- the annual adjustment mechanism
- the additional work and analysis that may need to be undertaken in advance of the next VCR review, to understand trends in increased reliance on electricity, the opportunities and barriers to self-generation and backup power and drivers of willingness to pay and how this informs future methodologies such as using surveys, modelling approaches and deliberative forums
- the frequency of further updates to the VCR.

We will consult with stakeholders as necessary on these issues.

2 Background

VCR seek to reflect the value different types of customers place on reliable electricity supply under different conditions and are usually expressed in dollars per kilowatt hour ($/kWh) of unserved energy.

VCR link efficiency and reliability, playing a pivotal role in network planning and investment and informing the design of wholesale market standards and settings and network reliability incentives. VCR play an important role in ensuring customers pay no more than necessary for reliable energy and promoting an efficient level of investment to deliver reliable energy services to customers.

There is no separate market for electricity reliability, so VCR are difficult to observe directly and must be estimated. VCR are a collection of numerical values that cover different customer segments, including residential, business and very large business customers.

2.1 Our VCR role

Under the National Electricity Rules (NER), the AER is responsible for developing and reviewing the VCR methodology and updating the VCR using that methodology.[13] In 2019 we developed the VCR methodology for standard outages and calculated the VCR using that methodology. Subsequently we have annually adjusted the VCR (in accordance with the annual adjustment mechanism in the 2019 VCR methodology) and published the annually adjusted VCR in December each year.

Consistent with the NER, we have reviewed the VCR methodology as part of our 2024 review and we have updated the VCR by 18 December 2024.

The NER set out the framework for developing the VCR methodology and publishing the VCR. Specifically, Part I, Rule 8.12 of the NER provides that:

- the AER must, in accordance with the rules consultation procedures, review, publicly consult on and publish a national methodology for calculating VCR
- the VCR methodology must include a mechanism for directly engaging with retail customers and customers (other than retailers), which may include the use of surveys, and must include a mechanism for adjusting the VCR on an annual basis
- the AER must ensure that VCR methodology and any VCR calculated in accordance with that methodology are consistent with the VCR objective
- the AER must review the VCR methodology prior to each date the VCR are updated and, following such a review, publish either an updated VCR methodology or a notice stating that the existing VCR methodology was not varied as a result of the review
- the AER must update the VCR at least once every 5 years and publish updated values promptly.

---

13 NER, r. 8.12.

The NER establish a VCR objective, which requires the VCR methodology and VCR be fit for purpose for any current or potential uses of VCR that the AER considers to be relevant.[14] Therefore, when developing the methodology for deriving VCR it is important to consider the current and potential future uses of VCR. In different contexts the relevant mix of consumers and outage scenarios will vary and the estimation of a VCR or set of VCR specific to the application will be required.

For many uses of the VCR, the more granular VCR are more likely to be used than the aggregate VCR (that is, state VCR and NEM-wide VCR). This is because in different contexts the relevant mix of consumers and outage scenarios will vary and the estimation of a VCR or set of VCRs specific to the application will be required. Consistent with our advice in various guidelines and guidance notes,[15] businesses will generally use the VCR that best align with the reliability preferences of the customers who are affected by a proposed investment and the characteristics of the outage(s) the investment is seeking to address.

2.2 Our 2024 VCR review

The 2024 review had 2 streams of work:

1. Reviewing the VCR methodology.
2. Updating the VCR.

We completed the first stream of work in August 2024, with the publication of our final determination on the VCR methodology. This determination set out the VCR methodology to be used to calculate the 2024 VCR, as well as the approach to the annual adjustment of the VCR. A copy of the VCR statement of methodology and other relevant materials can be found on our website.[16]

We then used that VCR methodology to update the VCR. This involved:

- surveying residential customers and business customers (with peak demand less than 10 megavolt amperes (MVA)) about their willingness to pay to avoid outages of different durations and characteristics (such as peak/off-peak or summer/winter)
- surveying large energy users (businesses with peak demand greater than 10 MVA) about the costs they would incur in a range of outage scenarios[17]
- combining the survey results with other inputs (such as estimates of unserved energy and outage frequencies) to derive $/kWh VCR for each outage scenario and segment
- aggregating the relevant VCR components into state and NEM-wide VCR.

The updated VCR values will be adjusted on an annual basis using the annual adjustment mechanism outlined in the VCR methodology.

---

14 NER, r. 8.12(a).

15 See for example, AER, *Regulatory Investment Test for Transmission Application guidelines*, Australian Energy Regulator, 2024.

16 See our Final Determination on the 2024 VCR methodology.

17 Only a small number of very large energy users were eligible to participate in the direct cost survey, with around 215 business sites across the NEM meeting the 10 MVA peak demand threshold.

2.3 Other outages and values of resilience

We do not currently compute $/kWh VCR for some outage types, such as planned outages, momentary outages and widespread outages.

Prolonged outages also fall outside the scope of our 2024 VCR review. Prolonged outages are less frequent than other outages but may have a significant impact on affected electricity customers and the broader economy. The storm-related outages in Queensland (December 2023 to January 2024), Victoria (February 2024) and Broken Hill (October 2024) are recent examples of some customers experiencing prolonged outages. Our Value of Network Resilience 2024 review established an initial value of network resilience (VNR) for prolonged outages.[18]

18 See our VNR webpage for more information.

3 Survey design and approach

This chapter sets out how the residential and business surveys as well as the direct cost survey for very large business respondents were designed and undertaken. These surveys provided key sources of data that contributed to our calculation of the VCR.

3.1 Residential and business surveys

This section will provide an overview of the design of the residential and business surveys.[19] As outlined in our VCR methodology, we combined contingent valuation and choice experiment survey techniques to estimate the willingness to pay to avoid standard outages (up to 12 hours in duration) in order to calculate VCR for residential and business customers.

3.1.1 Background and demographic questions

In addition to the questions that solicited information on the respondents' preferences towards electricity reliability, our survey included some background and demographic questions.

Background and screening questions

Background questions were included at the beginning of both the residential and business surveys to screen out ineligible customers.

For the residential cohort, the questionnaire asked participants for the postcode of the suburb or area in which they live. This was to ensure participants residing outside the NEM or the Northern Territory were removed from the response pool.

Residential respondents were also asked which of the following statements best described their local area. This was to inform the definitions of localised and widespread outages in the choice experiment section of the questionnaire.

- Most people live in units, townhouses or high rise apartments.
- Most people live in standalone houses in a capital city suburb.
- Most people live in a suburb in a regional town.
- Most people live on acreage or a farm.

For the business survey, respondents were asked to identify the postcode of their business site to ensure the location was within the NEM or Northern Territory. In addition, respondents were asked to confirm whether they had any input into how much their business either spends on electricity or consumes electricity. If either of these conditions were not met, responses were removed.

Additionally, business survey respondents were asked to:

- indicate which of the prescribed categories best described the business site as well as the local area of the site

---

19 Copies of the 2024 surveys are available on the VCR 2024 webpage.

- identify how often their business received an electricity bill, including an estimate of their last electricity bill
- outline how many times their business site experienced power outages in the last 12 months
- describe the potential losses the respondent may incur during a power outage at their business site and whether a particular time of day, month or season in the year would worsen the experience of a power outage.

Residential consumer demographics and behaviour questions

Consistent with 2019, these questions asked residential consumers about gender, age, financial circumstances, and household size and characteristics. We also asked about energy-specific factors, including whether the respondent:

- has rooftop solar panels
- has a battery connected to their solar system or electricity supply
- has a pool, slab heating or a mains gas connection
- owns/drives a fully electric vehicle (excludes hybrid vehicles)
- has a home automation system (a system that controls appliances and devices in the home over the internet)
- works from home at least one day per week
- thinks they may own an EV, rooftop solar panels, home automation system or work from home at least one day per week 5 years from now.

3.1.2 Contingent valuation technique

The contingent valuation technique asks 2 closed questions followed by one open-ended question about the respondent's willingness to pay to avoid 2 unexpected power outages a year (the baseline scenario) affecting either the home of a residential customer or the specified place of business of a business customer.

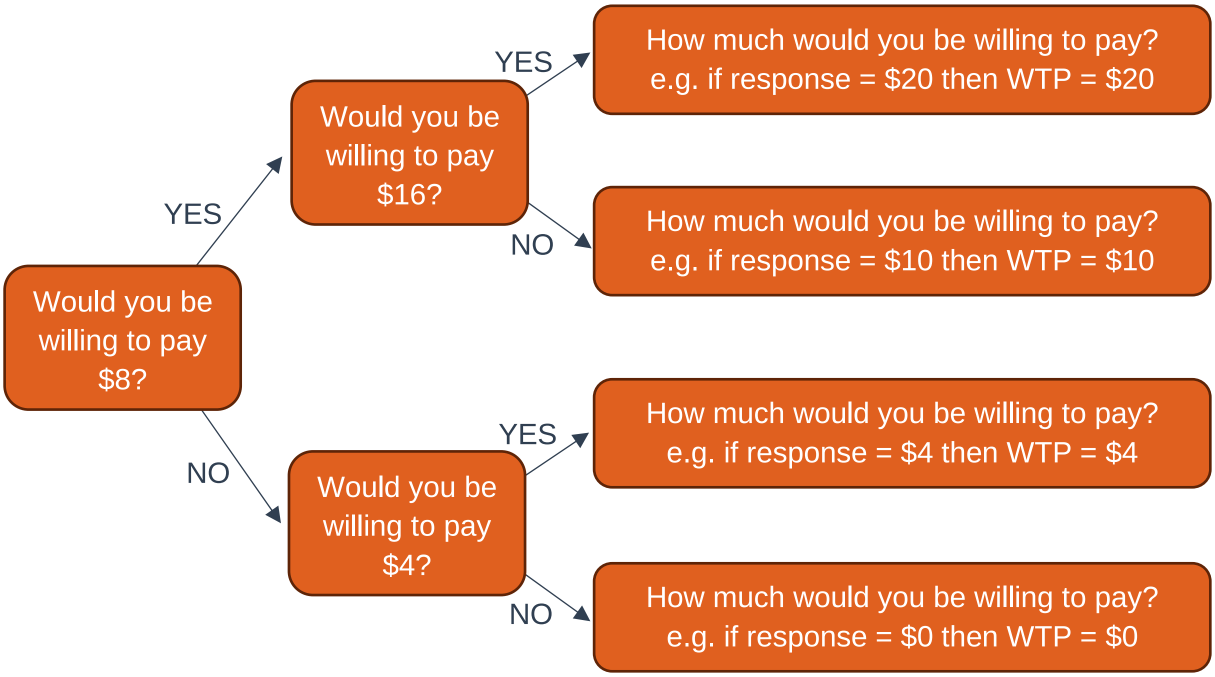
The closed questions presented a respondent with a baseline outage scenario and a corresponding bill increase. The baseline scenario was described as experiencing 2 unexpected power outages a year, with each outage occurring on a different random weekday in winter, lasting for one hour in off-peak times (outside 7–10 am and 5–8 pm) and only affecting the respondent's local area. The respondent was asked if they would be willing to pay an increase in their bill equal to a specified amount ('cost prompt') to avoid the baseline scenario. If the respondent answered YES to the first question, the cost prompt for the second closed question was doubled; if the respondent answered NO to the first question, the cost prompt for the second question was halved.

The open-ended question then asked respondents to enter the maximum bill increase they would be willing to pay to avoid the baseline scenario:

> *What is the maximum increase in $ you would be willing to pay in your [monthly, quarterly, etc.] electricity bill to avoid both the power outages outlined in the above scenario?*

A representation of our contingent valuation willingness to pay (WTP) question with example input values is set out in the Figure 1.

Figure 1 Tree diagram of residential contingent valuation question



Contingent valuation question – residential customers

For residential customers, the cost prompts were expressed as dollars per bill. The first cost prompt ranged from $2 to $11 per month, in $1 increments.[20]

As in 2019, responses were capped at the approximate cost of a backup power system capable of supplying electricity to a household for the duration of the baseline outage (which was set at $32 per month). If the respondent gave a willingness to pay amount greater than the cap, they were later asked about backup generation:

> *Imagine a company could install a backup power system at your premises. The system will readily provide electricity at your premises for one hour if an outage occurs. The total cost of the system, including installation, would be $32 per month.*
>
> *Would you get the company to install the backup system at your premises at a cost of $32 per month?*

If the response to the backup question was YES, then we assumed the willingness to pay is $32. If the respondent answered NO to the above follow-up question, they were asked the maximum amount they would be willing to pay per month for this system. Their response to the open-ended backup question was treated as the willingness to pay value for that respondent, with responses of more than $32 capped at $32.

20 In the 2019 VCR survey, the maximum value was $9.

Contingent valuation questions – business customers

The cost prompts were also expressed in dollars for business customers, but they were based on a percentage of the respondent's reported electricity bill. Percentages in the first cost prompt ranged from 1% to 10% of their bill, in 1% increments.

Responses to the open-ended question were capped at a value equal to 100% of their stated electricity bill.

3.1.3 Choice experiments

Overview

The choice experiment section presented customers with a series of options related to power outages and electricity bill discounts.

In both surveys, respondents were randomly given one out of 5 different blocks of questions. Each block consisted of 8 choice sets, each with 3 options. Each option in a set described a hypothetical power outage with specified characteristics, paired with a bill discount that they would receive if they chose to accept the outage scenario. Respondents were asked to choose their preferred option in each set out of the 3 options.

The trade-offs customers made when choosing between options with different attributes were used to determine the relative value respondents place on each of these attributes.

Each set of outage scenarios included the baseline scenario paired with no bill discount. The other 2 scenarios in each set had different levels of the outage attributes.

The outage attributes and their levels used in the choice experiment were:

- outage duration: 1 hour, 3 hours, 6 hours and 12 hours
- geographic impact: localised and widespread
- time of day: peak time and off-peak time
- season: summer and winter
- day of the week: weekday and weekend
- bill discount (residential): no change, $4 per month, $8 per month and $18 per month
- bill discount (business): no change, 1%, 2% and 3%.

These are the same attributes tested in 2019. The bill discounts we used were the values set out in our 2024 VCR methodology.[21]

Choice set presentation

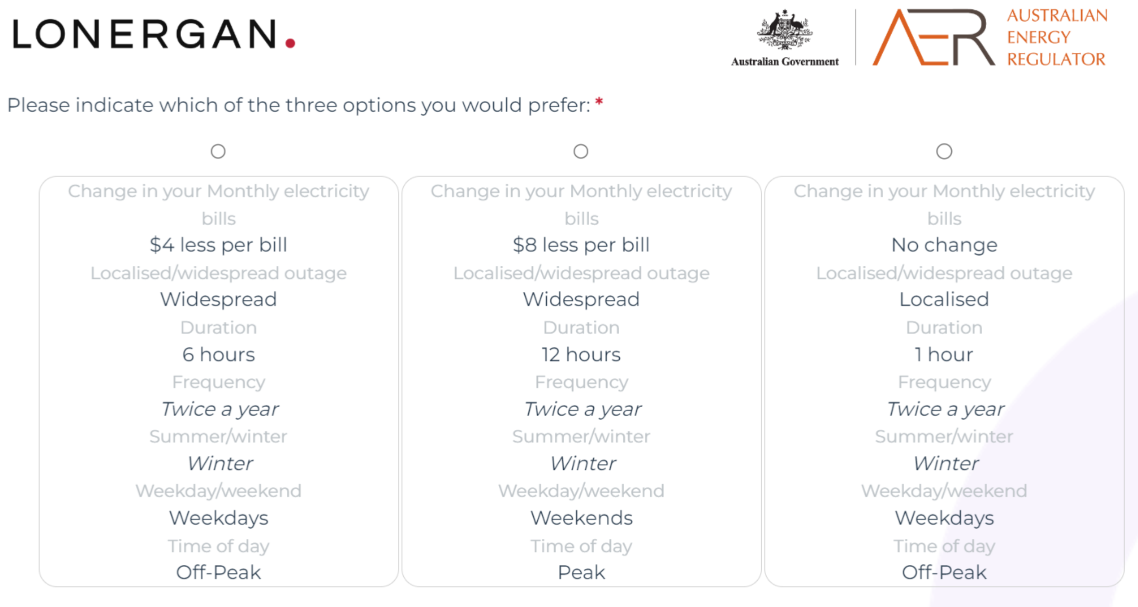
The choice model was presented as a choice set card showing 3 outage scenarios at a time. The order of the options within each of these cards was randomised to reduce any effects due to ordering.

---

21 See our 2024 final determination on the VCR methodology for further detail.

A screenshot of how the choice sets appeared on a desktop is shown in Figure 2.

Figure 2 Choice model survey question



3.1.4 Pilot and main surveys

Pilot survey

In March and April 2024, we conducted pilot surveys for both the residential and business cohorts. We engaged Lonergan Research to program the questionnaires, conduct the pilot surveys along with cognitive testing, and gather the data. Additionally, we employed Synergies Economic Consulting, and Community and Patient Preference Research (CaPPRe) to analyse the results.

The purpose of the pilot survey was to test the mechanics of the survey process. Following cognitive testing of the questionnaires, small changes were made to clarify the language and improve readability. Synergies' and CaPPRe's analysis of the results did not identify any critical flaws in either the survey instruments or the data collected. Reports from Lonergan Research and CaPPRe describing the outcomes of the pilot were published on our website.[22]

Main survey

The main survey was released on 3 September 2024 and we collected responses until 9 October 2024. We received 3,600 residential responses and 2,323 business responses. A more detailed breakdown of the response counts by VCR segments is provided in chapter 5, and by demographic factors in chapter 6, as well as a description of the steps taken to collect, validate and clean the responses.

3.1.5 Other questions

We added 2 questions to our residential survey and our business survey in 2024 that explored a scenario of interest to the Reliability Panel. The scenario involved a sequence of

---

22 See Lonergan Research – VCR pilot methodological report and Synergies Economic Consulting CaPPRe – VCR pilot report.

one-hour outages repeated over a period of time. The question was developed by the Australian Energy Market Commission's (AEMC's) staff and approved by the Reliability Panel. The responses will be analysed by the AEMC.

3.2 Very large business survey

3.2.1 Direct cost survey

We adopted a direct cost survey to collect information from very large businesses, defined as those with a peak demand equal to or greater than 10 MVA in the 2023–24 financial year. As in 2019, we asked different questions for this survey to those asked for residential and business respondents. This is because these very large electricity users are likely to have more detailed knowledge of the value of electricity to their business and of any costs they would incur as a result of an outage.

Preliminary questions asked of eligible respondents were whether their business site operated 24 hours a day 7 days a week (24/7) and a description of the core business processes that were critically reliant on continuous energy supply. Some questions were specifically tailored to target business sites that did or did not operate 24/7. Therefore, there were 2 versions of the direct cost survey.

Respondents operating 24/7

For customers with continuous 24/7 operations, respondents were asked to outline and quantify the costs they would expect to incur in an unplanned outage of the following durations:

- 10 minutes
- 1 hour
- 3 hours
- 6 hours
- 12 hours.

Respondents not operating 24/7

For customers with non-continuous operations, respondents were asked to outline and quantify the costs they would expect to incur for:

- unplanned outages that start at peak times (between 7am and 10am or 5pm and 8pm on a weekday) for the following durations – 10 minutes, 1 hour, 3 hours and 6 hours
- unplanned outages that occur at off-peak times (anytime except between 7am and 10am or 5pm and 8pm on a weekday) for the following durations – 10 minutes, 1 hour, 3 hours and 6 hours
- unplanned outages that start at any time and have a duration of 12 hours.

3.2.2 Contextualising the responses

Both versions of the direct cost survey also sought additional information to help contextualise the costs incurred from the outages outlined above. This included information about:

- the types of costs experienced by the business as a result of an outage
- measures they may have taken to reduce the impact of outages, and whether they have installed a backup supply
- how many times the business site experienced an outage in the past year
- whether the business received information about the outage and whether it helped reduce the costs of the outage
- on-site generation.

3.2.3 Survey implementation

Each survey response was intended to be completed for a single site. Eligible respondents with more than one site were asked to complete a separate survey for each. Network service providers (NSPs) were asked to inform their customers that they would be receiving an email from the AER requesting their participation in our direct cost survey. Additionally, the Energy Users' Association of Australia (EUAA) informed its members about the survey and the Australian Aluminium Council shared the survey link with its large members.

Following this process, the AER sent generalised direct cost survey links to around 200 eligible respondents. Correspondence with eligible respondents aimed to highlight the value of their contribution in developing the VCR. This included contributing to the AER's understanding of how unexpected power outages affected the operation of their sites.

To encourage the engagement of eligible respondents, reminder emails were sent throughout the period that the survey was open by the AER, NSPs and EUAA. Additionally, we individually called eligible respondents to highlight the value we place on their responses and to provide them with an opportunity to ask questions. This approach ensured a proactive engagement process.

4 Approach to calculating VCR

This chapter provides an overview of how we have implemented the VCR methodology to calculate the VCR.

4.1 Residential approach

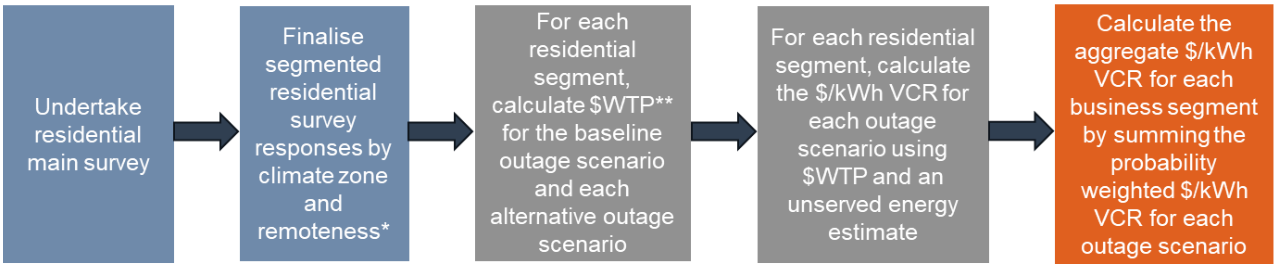
We calculated the residential VCR using data from 3,600 residential survey responses across the NEM and Northern Territory, combined with data from other sources such as AEMO and network businesses.

The VCR calculation for each residential segment used 3 key components:

1. Willingness to pay (for the baseline scenario and each alternative outage scenario), based on the residential survey responses
2. Unserved energy estimates for each outage scenario, based on consumption data from AEMO
3. Outage frequencies for each outage scenario, based on network outage data.

Figure 3 provides an overview of this calculation.

Figure 3 High-level overview of the calculation of a residential segment VCR



Note: * Northern Territory responses were grouped as a single segment, rather than being split by climate zone and remoteness. ** $WTP = willingness to pay in dollars to avoid an outage scenario.

The following sections set out our approach to calculation, including customer segmentation and estimating unserved energy and outage frequencies.

4.1.1 Residential customer segmentation

To consider customer preferences towards reliability, we group customers with similar preferences together into constructed VCR segments.

Our 2019 analysis of the residential responses showed climate zone was a strong driver of differences in reliability preferences. Remoteness was found to be a weaker driver of reliability preferences.[23] In 2024 we grouped residential responses by climate zone and remoteness into 12 segments. We continued the 2019 approach of having separate regional and CBD/suburban segments, given continued notable differences between the values for some of these segments and to allow these different values to be separately used in

---

[23] Please see 2019 final report for more information.

investment proposals. We kept residential responses from the Northern Territory as a separate segment, rather than being grouped by climate zone and remoteness.

We used our 2019 final residential segments to develop the 2024 residential survey sample plan. Those segments were:

- Northern Territory
- Climate zone 1 Regional
- Climate zone 2 CBD & Suburban
- Climate zone 2 Regional
- Climate zone 3 & 4 Regional
- Climate zone 5 CBD & Suburban NSW
- Climate zone 5 CBD & Suburban SA
- Climate zone 5 Regional
- Climate zone 6 CBD & Suburban
- Climate zone 6 Regional
- Climate zone 7 CBD & Suburban
- Climate zone 7 Regional

Based on our analysis of the 2024 residential survey results, we decided to retain this segmentation.

Segment mapping and postcode allocation

Consistent with 2019, segments were constructed using postcodes as 'building blocks'. Every postcode in the NEM and NT was allocated to a single VCR segment based on its climate zone, remoteness and jurisdiction, and customer responses were then assigned to segments based on their postcode.

To allocate postcodes, we combined climate zone mapping from the Australian Building Codes Board (ABCB)[24] and remoteness data from the Australian Bureau of Statistics (ABS) Australian Statistical Geography Standard (ASGS).[25] Smaller ASGS structures were used to align boundaries between sources where required.[26] In 2019 when a postcode was in multiple climate zones it was allocated to the lowest numbered climate zone and when a postcode was in more than one remoteness classification it was allocated to the least remote classification. For 2024 we have used a slightly different method, allocating a postcode to the segment where that postcode has the highest number of dwellings. This:

---

24 See the ABCB's climate zone map.

25 Remoteness classification is based on the Accessibility/Remoteness Index of Australia Plus (ARIA+), produced by the Australian Centre for Housing.

26 The base units for climate zones (Local Government Area) and remoteness areas (Statistical Area 2) are not consistent with postal area boundaries. Misalignments were bridged using ABS Mesh Blocks, which do not cross LGA, SA2 or postcode boundaries.

- increases the chance a customer will be allocated to the VCR segment where they actually reside
- better aligns with the data source we are using to estimate residential unserved energy (see 4.1.2 for more information)
- allows the segmentation to better adapt to future changes in population and distribution.[27]

More information on our 2024 approach to mapping climate zones and remoteness is provided in Appendix D.

Sampling and final segmentation

We developed the 2024 residential sample plan using the final segmentation from 2019 as a starting point, with the intention of maximising comparability between updates. The sample plan is provided in Appendix C and sets out the sample targets used for each segment.

Following the residential survey, we analysed the survey results to determine whether this segmentation remained appropriate for the 2024 VCR. This analysis confirmed the 2019 final residential segments remained appropriate and consequently we decided the segments should be retained for 2024. Regarding stakeholder requests for alternative residential segments, we determined:

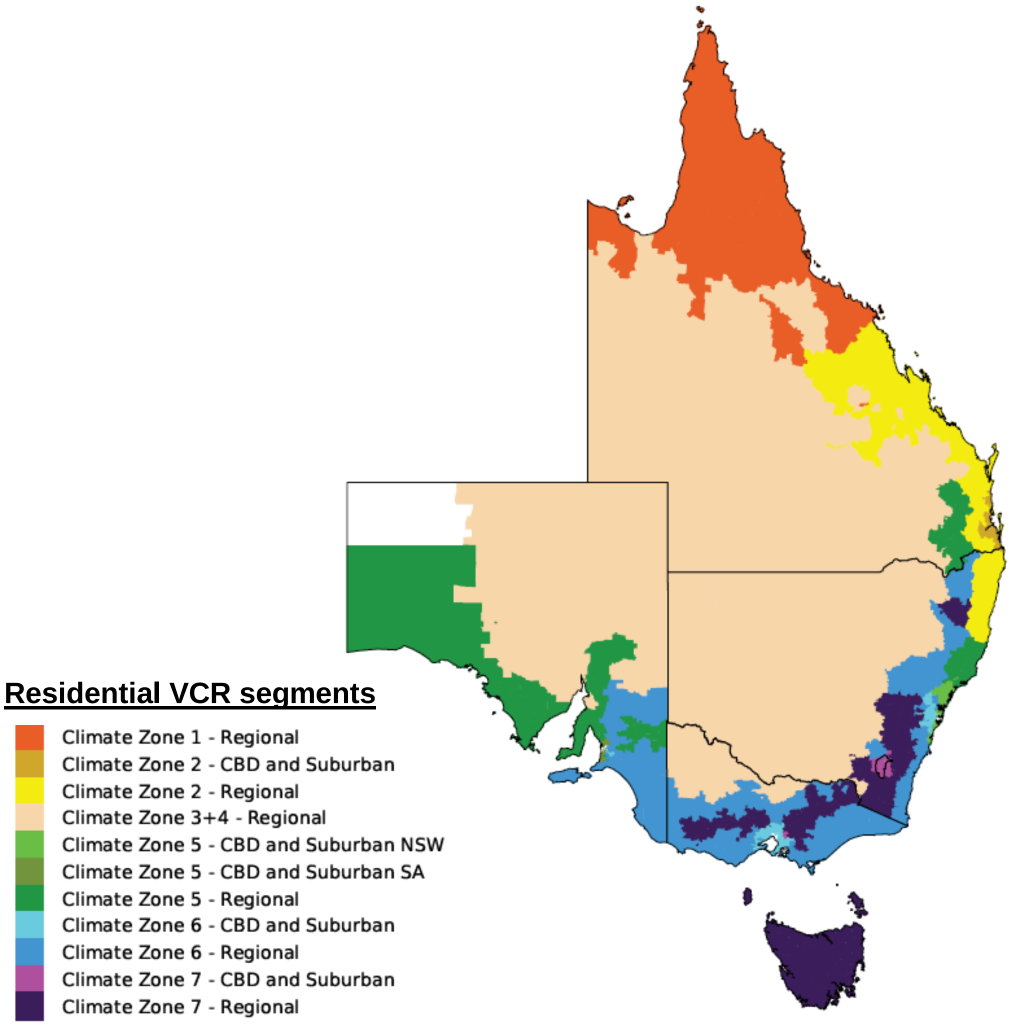
- the CBD should not be a separate cohort because the sample size was too small
- climate zone 7 Regional (Tasmania) should not be split because there was no statistically significant difference in choice modelling coefficients (at the 95% confidence level) for outer regional Climate zone 7 and inner regional Climate zone 7
- we also determined that climate zone 5 Suburban NSW and Climate zone 5 Suburban South Australia should remain separate because there was a statistically significant difference in choice modelling coefficients for summer (99%), and the 6-hour and 12-hour durations (95%) for these 2 cohorts, and the 2 cohorts are also physically separate.

A map of the final 2024 residential segments (other than Northern Territory) is provided in Figure 4.

---

27 The revised approach resulted in a change in segment from 2019 for around 140 postcodes (out of more than 2,250) of the postcodes we mapped in 2024.

Figure 4 Final 2024 residential segment map



Note: The NT segment is not shown as the NT regulated electricity network areas are irregular and non-contiguous.

4.1.2 Calculating residential VCR values

To convert the residential survey results into $/kWh VCR values for each segment we used the same overall process as in 2019:

- we used the survey responses and a combination of contingent valuation and choice modelling to calculate the willingness to pay ($/month) for 32 unique outage scenarios
- we converted the dollar values for each of the outage scenarios into $/kWh using estimates of unserved energy
- we computed a probability weighting for each outage scenario and then summed the probability weighted outage scenario $/kWh VCR values to derive the segment $/kWh values.

Each of these steps is discussed below.

Outage scenarios

The VCR methodology specifies the baseline outage scenario as two unexpected outages occurring on a different random weekday in winter, lasting for one hour in off-peak times, and only affecting the local area.

There are a total of 32 unique outage scenarios consist of combinations of the following characteristics:

- summer or winter
- off-peak or peak
- weekend or weekday
- outage duration of 3 minutes to 1 hour, 1 to 3 hours, 3 to 6 hours or 6 to 12 hours.

Willingness to pay

We used a combination of contingent valuation and choice modelling survey techniques to estimate the willingness to pay ($/month) for each of the 32 outage scenarios identified above.

Contingent valuation

Contingent valuation involves asking the respondent the maximum bill increase they would be willing to pay to avoid the baseline outage scenario. It was used to determine the value of the baseline outage scenario, with the willingness to pay for each residential segment calculated using a simple average of survey responses (individual survey responses were capped at $32 – see chapter 3 for more information).

Choice modelling

Choice modelling is used to estimate relative values of specific outage attributes (such as duration, summer/winter, peak/off-peak, etc.), by asking people to choose from different options. It was used to determine the increment (or decrement) in value respondents placed on specific outage attributes in addition to the baseline outage scenario. Attributes tested in the choice model were peak (7–10 am and 5–8 pm) and off-peak time of day, season (winter/summer), day of week (weekday/weekend), severity (localised/widespread) and duration (1 hour, 3 hours, 6 hours, 12 hours).

Consistent with our approach in 2019, we used a statistical model (a multinomial logit model) to produce the choice modelling results, including willingness to accept dollar estimates for the outage attributes tested. The estimate for each attribute is the incremental amount of compensation a customer would require to accept an outage attribute (such as duration and timing) in addition to the baseline outage scenario. For ease of reading, the estimates are expressed in willingness to pay form in our report.

In developing the VCR, outage variables were included where the choice modelling regression coefficients had at least 99% statistical significance and $/month estimates derived from the coefficients had at least 90% statistical significance (significance criteria).

Inclusion of other variables that did not meet these criteria were considered on a case by case basis; no further variables were included for the residential estimations in 2024.[28]

Estimating unserved energy of residential customers

Unserved energy

Unserved energy is an estimate of the energy that customers would have used had the outage not occurred. Conceptually, it may include any energy that would be lost due to an outage, not only energy supplied from the grid.

Our 2019 approach

To estimate the unserved energy for the residential cohort in 2019 we primarily relied on the 2017 ACIL Allen's energy consumption benchmarks for residential customers.[29] This study was commissioned by the AER from ACIL Allen and was based on 2017 survey data and 2014-2017 electricity consumption data for the survey participants.[30] We also used other data sources to make a series of adjustments to the electricity consumption benchmarks to arrive to the unserved energy estimate for each outage scenario and each residential customer segment.

For each residential segment, we first created a 'base' annual consumption for a 2.6-person household by combining the annual consumption amounts associated with 2 person and 3 person households.[31] We then adjusted these annual consumption amounts by applying a 'solar factor' for each state. We then further adjusted these annual consumptions where applicable, to take into account the proportions of households in each segment that have gas,[32] swimming pool[33] and slab heating.[34]

To construct consumption profiles[35] for each residential segment we used a separate data set containing 30-minute interval consumption data, taken from bill benchmarks previously developed by the AER, for households in climate zones 2, 5, 6 and 7 disaggregated to individual postcodes. Climate zones 1 and 3 & 4 consumption profiles were based on the interval data from the most comparable climate zones available in the dataset.[36] We multiplied these consumption profiles by the relevant annual consumption amount to

---

28 In 2019 for example, NT duration 3 hours was included despite not reaching the statistical significance levels of other duration variables. This was done to maintain consistency with all other residential segments where this variable was included.

29 ACIL Allen, Electricity and gas bill benchmarks for residential customers, ACIL Allen report commissioned by the AER (updated 5 June 2018).

30 We note these benchmarks were commissioned for a different AER purpose and that purpose has now been discontinued.

31 This was done by calculating a weighted average of the consumption levels, with weights of 0.6 for 3 person household consumption levels and 0.4 for 2 person household consumption levels.

32 Climate Zone 3+4.

33 Climate Zones 2, 5 and 6.

34 Climate Zone 7.

35 That is, the percentage amount of annual consumption falling into each of the 32 outage scenarios.

36 Climate Zone 1 summer consumption profile used Climate Zone 2 summer interval data. Climate Zone 1 winter consumption profile used Climate Zone 6 summer interval data. Climate Zone 3+4 summer consumption profile used a combination of Climate Zone 2 and 5 summer interval data. Climate Zone 3+4 winter consumption profile used a combination of Climate Zone 2 and 6 winter interval data.

estimate the unserved energy associated with each of the 32 outage scenarios for each residential segment.

In our 2024 VCR methodology final determination, we indicated we were exploring alternative approaches because of data availability issues with replicating the 2019 approach (the publication of the electricity consumption benchmarks has been discontinued). We also outlined different approaches to estimating unserved energy we were considering, including methods based on data from:

- ACIL Allen's residential consumption benchmarks
- Frontier Economics' residential consumption benchmarks[37]
- AEMO's Market Settlement and Transfer Solutions (MSATS) data for 2023–24.

Stakeholder views on unserved energy approach

Following the publication of the VCR methodology final determination, we undertook further targeted stakeholder consultation on the approach to estimating residential unserved energy. We received comments from 3 stakeholders.

- Evoenergy considered the ACIL Allen/Frontier benchmarks did not capture trends in electrification and electric vehicle uptake or differences in consumption patterns across networks. It supported using interval metering data over the benchmarks.[38]
- Ausgrid considered there was merit in using MSATS data to estimate consumption rather than the ACIL Allen or Frontier benchmarks.[39]
- AusNet suggested we use metering data similar to the data it used for its Quantifying Customer Values work.[40]

Our 2024 approach

Having considered the above stakeholder views, and having explored the advantages, disadvantages and practical implementation of the potential options, we have decided to use an approach that utilises AEMO MSATS 30-minute interval data to estimate residential unserved energy. Our reasons for this decision – which set this approach apart from the one we adopted in 2019 – include:

- **authority and reliability:** MSATS is a current, continuously updated and verifiable dataset from an authoritative source
  - in comparison, energy consumption benchmarks were updated relatively infrequently (every three years), and their publication is now discontinued; the approach used for their derivation has also varied over time
- **completeness and granularity:** MSATS is a comprehensive set of meter readings for individual relevant electricity customers throughout the NEM

---

37 Frontier Economics, Residential energy consumption benchmarks, Frontier Economics final report for the AER (9 December 2020).

38 Evoenergy, email correspondence, September 2024.

39 Ausgrid, email correspondence, September 2024.

40 AusNet, email correspondence, September 2024.

  - in comparison, our 2019 approach was based on a set of benchmarks estimated using a sample of (around 8,000) electricity customers throughout the NEM and NT
- **simplicity:** the same data set can be used to inform the unserved energy estimates for all of the 32 VCR outage scenarios
  - our 2019 approach relied on several data sources and also required a number of further adjustments to ACIL Allen's benchmarks
- **replicability:** this data set is likely to remain available for the future VCR updates
  - producing an updated set of energy consumption benchmarks and then estimating residential unserved energy using our 2019 approach would require much greater commitment of resources and time compared to updating residential unserved energy using MSATS data.

Our 2024 approach to estimating residential unserved energy involves:

1. Extracting relevant MSATS data for the 2023–24 financial year:
   a) we group residential customers into VCR segments by postcode (using the method described above at 4.1.1).
   b) we obtain 30-minute meter readings for the residential customers in each segment that have interval meters (from AEMO)
   c) we then assign each 30 minute reading interval into one of the 32 outage scenarios based on season, day of week, and time of day.
2. Estimating average household electricity demand by outage scenario for each VCR segment, based on the load readings and number of meters in the segment.

Below we explain the 2 key assumptions used in this approach.

- Residential customers generally have one of 2 types of meters: a basic (accumulation) meter or an interval meter. To estimate unserved energy for a segment, we use the consumption data for customers with interval meters only. This assumes that consumption profiles of these 2 groups of customers are similar. We made this assumption for practical reasons (basic meter readings are done less frequently and are challenging to combine with interval meter readings). Further, we consider this a reasonable assumption because:
  - interval meter penetration is high[41] and will continue to grow
  - using interval meter readings allows us to achieve greater data granularity (30-minute intervals) than basic meter readings
  - meter type is unlikely to be a strong driver of total household consumption.
- To estimate unserved energy for each residential segment we rely on the consumption data in that segment for households without PV. That is, we assume that the unserved energy for customers with PV and without PV residing in the same segment would be similar, though households without PV are supplied only by the grid.

---

41 Over 60% overall in the NEM, and 37.4-99.5% across different states in the NEM as of 1 July 2024. NEM Interval Metering and Distribute Energy Resources Dashboard, (accessed 11 December 2024).

- Unserved energy for PV households would generally include both energy consumed from the grid and energy generated and consumed behind the meter (self-consumption). Self-consumption is not measured by meter readings (including MSATS data). We are also not aware of other verifiable and granular data sources for self-consumption of individual households with PV. Therefore, we can neither ascertain whether there is difference between unserved energy for PV household and those without PV nor quantify it.
- We note that this issue arises regardless of the data source we use to estimate residential unserved energy. This is due to the lack of verifiable comprehensive data on self-consumption of individual households with PV.

The Northern Territory (NT) is not part of the NEM; therefore, metering information and consumption data for NT residential customers is not collected by AEMO's MSATS database. We were unable to obtain comparable metering data directly from Power and Water Corporation, the NT's only regulated electricity distributor.

The AER had similar issues with data availability for the NT in the 2019 review. This was resolved by combining benchmark consumption data for the NT with time-of-use metering data from climate zones 2 and 6 to compute unserved energy estimates.

To address the gap for 2024 we have used a similar approach that combines NT-specific consumption volumes with time of use data from comparable regions. We have used:

- data from Power and Water Corporation's latest Economic Benchmarking RIN responses on energy deliveries to residential customers to set the total level of consumption.
- a weighted average of MSATS data for CZ1 Regional and CZ3+4 Regional segments to estimate the relative profile of consumption and vary the unserved energy by season, day of week and time of day to match the VCR outage scenarios.

We consider this approach is appropriate because an analysis of historical consumption data shows residential NT customers typically use more electricity per capita than customers in the same climate zones in other states. This can be seen in past benchmarks published by the AER and when comparing Power and Water Corporation's economic benchmarking regulatory information notice (RIN) data on residential energy deliveries with other distribution network service providers. Unlike AEMO's MSATS data used for the other segments, the RIN data does not differentiate between customers with and without PV. Therefore, here we have included network supplied electricity for both PV and non-PV households in the estimation.[42].

The annual consumption amounts for each residential cohort are set out in Table 4.

[42] This would likely have the effect of decreasing the average household consumption estimate for the NT. PV households may have lower network consumption figures due to a portion of their electricity being supplied by PV generation rather than the network. Despite any effect from this, the NT residential consumption estimate is higher than that for other residential segments.

Table 4 Annual consumption by residential segment (kWh)

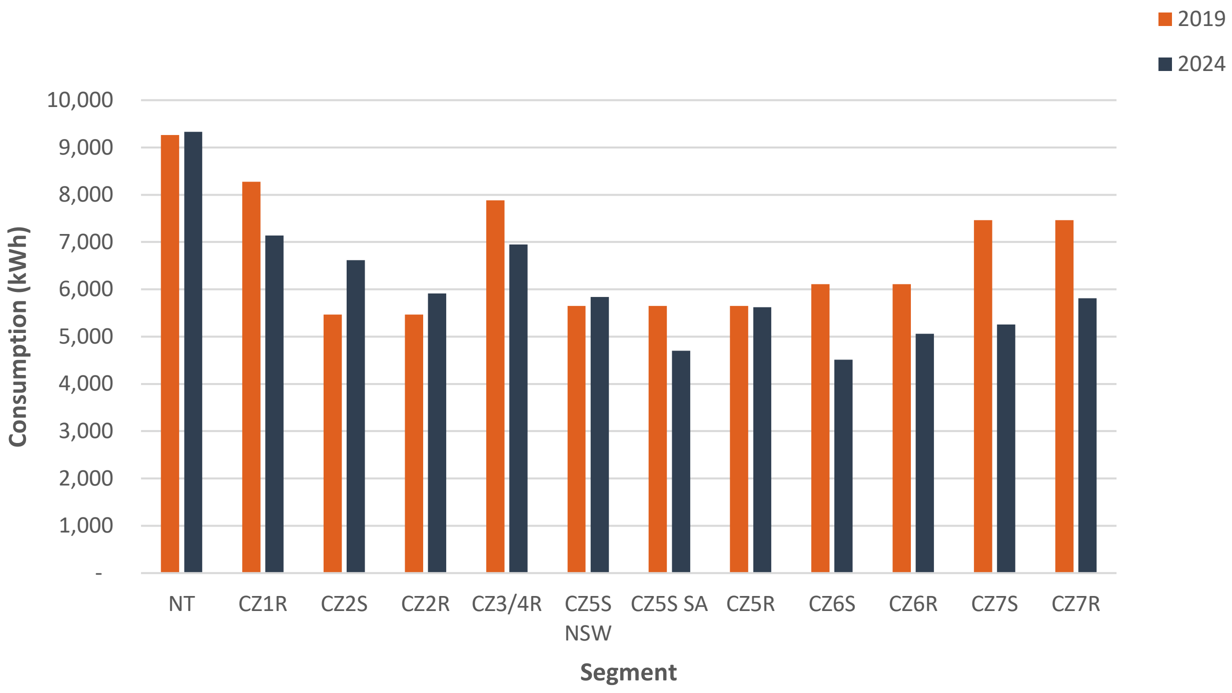
Residential customer segment	2024 Annual consumption (kWh)	2019 Annual consumption (kWh)
CZ1 Regional	7,141	8,274
CZ2 CBD & Suburban	6,615	5,467
CZ2 Regional	5,912	5,467
CZ 3&4 Regional	6,949	7,884
CZ5 CBD & Suburban NSW	5,838	5,649
CZ5 CBD & Suburban SA	4,699	5,649
CZ5 Regional	5,622	5,649
CZ6 CBD & Suburban	4,514	6,109
CZ6 Regional	5,064	6,109
CZ7 CBD & Suburban	5,255	7,466
CZ7 Regional	5,815	7,466
Northern Territory	9,328	9,262[43]

As can be seen from Table 4 and Figure 5, the 2024 residential unserved energy estimates are lower for 8 segments and higher for 4 segments than the corresponding values we estimated in the 2019 VCR review.[44]

43 We note that the annual consumption figure for Northern Territory was misquoted as 8,207 kWh in Table 5.9 of our 2019 Final report on VCR values. The actual figure used in the VCR calculations is 9,262 kWh.

44 The estimates of unserved energy for each of the 32 outage scenarios for each residential segment are set out in Appendix B.

Figure 5 Annual consumption by residential segment (kWh)



Because we used a new data source to estimate residential unserved energy for 2024, the differences between the 2019 residential unserved energy estimates and the 2024 unserved energy estimates may be due to either this, changes in residential consumption over time or both.

We note that, compared to 2019, our 2024 approach allows for more granular estimates, such as producing separate values for segments with different remoteness within the same climate zone. For instance, while in 2019 we had the same figure for annual consumption (5,649 kWh) in all three segments in climate zone 5, we are now able to produce three different estimates. We observe that while one of them (5,838 kWh for CZ5 CBD and Suburban NSW) is higher than the corresponding 2019 value, the other two are lower (4,699 kWh for CZ5 CBD and Suburban SA and 5,622 kWh for CZ5 Regional).

We undertook some further analysis to better understand the 2024 figures. This included reviewing other information sources that can shed light on residential consumption patterns between 2019 to 2024 (AER's Economic Benchmarking RIN data[45] and the ACCC's Inquiry into the NEM insights[46]).

Figure 6 presents average energy delivered per residential customers for the 2018-19 financial year and 2023-24 financial year based on the 2024 Economic Benchmarking data for a range of regulated distribution networks. We note that this data is not directly comparable to our estimates of unserved energy for 2019 and 2024 VCR calculations. This is because the Economic Benchmarking data includes the total of energy delivered to

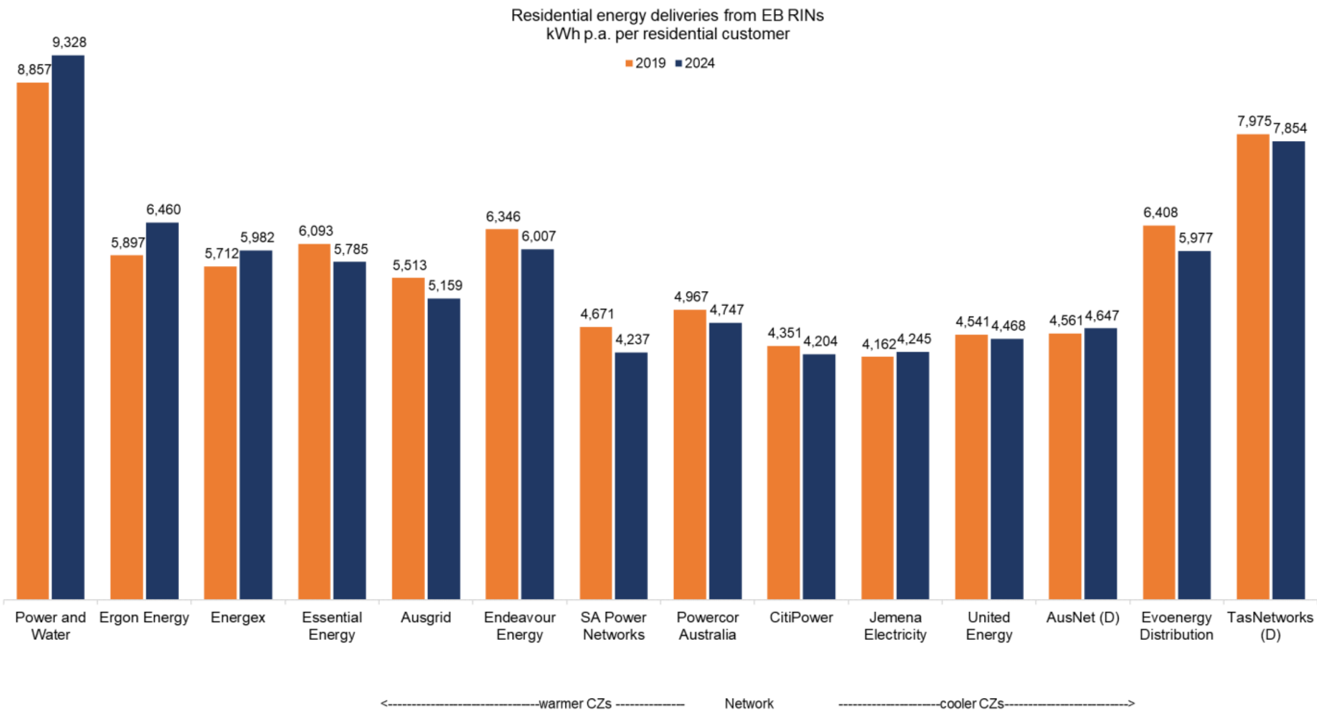
45 RIN data can be accessed on our publications webpage.

46 ACCC, *Inquiry into the National Electricity Market report - June 2024*, Australian Competition and Consumer Commission, 28 June 2024.

households with and without PV and does not allow us to separate energy delivered to households without PV from energy delivered to households with PV. Further, the energy delivered data in Figure 6 is presented by network service provider, rather than by VCR segments, which further complicates any comparison.

We note that from the 2018-19 financial year to the 2023-24 financial year energy delivered decreased for 9 out of 14 network service providers (by 1.6-9.3%) and increased for the remaining 5 (by 1.9-9.5%).

Figure 6 Economic Benchmarking RIN data, 2019 and 2024



We also considered the insights into the residential consumption trends offered by the ACCC's Inquiry into the NEM. The June 2024 ACCC Inquiry report[47] noted that residential median electricity usage decreased by 8% between Q3 2018 and Q3 2023, for all regions combined. Downward trends were observed for each NEM region separately, though to varying extents. As for the Economic Benchmarking data, this data includes PV households and so cannot be strictly compared with our estimates of residential unserved energy (based on MSATS data for households without PV). However, it too gives evidence of a general downward trend in residential electricity consumption within the relevant timeline.

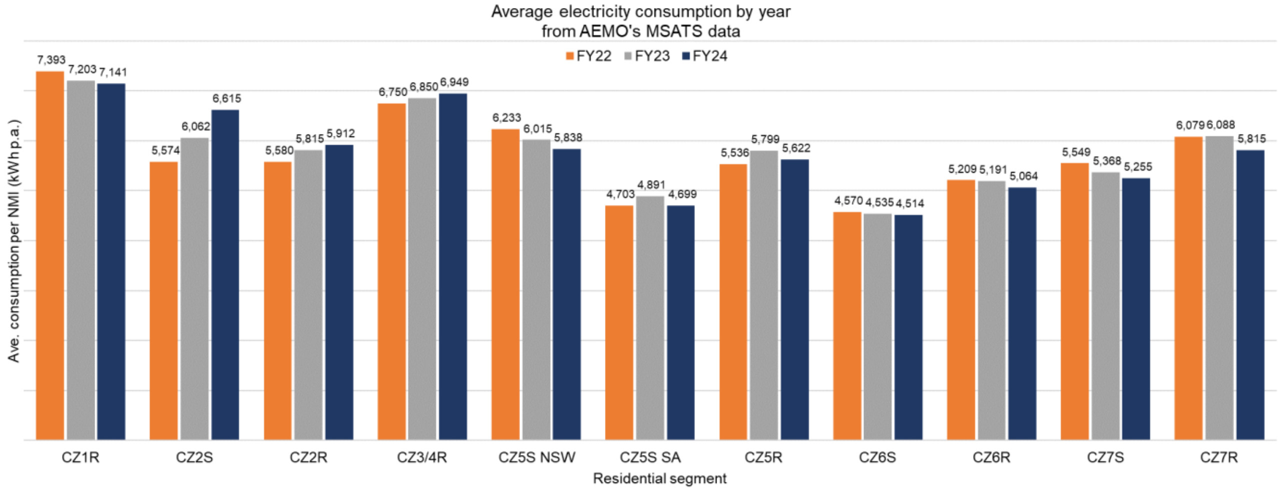
Further, we obtained the MSATS data enabling us to estimate the residential unserved energy using our 2024 approach for the two years immediately prior to consider how those estimates evolved over that time. Figure 7 presents unserved energy estimates for our residential customer segments (excluding Northern Territory) for 3 consecutive years, including the estimates we used for calculating the 2024 VCR. We observe that pattern of changes in unserved energy from year to year vary between segments in scale and direction, with the most rapid change (increase) observed in CZ2 – CBD and Suburban segment. We

---

47 ACCC, Inquiry into the National Electricity Market report - June 2024, 28 June 2024, p. 25.

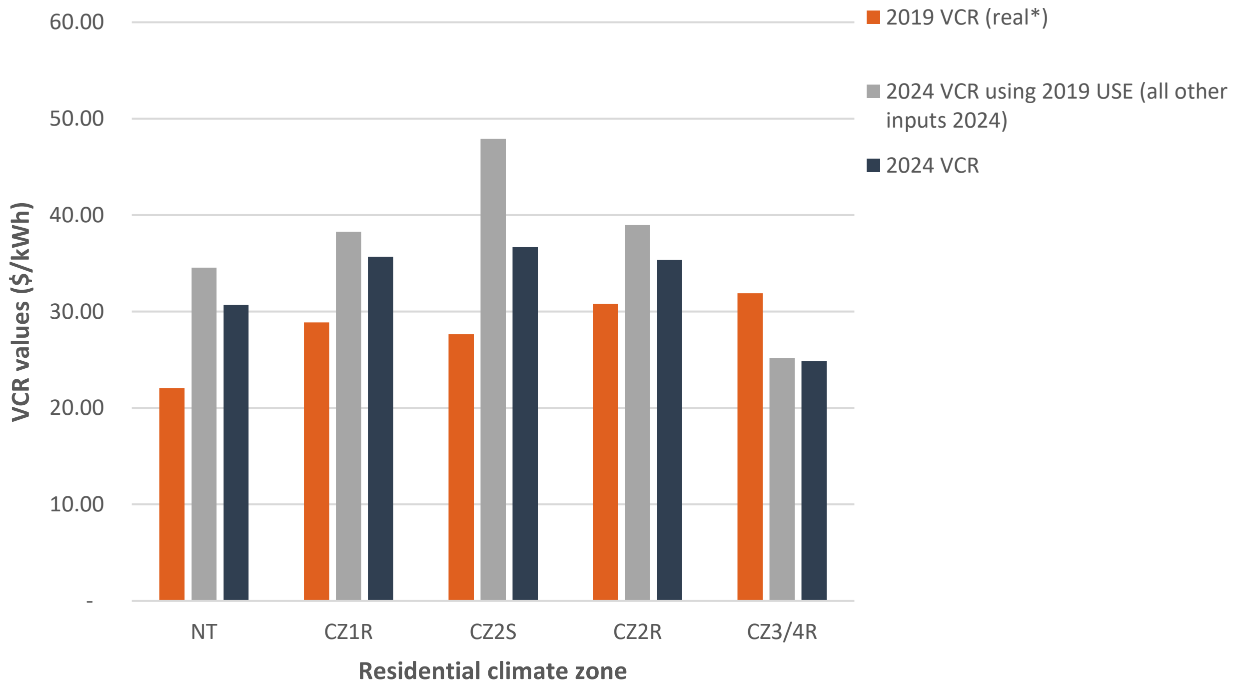
note that the direction of this change and several others in Figure 7 is consistent with the direction of changes between the unserved energy estimates for 2019 and 2024 VCR calculations (see Table 4 above).

Figure 7 Unserved energy by year based on the 2024 approach



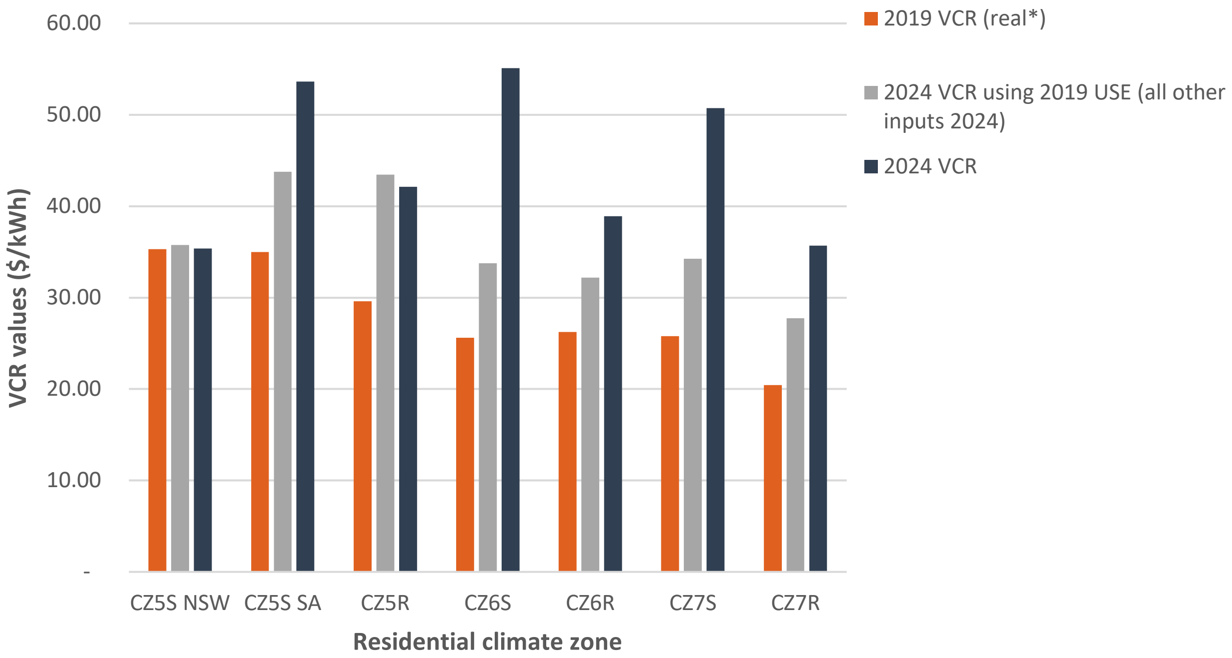
We also explored how the 2024 VCR would change if we used the 2019 unserved energy estimates as an input into the 2024 VCR calculations once again.

Figure 8 VCR comparison using the different residential unserved energy approaches: Northern Territory and Climate Zones 1 to 4



Note: The 2019 VCR, real ($2024), have been calculated consistent with our annual adjustment mechanism (nominal 2019 VCR multiplied by a ratio of CPI for September 2024 and CPI for September 2019).

Figure 9 VCR comparison using the different residential unserved energy approaches: Climate Zones 5 to 7



Note: The 2019 VCR, real ($2024), have been calculated consistent with our annual adjustment mechanism (nominal 2019 VCR multiplied by a ratio of CPI for September 2024 and CPI for September 2019).

This analysis highlights that:

- switching to a new data source to estimate the residential unserved energy has not had a uniform impact across the residential segments
- the change in willingness to pay between 2019 and 2024 is also a key driver of the changes in the residential VCR.

To summarise our analysis in this section, we observed that the differences between our 2019 and 2024 residential unserved energy estimates (in Table 4) are not uniform and vary across customer segments both in direction and magnitude. Further, while other data sources we examined do not allow for a 'like for like' comparison, they show similar patterns of residential unserved energy dynamics over 2019-2024. It is also likely to be more robust and reliable in the face of the various drivers of electricity consumption changing in different ways over time (for example, some are expected to drive increases, while others are expected to drive decreases), making model based estimates difficult and leading to a preference for a more direct measurement of consumption.[48]

While the approach we used to estimate unserved energy in 2019 was the most appropriate at that point in time, it relied on a benchmark that was based on a relatively small sample of residential consumption data (over 2014 to 2017). We now have access to a much larger and richer set of MSATS data for the 2024 VCR update. We consider that using this new comprehensive data source, which we expect to be available at future VCR updates, is an improvement.

Outage frequencies

Consistent with our approach in 2019, we computed outage frequencies within segments for each of the 32 unique outage scenarios. They were derived using a combination of network outage data from Category Analysis Regulatory Information Notices (CA RIN) and feeder location and customer count data provided to the AER by distribution network service providers.

For calculating the probabilities, outages were compiled using the following criteria:

- the outages must be unplanned
- the outages must be 3 minutes[49] or more in duration and not longer than 12 hours duration[50]
- the outages must affect at least one customer
- the outages must take place in summer or winter.

Outage customer-minutes interrupted were allocated to the 32 scenarios using a combination of the date of the outage, start time and duration. Outage probability weightings were then based on the customer minutes interrupted in a given segment that fell into each outage scenario in regulatory year 2022–23, as a proportion of all in-scope customer minutes interrupted for the segment.

Feeder location data was used to apportion customer minutes interrupted geographically into segments. Where a feeder served customers in multiple VCR segments, its customer minutes interrupted were distributed based on the proportion of customers served by the feeder in each segment.

Looking at the NEM + NT overall, the distribution of outage frequencies across different outage types did not change dramatically between the 2019 and 2024 VCR processes. The

---

48 AEMO's 2024 Integrated System Plan found that, taken as a whole, households were forecast to draw about as much from the grid across a year in 2050 as they do now. Their EVs and appliances will drive up underlying consumption, but this will be offset by their investments in rooftop solar and energy efficiency. AEMO noted that individual households will differ in how they rely on the grid and many will continue to be without rooftop solar and draw electricity from the grid, while those with solar may export excess energy during the day and import from the grid overnight. See AEMO, 2024 Integrated System Plan, AEMO, 2024, p. 26.

49 This is to ensure consistency with the definition of momentary, which is defined as an outage of less than 3 minutes.

50 Outages longer than 12 hours are not within the scope of the VCR.

distribution of outages across the key attribute of outage duration changed by a maximum of 2 percentage points between 2019 and 2024.

Table 5 Proportion of customer-minutes interrupted for outages of different durations between 3 minutes and 12 hours, in the NEM + NT

NEM + NT	3 minutes to 1 hour	1 to 3 hours	3 to 6 hours	6 to 12 hours	Total
AER 2024	11%	44%	28%	18%	100%
AER 2019	12%	45%	26%	18%	100%

Source: AER analysis using CA RIN feeder-level outage event data and customer count and feeder location data provided by distribution network service providers.

The proportion of outages occurring in summer decreased from 70% to 62% and the proportion of outages on weekdays increased from 69% to 75%. A majority of outages, measured by customer minutes interrupted, continued to occur in summer versus winter, perhaps reflecting that the majority of the electricity networks are summer peaking. A majority of customer minutes interrupted also continued to occur during weekdays rather than weekends and at off-peak times over peak times, largely consistent with the time distribution in terms of day of the week (around 71% of days being weekdays) and hour of the day (75% of hours being off-peak hours). Each of these outage attributes plays a much smaller role in residential consumer preferences over outages relative to duration. Duration is included in all versions of the residential VCR model, but these other attributes are only occasionally included in the VCR calculations, for some residential segments, due to their generally lower levels of statistical significance in the results.

Table 6 Proportion of customer-minutes interrupted, summer vs winter, weekday vs weekend, peak vs off-peak, in the NEM + NT

NEM + NT	Summer	Winter	Weekday	Weekend	Peak	Off-peak
AER 2024	62%	38%	75%	25%	26%	74%
AER 2019	70%	30%	69%	31%	29%	71%

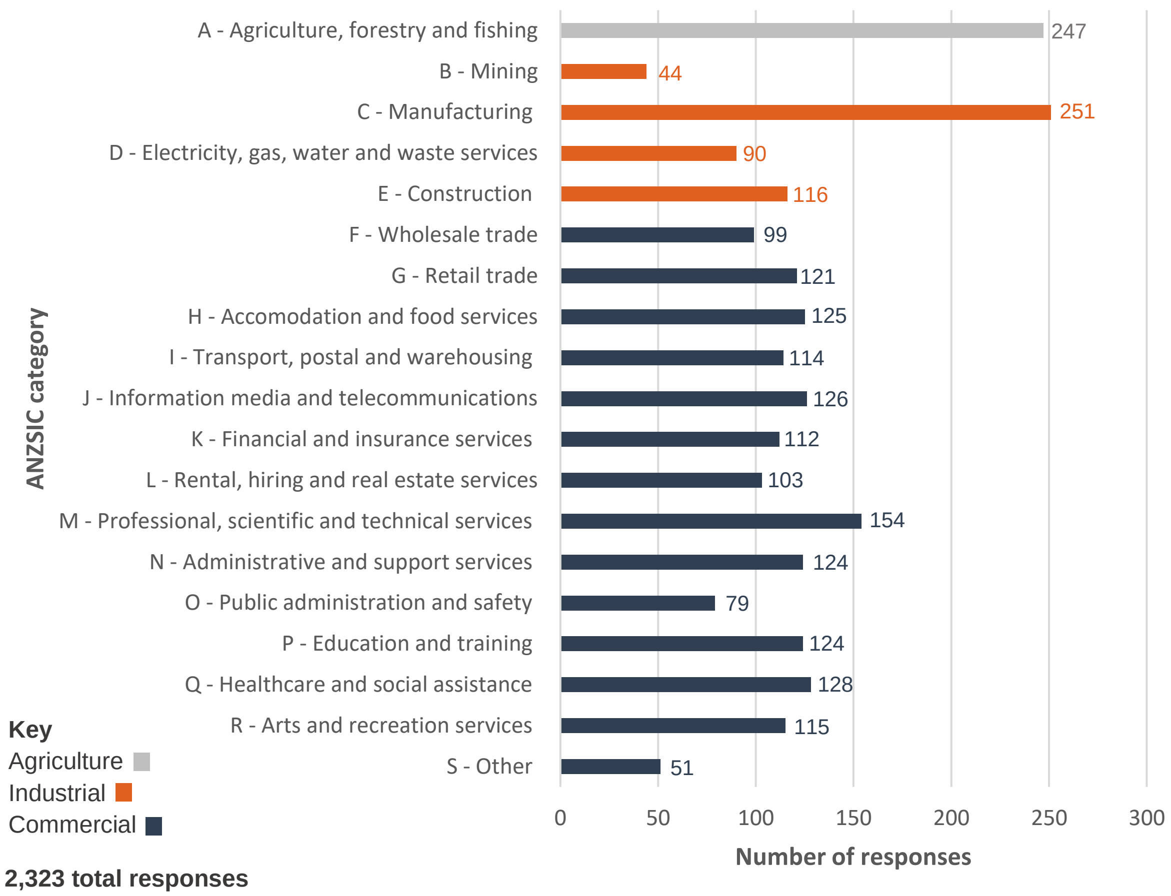
Source: AER analysis using CA RIN feeder-level outage event data and customer count and feeder location data provided by distribution network service providers.

4.2 Business (peak demand less than 10MVA) approach

We surveyed 2,323 business customers across the National Electricity Market (NEM) and the Northern Territory (NT) in our business survey. Business responses were collected across all 19 of the Australian Bureau of Statistics' Australian and New Zealand Standard Industrial Classification (ANZSIC) sectors.[51]

51 Our business customer sample plan is provided in Appendix C.

Figure 10 Business responses by ABS ANZSIC sectors



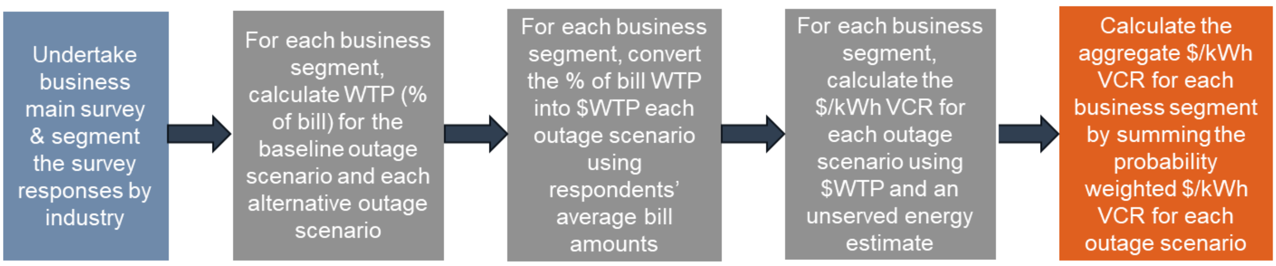
We used these survey responses, along with data from other sources such as AEMO to calculate the business VCR.

The VCR calculation for each business segment has 3 key components:

1. willingness to pay (for the baseline scenario and each alternative outage scenario), based on the business survey responses
2. unserved energy estimates for each outage scenario, based on consumption data from the survey responses and other sources
3. outage frequencies for each outage scenario, based on historical network outage data.

Figure 11 provides an overview of this calculation.

Figure 11 High-level overview of the calculation of a business segment VCR



The following sections set out our approach to the above calculation, including our approach to business customer segmentation and estimating business unserved energy and outage frequencies.

4.2.1 Business customer segmentation

Our VCR methodology uses choice modelling in the business surveys, and this technique provides for flexibility in grouping the survey responses. Consequently, we can identify and group customers with similar reliability preferences together in a segment.

Our 2024 business customer segmentation is the same as in 2019, to allow for a degree of comparability between these 2 sets of values, and we obtained enough responses for each of these segments to run a robust choice model. Table 7 provides an overview of the business customer segmentation for the 2024 VCR.

Table 7 2024 Business customer segmentation

Business VCR segment	ANZSIC codes included in segment
Agriculture	A – Agriculture, Forestry and Fishing
Industrial	B – Mining C – Manufacturing D – Electricity, Gas, Water and Waste Services E – Construction
Commercial	F – Wholesale Trade G – Retail Trade H – Accommodation and Food Services I – Transport, Postal and Warehousing J – Information Media and Telecommunications K – Financial and Insurance Services L – Rental, Hiring and Real Estate Services M – Professional, Scientific and Technical Services N – Administrative and Support Services O – Public Administration and Safety P – Education and Training Q – Health Care and Social Assistance R – Arts and Recreation Services S – Other Services

4.2.2 Calculating business VCR values

To convert the business survey results into \$/kWh VCR values for each segment we used the same overall process as in 2019:

- we used the survey responses and a combination of contingent valuation and choice modelling to calculate the willingness to pay as percentage of bill values for each of the 32 unique outage scenarios
- we converted the percentage of bill values into dollar values using the average bill amounts provided by respondents in their survey responses
- we converted the dollar values for each of the outage scenarios into $/kWh using estimates of unserved energy
- we developed a probability weighting for each outage scenario and then summed the probability weighted outage scenario $/kWh VCR values to derive the segment $/kWh values.

Each of these steps is discussed below.

Outage scenarios

Like for the residential survey, the 32 alternative unique outage scenarios consist of combinations of the following characteristics:

- summer or winter
- off-peak or peak
- weekend or weekday
- outage duration of 3 minutes to 1 hour, 1 to 3 hours, 3 to 6 hours or 6 to 12 hours.

Willingness to pay

Consistent with the residential survey approach, we used a combination of contingent valuation and choice modelling survey techniques to estimate the willingness to pay (percentage of bill) for each of the 32 outage scenarios identified above.

Contingent valuation

Contingent valuation involves asking the respondent the maximum bill increase they would be willing to pay to avoid the baseline outage scenario. It was used to estimate the willingness to pay (in percent of bill terms) to avoid the baseline outage scenario, with the willingness to pay for each business segment calculated using a simple average of survey responses (with individual survey responses capped at 100% of a respondent's last bill). See chapter 3 for more information.

Choice modelling

Similar to the residential approach, choice modelling was used to determine the increment (or decrement) in value (in percentage of bill amounts) respondents placed on specific outage attributes in addition to the baseline outage scenario. Attributes tested in the choice model were the same as in the residential approach (peak/off-peak, winter/summer, weekday/weekend, localised/widespread outage and duration).

Consistent with our approach in 2019, we used a statistical model (a multinomial logit model) to produce the choice modelling results, including willingness to accept percentage of bill estimates for the outage attributes tested. The estimate for each attribute is the incremental percentage of bill amount a customer would require to experience that attribute in addition to the baseline outage scenario. For ease of reading, we express the estimates in willingness to pay form.

In developing the VCR, outage variables were included where the choice modelling regression coefficients had at least 99% statistical significance and percentage of bill estimates derived from the coefficients had at least 90% statistical significance (significance criteria). Inclusion of other variables that did not meet these criteria were considered on a case by case basis. Here 3-hour duration was included for the industrial segment. The coefficient for this variable was statistically significant at the 95% level and was included to maintain consistency across the business segments and with 2019.

Converting willingness to pay as percent of bill to dollar values

We converted the willingness to pay estimates into dollar values by multiplying the relevant willingness to pay estimates by the average bill amounts for small and medium, and large respondents within each cohort. These average bill amounts were based on bill information survey respondents provided in their survey responses. The average bill amounts are set out in Table 8.

Table 8 Business respondents – average annual bills ($/year)

Size	Agriculture	Industrial	Commercial
Small and medium	$5,064	$5,538	$4,754
Large	$131,480	$1,260,763	$164,791

Estimating unserved energy of business customers

We calculated the average amount of unserved energy for small/medium and large customers within each cohort consistent with the approach we took in 2019. This involved the steps set out below.

1. Calculating the average sample small/medium and large annual consumptions for each cohort. These were estimated by dividing the average annual bill amounts for small/medium and large survey respondents by the respective volume weighted average effective c/kWh rate for small/medium enterprise and large commercial and industrial customers calculated by the ACCC in its Inquiry into the NEM reports.[52]
2. Converting these sample annual consumption amounts to sample average hourly consumptions for small/medium and large customers within each cohort.
3. Adjusting the sample average hourly consumption amounts by summer/winter, peak/off-peak and weekday/weekend factors specific to each cohort to reflect variation in usage throughout the year. These factors were estimated by comparing the differences in operational demand among NEM regions due to differences in the composition of

52 ACCC, *Inquiry into the National Electricity Market – December 2023 Report*, Australian Competition and Consumer Commission, Appendix C.

industrial, agricultural and commercial customers among NEM regions. These factors are set out in Appendix B.

The sample average hourly demand figures are set out in Table 9.

Table 9 Business respondents – average annual consumption (kWh/year)

Size	2024 average annual consumption			2019 annual average consumption		
	Agriculture	Industrial	Commercial	Agriculture	Industrial	Commercial
Small and medium (<100 MWh)	16,986	18,576	15,947	15,007	16,066	13,152
Large (>100 MWh)	751,742	7,208,482	942,199	981,437	3,737,052	940,047

As can be seen from Table 9, estimated unserved energy has increased for most business cohorts, other than large agricultural customers, between 2019 and 2024. Consistent with our approach in 2019, the 2024 methodology for calculating business unserved energy relied on calculations using the specific responses from the survey. This introduces more variation than a population-wide estimate would and business variation in consumption is particularly variable so the specific responses received can greatly influence this result.

Outage frequencies

The outage frequencies for each of the 32 unique outage scenarios were derived using the same outage data sources and outage filter criteria as those used for the residential outage probability profiles (see section 4.1.2).

We used different subsets of the outage data for distribution Service Target Performance Incentive Scheme feeder classifications to calculate the outage frequencies for the different business segments, with outage frequencies for:

- **the Agriculture segment**, based on the subset of outages affecting customers served by rural short and rural long feeders, reflecting that the typical agricultural business is located in regional Australia, rather than urban or central business district (CBD) locations
- **the Commercial segment**, based on all outages affecting customers served by all feeder classifications. This is because the commercial segment covers a broad range of business types that cannot be generalised to a particular remoteness category or categories
- **the Industrial segment**, based on a combination of outages – large industrial customer outages and small/medium industrial customer outages are both based on the subset of outages affecting customers served by CBD feeders and urban feeders.[53]

53 This is a revised different subset to 2019, where for large industrial we only used outages affecting customers served by CBD feeders.

4.3 Very large business approach

As discussed in chapter 3, we used a direct cost survey approach for very large business customers as these customers are better able to quantify the costs incurred as a result of an outage. To be eligible for this survey, a business site had to be connected to a transmission or distribution network and have a peak demand of 10 MVA or more at some time in financial year 2023–24. We identified around 200 business sites across the NEM that met these criteria.

We sent survey invitations to all of the businesses that were eligible to participate in the direct cost survey, which was undertaken between 20 September 2024 and 1 November 2024. We received 64 responses from very large business customers across the NEM. The survey respondents were from a range of industries, including metals processing, mines, manufacturing (various industries) and services. Only 2 of the 64 respondents did not operate 24 hours a day.

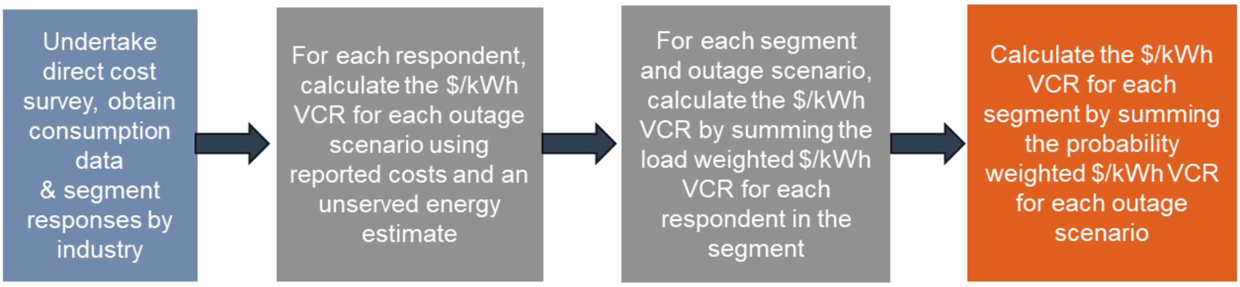
Of the survey responses we received, 37 included outage cost data, gave consumption data permissions and met other criteria we set for inclusion of their responses into the VCR calculations. We used these survey responses, along with data from other sources such as AEMO to calculate the very large business VCR.

The VCR calculation for each very large business segment has 3 key components:

1. Reported costs of outages, based on the direct cost survey responses
2. Unserved energy estimates for each outage scenario, based on consumption data from AEMO (survey respondents provided permission for us to obtain this data from AEMO)
3. Outage frequencies for each outage scenario, based on historical network outage data.

Figure 12 provides an overview of this calculation.

Figure 12 High-level overview of the calculation of a very large business segment VCR



4.3.1 Very large business customer segmentation

We have grouped responses in a way that provides some granularity, but which also maintains the confidentiality of individual respondents. The segment groupings align with the segments from which we received survey responses. This is the same approach we took in 2019.

For the 2024 review, we have grouped the direct cost survey responses into the following segments:

- services

- industrial
- metals
- mines.

4.3.2 Consumption data

To derive the very large business VCR, we divided the reported estimated outage costs by the respondents' consumption. We obtained metering data from AEMO, after requesting permission from survey respondents to do so in the direct cost survey.

As in 2019, the metering data we obtained are net readings (that is, consumption minus any exported energy) and we do not know the total energy amount (that is, imports plus exports). However, in 2019 we did not know whether the outage costs reported by respondents factor in the loss of revenue associated with exports to the grid as the survey did not prompt respondents to include these costs explicitly.

To address these limitations, we applied a series of assumptions to estimate more accurate consumption figures. In 2024, we refined our methodology to better capture the impact of export-related revenue losses. Specifically, we asked respondents whether a 10-minute outage would result in costs like 'loss of revenue due to not being able to export to the grid'. This enhancement allowed us to identify businesses factoring in export losses. However, when respondents did not indicate such costs, we continued using our 2019 approach to ensure consistency and address incomplete data.

Consistent with our approach in 2019, we made the assumptions set out below.

- **Handling negative consumption readings**

  For net readings with negative consumption amounts, we assessed the impact of exports:

  - If exported energy made up less than 5% of the total energy flow (imports plus exports), we treated negative readings as zero to remove the effect of export data on reducing the consumption figures.
  - If exported energy exceeded 5%, we assumed substantial cogeneration and included the exported energy as a positive amount to better estimate the total energy amount.

- **Considering export-related costs**

  - Respondents with substantial generation, or those who indicated that a 10-minute outage would result in costs like 'loss of revenue due to not being able to export to the grid', were assumed to have included this factor in their reported outage costs.

4.3.3 Outage frequencies

To combine the load weighted $/kWh values into a single figure for each customer segment we weighted by the relative frequency of each outage duration occurring. To calculate the weights, we analysed the number and length of outages occurring in the transmission system between 1 July 2019 and 30 June 2024, and used this data to develop outage frequencies. The transmission outage data was provided by AEMO and is based on incidents which meet the criteria reviewed by AEMO under clause 4.8.15 of the Rules.

These transmission derived outage frequencies were applied to the responses of both distribution-connected and transmission-connected customers, consistent with our approach in 2019. We consider this approach is reasonable given distribution-connected businesses using above 10 MVA peak demand have high voltage connections and are likely to experience similarly high levels of reliability to transmission-connected businesses.[54]

4.3.4 Transmission and distribution VCR

In addition to calculating sector VCR, we also calculate VCR for transmission-connected and distribution-connected very large business customers. We use the VCR for transmission-connected very large customers to calculate the NEM-wide and state VCR values (see section 4.4).

To calculate transmission and distribution VCR values, we calculated the load weighted average of the transmission-connected respondents and the distribution-connected respondents, respectively.

We use the transmission-connected very large business VCR rather than the overall very large business VCR to calculate the aggregate VCR because we do not have the information on the load of distribution-connected very large customers relative to other distribution-connected residential and business customers. This follows the same approach used 2019.

4.4 Developing NEM-wide and regional VCR values

We use the residential, business and very large business VCR (transmission-connected customers' VCR only) to calculate the following aggregate VCR:

- NEM-wide VCR
- state and territory VCR.

We calculate these aggregate VCR by summing the VCR of the relevant customer segments weighted by the proportion of total load for that area. This can be expressed as:

$$Area\ VCR = P1(residential\ VCR) + P2(business\ VCR) + P3(large\ business\ VCR)$$

where P is the proportion of total load made up for by the relevant customer segment.

Where an area consists of more than one type of residential, business or very large business segment they are added together separately in proportion to their contribution to the area's total load. For example, if an area consists of residential customers from climate zone 6 suburban and climate zone 6 regional, the residential contribution to area VCR should be the load weighted sum of both residential segment VCR.

---

54 High voltage distribution connections usually have similarly high levels of reliability to transmission customers due to the designed redundancy in their connections and the high level of reliability of the high voltage distribution network.

4.4.1 NEM-wide and state and territory residential VCR

To calculate state and territory residential VCR values, we weighted the VCR segment groupings using a combination of census and consumption data following the steps outlined below.

1. Mapping each ABS Mesh Block to a state/territory, postcode, climate zone, and remoteness category, as described in 4.1.1.
2. Calculating dwelling counts within each VCR segment using ABS Mesh Block and census count data. This gives an estimate of the number of the jurisdictions' households in each VCR segment.
3. Multiplying the number of dwellings by the corresponding average household consumption for their VCR segment. This gives the total energy load for each residential segment in each state, which was divided by the total load of all households within the state to give a weighting percentage.
4. Combining segment VCR figures into state/territory residential VCR using the load weighted sum of segment VCR figures in the state.

The load weightings we have used for the 2024 aggregate residential VCR are set out in Appendix B.

4.4.2 NEM-wide and state and territory aggregate VCR

To combine VCR across customer cohorts to produce NEM and state/territory VCR, we also weight the constituent VCR based on contribution to the larger area's total electricity load.

- Residential segment VCR are weighted using dwelling counts and average consumptions, as described above.
- Business VCR are weighted by industry load using statistics on electricity consumption by state and ANZSIC sector from the Australian Energy Update (AEU), published annually by the Australian Department of Climate Change, Energy, the Environment and Water.

We then combine residential and business VCR using the same AEU data, which also contains data for the total residential consumption. This gave our VCR for the distribution-connected cohort for the purposes of a composite NEM/state-wide VCR.

We computed the transmission-connected VCR using the VCR for the relevant transmission-connected very large businesses from our direct cost survey cohort. We combined sector VCR and weighted them by the actual load of the businesses in our survey.

We combined the distribution-connected (residential and business composite) VCR and transmission-connected (very large business) VCR into the final NEM and state VCR. We load weighted the VCR components for distribution and transmission connected customers using data from Economic Benchmarking RIN responses submitted by network businesses. We used this data to estimate the load split in each jurisdiction between distribution and transmission connected end users, which we then used to weight and sum the aggregate VCR.

5 Detailed 2024 results

This chapter sets out the detailed 2024 VCR results for residential, business and very large business customers, along with some observations on those results and the annual adjustment mechanism.

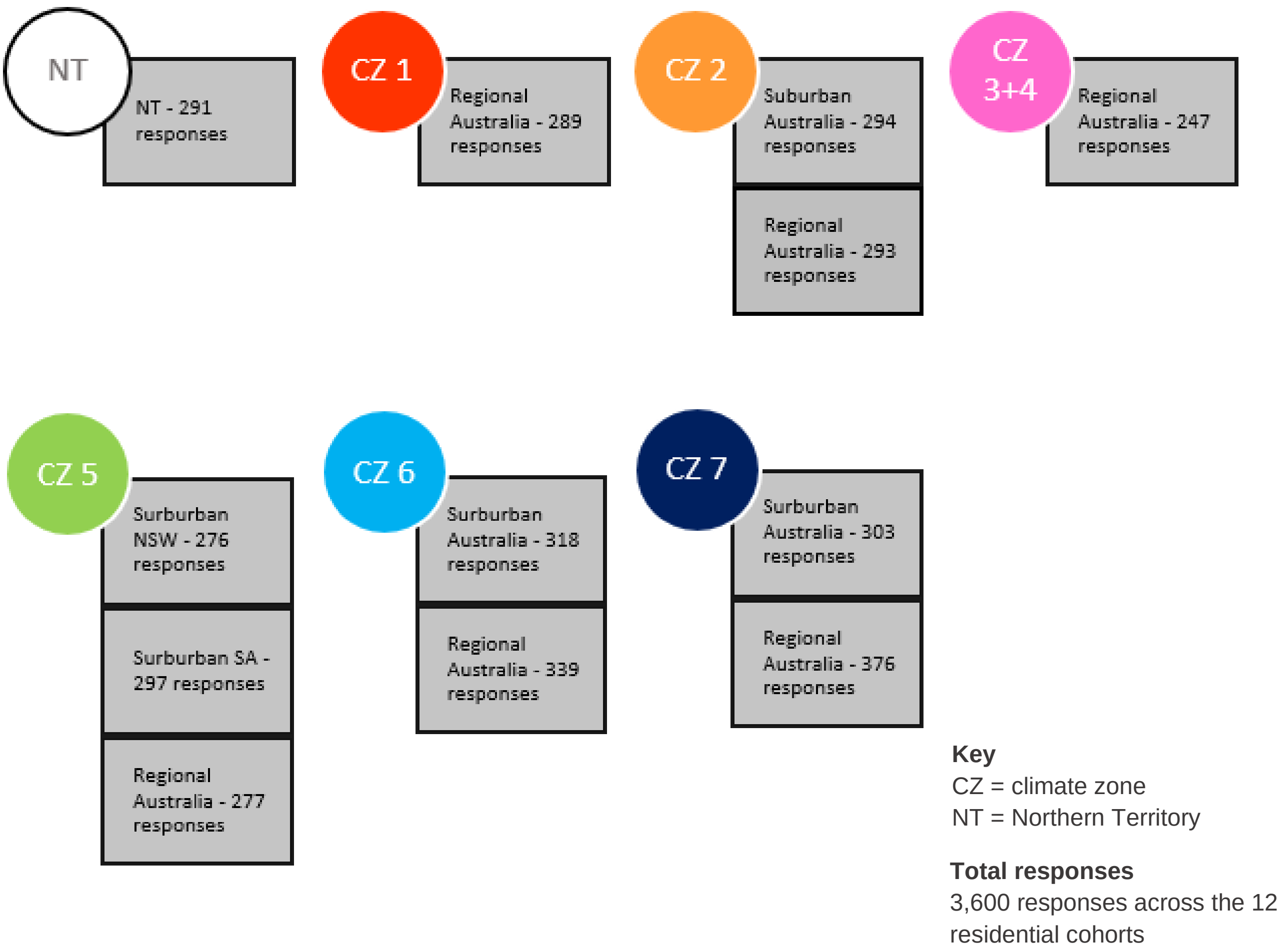
For the residential and business customer cohorts, we have presented the willingness to pay results in addition to the VCR because the willingness to pay results are a key input to the VCR calculation and changes in willingness to pay can have a material impact on the VCR.

While we have included some observations on the differences between the 2024 VCR and the 2019 VCR for residential customers, caution should be used when drawing parallels with the 2019 results because we are using a new data source as one of the inputs into the VCR calculation (unserved energy).

5.1 Residential customers

Our survey response rates by cohort were consistent with the targets for each cohort that were set out in our sample plan (see chapters 3 and 4 for more information). A breakdown of the responses by cohort is provided in Figure 13.

Figure 13 Residential survey response numbers by cohort



5.1.1 Contingent valuation (willingness to pay) results

For residential customers, average willingness to pay to avoid the baseline outage scenario increased by 16% in real terms since 2019. This is equivalent to an average annual increase of approximately 3% in addition to inflation between 2019 and 2024 for the same period.

Across the individual residential segments, the baseline average willingness to pay also increased between 2019 and 2024, with the largest percentage increases occurring in CZ1 Regional and CZ5 Regional. The range between the highest and lowest segment average willingness to pay is wider in 2024 than in 2019 ($3.47 to $6.49 in 2024 versus $2.68 to $4.20 in 2019). We also capped a higher proportion of responses at the approximate cost of a backup power system in 2024 (3.1% of responses) compared to 2019 (0.6% of responses).

Approximately 37% of residential respondents declared a willingness to pay of zero to avoid the baseline outage scenario compared to around 41% in 2019. Additionally, approximately 3.1% of willingness to pay responses were capped compared with around 0.6% in 2019.

It is not possible to isolate a specific reason for the increased willingness to pay, as reasons can conceivably vary widely, with each respondent taking a range of factors into account when they respond to the survey. However, the observed dynamics would be consistent with some trends we have observed since 2019:

- **Electrification** – some respondents may have a higher willingness to pay because of the increased importance of electricity for some residential customers, including those households switching from gas. For example, a customer who charges their electric vehicle (EV) at home might have a higher willingness to pay to avoid outages during their usual charging hours. The number of EVs in Australia has increased from around 3,000 pure EVs[55] in 2019 to an estimated 109,000 pure EVs in 2023.[56] Pure EVs make up 0.51% of total vehicles in Australia.
- **Customer perceptions and lived experience** – while reliability has not materially changed, there have been some high-profile outage events that have been either widespread and/or prolonged and which have been the subject of media coverage (for example, storm-related outages in Victoria, NSW and Queensland in 2023 and 2024). These may have made people more aware of the potential implications of an outage and impacted on perceptions of reliability
- **Work from home** – since the COVID-19 pandemic, there may have been changes in working arrangements that affect the way people work from home and people may be working from home more days per week than in 2019. For example, 32.1% of employed people usually worked some or all of their hours from home in 2019, whereas in 2024 this had increased to 36.3%.[57]

---

55 A pure EV uses only a battery and an electric motor to run. This differs from a hybrid which is powered by both an internal combustion engine and an electric motor with separate batteries for each.

56 Electric Vehicle Council, State of Electric Vehicles Report 2023, Electric Vehicle Council, 2023.

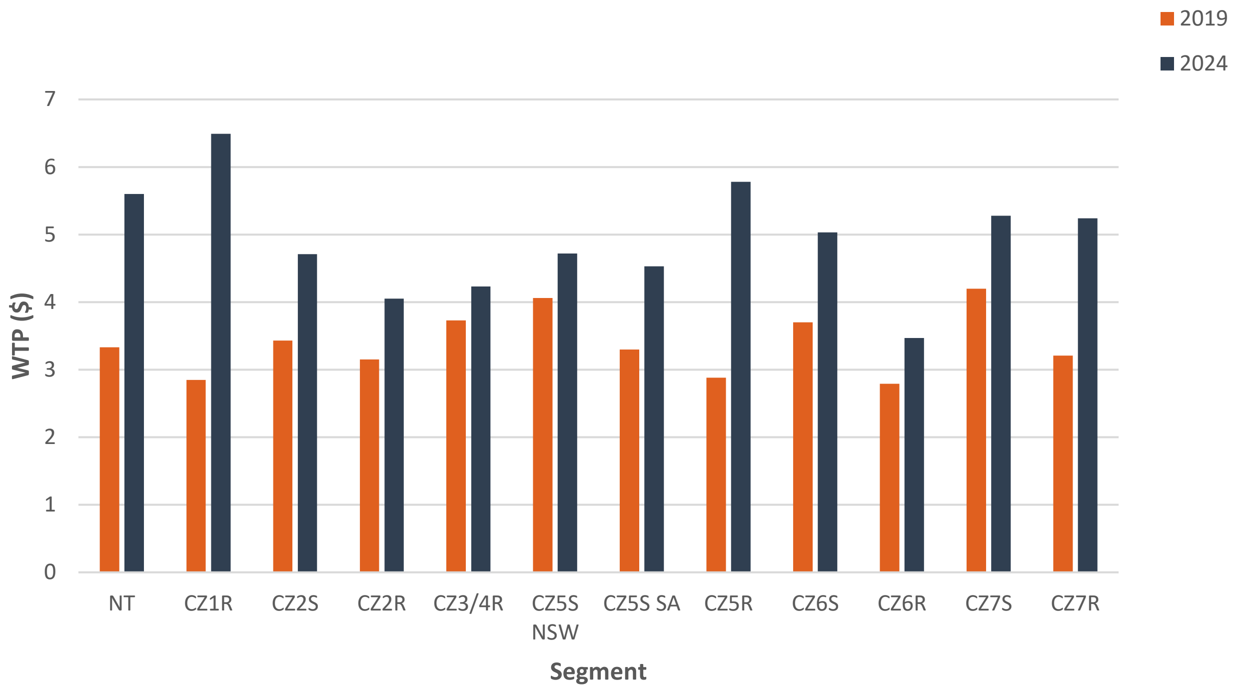
57 Australian Bureau of Statistics, Working arrangements, ABS, August 2024.

The baseline willingness to pay values also passed “face validity” or sense checks (for example, results for sub-groups of respondents, such as EV owners, align with common intuition) and the results of these checks are discussed in chapter 6.

Table 10 Residential willingness to pay (baseline scenario) by segment

Residential customer segment	Average residential willingness to pay ($/month)
Northern Territory	5.60
Climate Zone 1 Regional	6.49
Climate Zone 2 CBD & Suburban	4.71
Climate Zone 2 Regional	4.05
Climate Zone 3&4 Regional	4.23
Climate Zone 5 CBD & Suburban NSW	4.72
Climate Zone 5 CBD & Suburban SA	4.53
Climate Zone 5 Regional	5.78
Climate Zone 6 CBD & Suburban	5.03
Climate Zone 6 Regional	3.47
Climate Zone 7 CBD & Suburban	5.28
Climate Zone 7 Regional	5.24
Total (simple average)	4.92

Figure 14 2024 residential willingness to pay by segment compared with 2019 willingness to pay by segment (real) – baseline scenario



5.1.2 Choice experiments (alternative outage scenarios)

Table 11 sets out the attribute estimates derived from the choice modelling results that we included in the calculation of VCR values. The regression estimate for each attribute is the incremental amount of compensation a customer would require to accept an outage attribute (such as duration and timing) in addition to the baseline outage scenario. For ease of reading, the estimates are expressed in WTP form. In developing the VCR set out in this chapter, outage variables were included where the choice modelling regression coefficients had at least 99% statistical significance and $/month estimates derived from the coefficients had at least 90% statistical significance (significance criteria). Inclusion of other variables that did not meet these criteria were considered on a case-by-case basis; no further variables were included for the residential estimations in 2024.[58]

Table 11 Residential choice model estimates ($/month) expressed in willingness to pay form

Customer segment	Widespread	Duration 3 hours	Duration 6 hours	Duration 12 hours	Peak	Summer	Weekend
NT	–	10.79	18.79	25.92	–	4.61	–
CZ1 regional	–	13.47	20.79	23.20	–	–	–

58 In 2019 for example, NT duration 3 hours was included despite not reaching the statistical significance levels of other duration variables. This was done to maintain consistency with all other residential segments where this variable was included.

CZ2 CBD & suburban	–	13.57	22.95	27.25	–	–	–
CZ2 regional	–	12.81	19.92	24.32	–	–	–
CZ3&4 regional	–	8.87	14.93	19.28	–	–	3.51
CZ5 CBD & suburban NSW	–	10.59	16.87	21.48	–	–	–
CZ5 CBD & suburban SA	–	9.81	20.84	25.97	–	4.94	–
CZ5 regional	–	12.42	20.49	24.03	–	–	–
CZ6 CBD & suburban	–	12.04	19.05	23.92	–	–	–
CZ6 regional	–	10.76	17.76	24.08	–	–	–
CZ7 CBD & suburban	–	12.46	19.30	23.75	–	–	–
CZ7 regional	–	12.46	18.83	27.58	–	-3.87[59]	–

The results from the choice experiment section of the residential survey highlighted that the duration of the outage was the most significant driver of the willingness to pay results for all residential cohorts. This is consistent with the AER 2019 VCR and the AEMO 2014 VCR. In all the residential segments, the WTP estimate increases as duration increases. However, as duration increases the WTP does not increase as fast. All duration levels are included in the estimation of the VCR.

We have had difficulty incorporating the severity attribute into the residential $/kWh VCR values because the attribute is described qualitatively and we do not have supporting data to indicate which outages should be considered severe. We have not included the severity attribute.

The summer attribute results were in line with expectations based on climate, with warmer climate zones more likely to have a preference to avoid outages in summer over winter, with this preference tending to weaken and eventually reverse for cooler climate zones. These preferences were strong enough for the summer/winter variable to be included in the VCR estimation for 3 segments.

59 The negative value means that customers in this segment favour summer outages over winter outages (for example, they would pay more to avoid an outage in winter).

The regression results in 2024 for peak did not meet our thresholds for inclusion in the model, unlike in 2019 when peak met the thresholds for all residential segments. Five of the segments in 2024 had results that were statistically significant at the 95% level for the choice modelling coefficient and WTP level. The results of all but 2 of the segments suggested residential consumers would prefer to avoid outages at peak times over off-peak times. It is unclear exactly why this preference may have weakened. One possibility is that people working from home are more affected by off-peak outages and there are more such people than in the past. One segment, CZ3&4 Regional, recorded a sufficiently statistically significant willingness to pay to avoid weekend outages for that attribute to be included for that segment.

5.1.3 2024 VCR

The 2024 residential VCR are higher than the 2019 VCR for nearly all residential segments (only climate zone 3 + 4 regional is lower), with the change between 2019 and 2024 not uniform across segments.

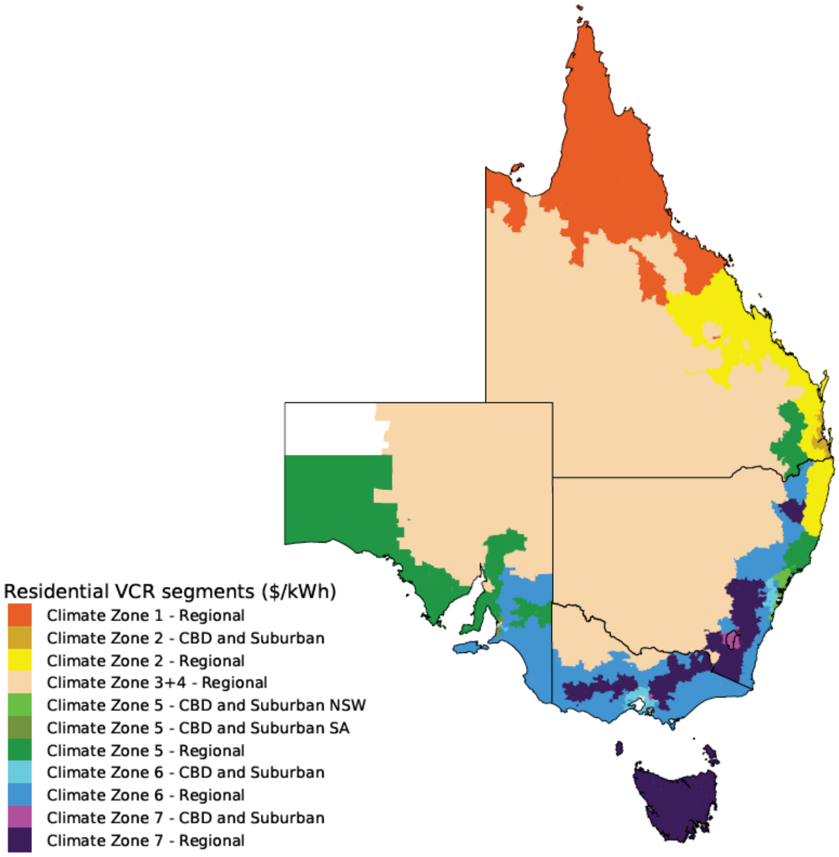
While the main drivers of this change are an increase in residential willingness to pay and a decrease in residential unserved energy, the specific VCR outcomes for each segment are a combination of these movements as well as outage frequencies across a range of different outage scenarios.

The largest changes in state-/territory-level residential VCR occurred in Victoria, ACT and Tasmania (see Figure 17). These outcomes are largely driven by the changes in the residential VCR in some of their residential customer segments, notably, CZ6 CBD & Suburban, CZ6 Regional, CZ7 CBD and Suburban and CZ7 Regional – which are the segments with the coldest climates in our sample. These four segments saw the largest reduction in their estimated unserved energy (17% and more). However, increases in willingness to pay have also significantly contributed to the changes in those segments' VCR, as illustrated in Figure 9.

We have made some observations on potential reasons for movements in willingness to pay between 2019 and 2024 in section 5.1.1. We have also discussed the movements in residential unserved energy and outage frequencies in chapter 4.

The residential VCR results are set out below.

Figure 15 Residential VCR segments

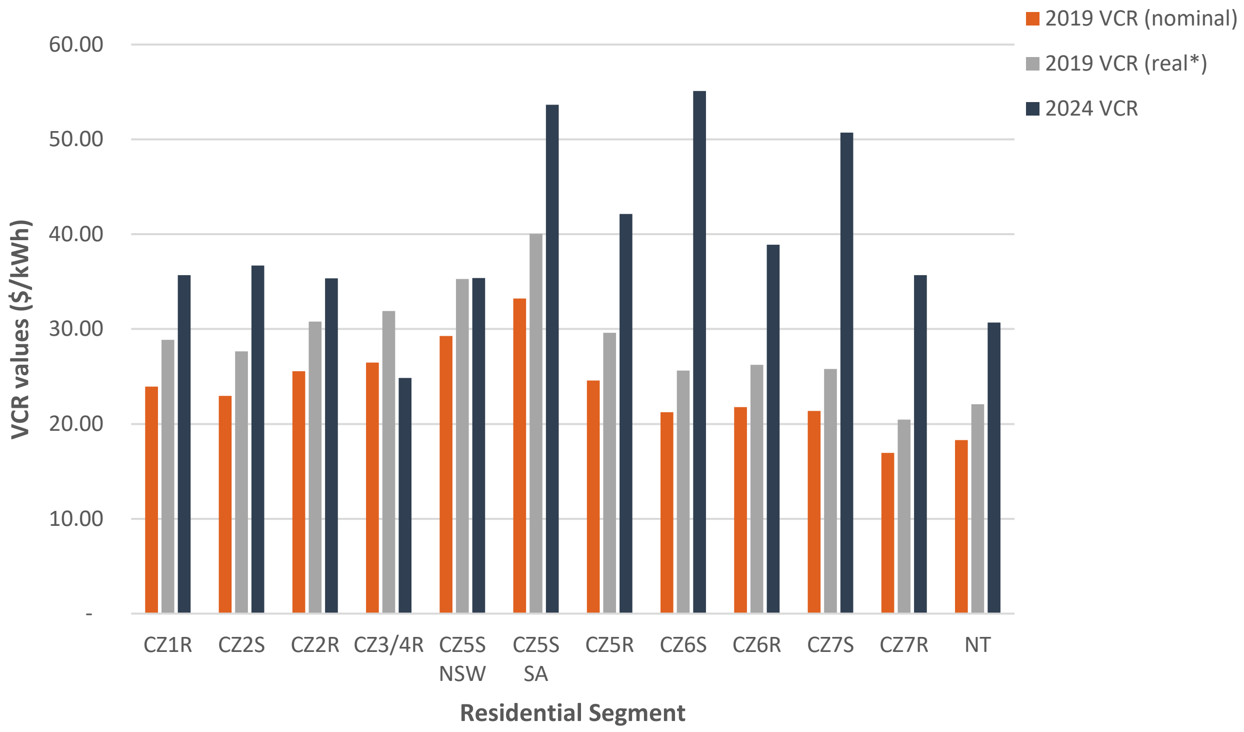


The residential VCR values for 2024 are set out in Table 12 by residential customer segment.

Table 12 Residential VCR values ($2024)

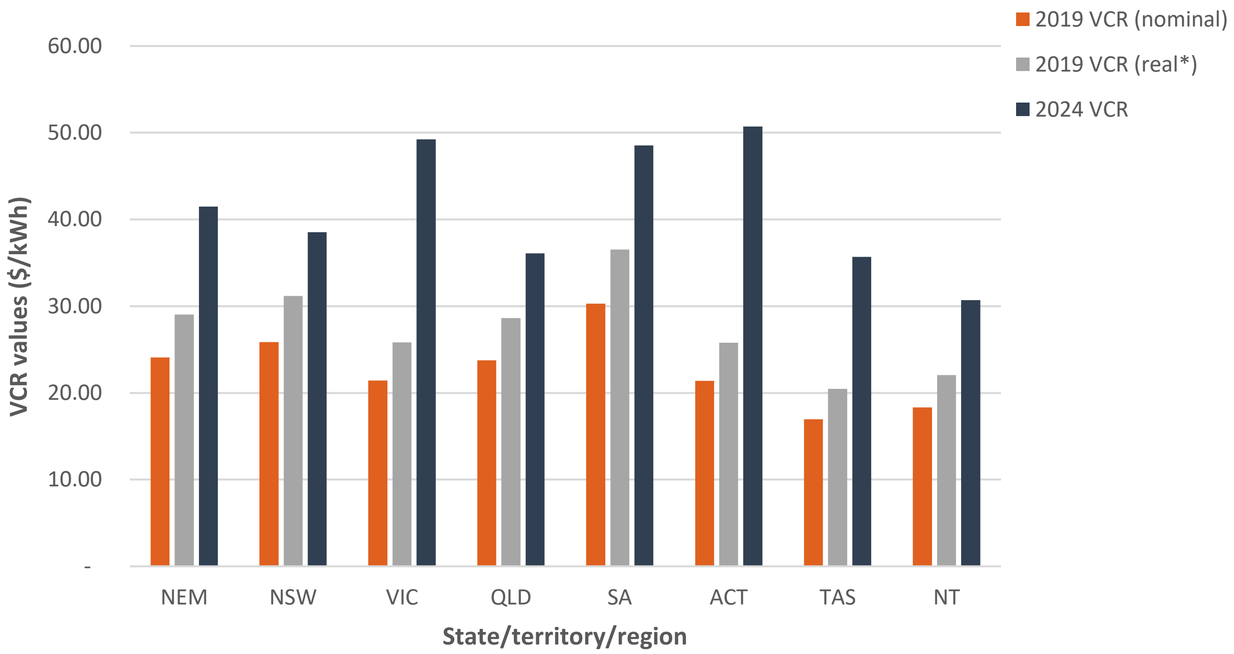
Residential customer segment	Applicable state and territory	Aggregate residential VCR ($/kWh)
Northern Territory	Northern Territory	30.69
Climate Zone 1 Regional	Queensland	35.69
Climate Zone 2 CBD & Suburban	Queensland, New South Wales	36.69
Climate Zone 2 Regional	Queensland, New South Wales	35.35
Climate Zone 3&4 Regional	Queensland, New South Wales, Victoria, South Australia	24.86
Climate Zone 5 CBD & Suburban NSW	New South Wales	35.37
Climate Zone 5 CBD & Suburban SA	South Australia	53.65
Climate Zone 5 Regional	New South Wales, South Australia, Queensland	42.14
Climate Zone 6 CBD & Suburban	Victoria, New South Wales, South Australia, Australian Capital Territory	55.10
Climate Zone 6 Regional	Victoria, New South Wales, South Australia	38.90
Climate Zone 7 CBD & Suburban	Australian Capital Territory, Victoria	50.72
Climate Zone 7 Regional	Tasmania, Victoria, New South Wales	35.69

Figure 16 2024 residential VCR by segment compared with 2019 VCR (nominal) and 2019 VCR (real*)



Note: The 2019 VCR, real ($2024), have been calculated consistent with our annual adjustment mechanism (nominal 2019 VCR multiplied by a ratio of CPI for September 2024 and CPI for September 2019).

Figure 17 2024 Residential VCR by state/territory/region compared with 2019 VCR (nominal) and 2019 VCR (real*)

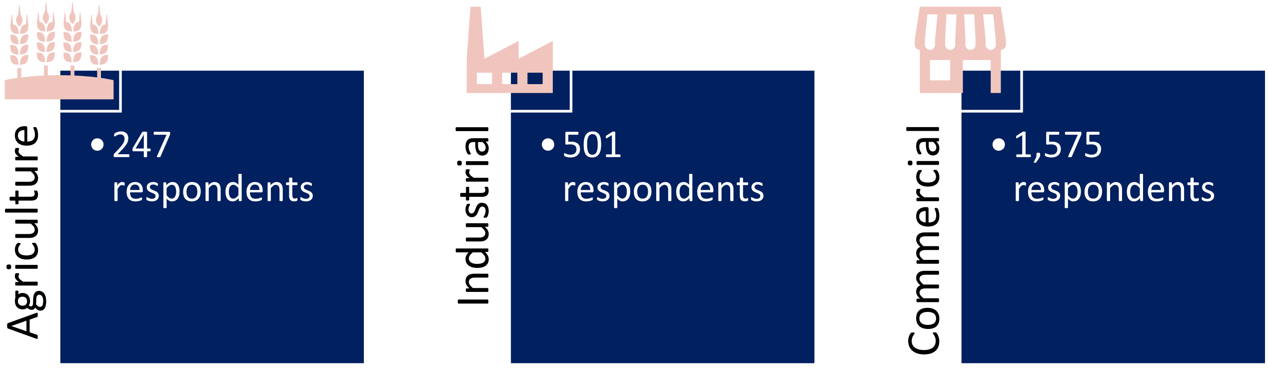


Note: The 2019 VCR, real ($2024), have been calculated consistent with our annual adjustment mechanism (nominal 2019 VCR multiplied by a ratio of CPI for September 2024 and CPI for September 2019).

5.2 Business customers (peak demand < 10 MVA)

Our survey response rates by cohort were consistent with the targets for each cohort that were set out in our sample plan (see chapters 3 and 4 for more information). A breakdown of the responses by business customer segment is provided in Figure 18.

Figure 18 Business survey response numbers by segment



5.2.1 Contingent valuation (willingness to pay)

As can be seen from Figure 19, for business customers, willingness to pay to avoid the baseline outage scenario as a percentage of their bill decreased between 2019 and 2024.

Approximately, 20% of business respondents declared a willingness to pay of zero to avoid the baseline outage scenario compared to around 24% in 2019. Additionally, approximately 2.5% of willingness to pay responses were capped at 100% of the respondent's electricity bill compared with around 4% in 2019.

Given businesses are not a broadly homogenous group – businesses undertake a wide range of activities, even within an industry, and vary significantly in their size, it is difficult to draw meaningful conclusions about drivers of changes in willingness to pay.

We undertook some further analysis of the difference in willingness to pay to avoid the baseline outage scenario between business survey respondents that indicated they had a backup option (e.g., on-site generation, battery cells, backup fuel, etc.) and those that did not.

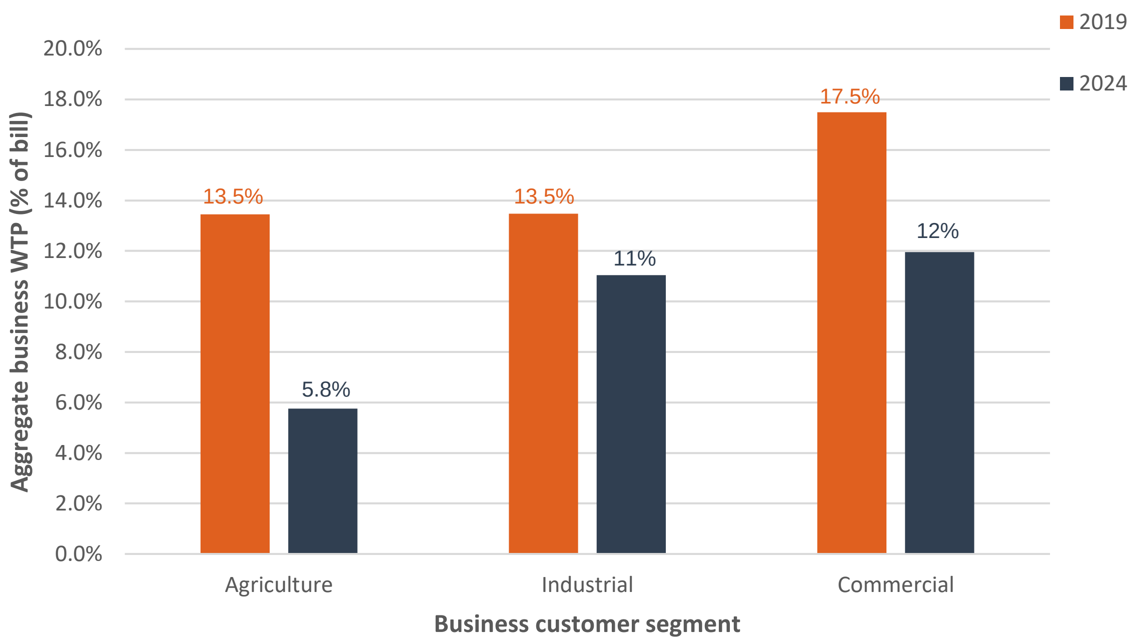
- Across the pooled 2024 business sample, the willingness to pay to avoid the baseline outage is higher for those who answered they had a backup option than for those who did not. We also found this in 2019 (not previously reported).
- While for any individual business adding a backup option would be expected to reduce their willingness to pay (all else equal), the above dot point is not necessarily counterintuitive. It would be consistent with businesses that install a backup option being those who tend to value electricity reliability more than those who do not; so much more that their average willingness to pay as a group remains higher even after getting some form of backup option.
- We had slightly lower proportions of business respondents reporting having backup options in 2024 than in 2019. These lower proportions, combined with the effect of the higher observed willingness to pay (to avoid the baseline outage scenario) for those with

a backup, have contributed a little to the observed reduction in business willingness to pay.

- If the 2019 pooled proportions reporting having a backup option are applied to the 2024 willingness to pay values then the pooled average willingness to pay would be a little higher at ~10.9% vs 10.7%.

We will consider what further analysis might be undertaken in the future to explore the robustness of the survey results and the potential drivers of the change in the willingness to pay for the business cohort.

Figure 19 Business contingent valuation willingness to pay results



5.2.2 Choice experiments (alternative outage scenarios)

Table 13 sets out the attribute estimates derived from the choice modelling results that we included in the calculation of VCR values. The estimate for each attribute is the incremental percentage of bill amount a customer would require to experience that attribute in addition to the baseline outage scenario. For ease of reading, the estimates are expressed in WTP form rather than WTP. As with the residential survey, outage variables were included in the calculation of VCR values where regression coefficients had at least 99% statistical significance and percentage of bill estimates had at least 90% statistical significance. Inclusion of variables that did not meet these criteria was considered on a case-by-case basis.

The choice experiment results derived from the business survey are mixed but are mostly similar to the 2019 AER results and the 2014 AEMO results.

The duration of the outage was found to be the most important factor for all business segments. Compared to 2019, the duration attribute value is higher for agriculture, but mostly lower for the industrial and commercial segments. The season was statistically significant for the agriculture and commercial segments with a preference to avoid a summer outage. Additionally, the weekend and peak outage scenarios were statistically significant for the commercial segment with a preference to avoid weekday and peak outages.

Table 13 Business choice model estimates (% of bill) expressed in willingness to pay form

Outage variable	Agriculture	Industrial	Commercial
Widespread	–	–	–
Duration 3 hours	2.45	0.87[60]	1.53
Duration 6 hours	4.26	1.80	2.40
Duration 12 hours[61]	4.87	1.80	2.40
Peak	–	–	0.32
Summer	1.18	–	0.26
Weekend	–	–	-0.42[62]

5.2.3 2024 VCR

The 2024 business VCR are significantly lower than the 2019 VCR, with the largest decline occurring in the industrial business segment.

This change has been driven primarily by changes in willingness to pay as a proportion of a customer’s bill. As we discuss in chapter 4, estimated unserved energy has increased for most business cohorts, other than large agricultural customers, between 2019 and 2024. However, these changes have been largely offset by changes in customer bills.

While we have made some observations on the residential VCR, it is considerably more challenging to make meaningful observations on the business VCR and movements in the underlying components of the business VCR calculation. This is because businesses are not a broadly homogenous group in the nature and amount of their energy needs – businesses undertake a wide range of activities, even within an industry, and vary significantly in their size. This makes it difficult to draw conclusions about drivers of changes in willingness to pay and consumption. It makes the consistency of sampling more difficult as well. However, we note the reasons why business willingness to pay as a proportion of a customer bill may have declined between 2019 and 2024 could include shifts in business composition and activities, changes in technology and production processes, additional backup options and other factors such as changing economic conditions and cost pressures.

60 This attribute was statistically significant at the 95% level and has been included in the calculation of $/kWh VCR values.

61 For 6hr and 12hr durations the industrial and commercial results were close but had 12hr less than 6hr. In AER 2019 VCR and AEMO 2014 VCR work this occasionally occurred with 12hr slightly exceeding 6hr. We set the coefficients for these durations to be equal in the modelling.

62 For commercial customers weekend outages are preferred to weekday.

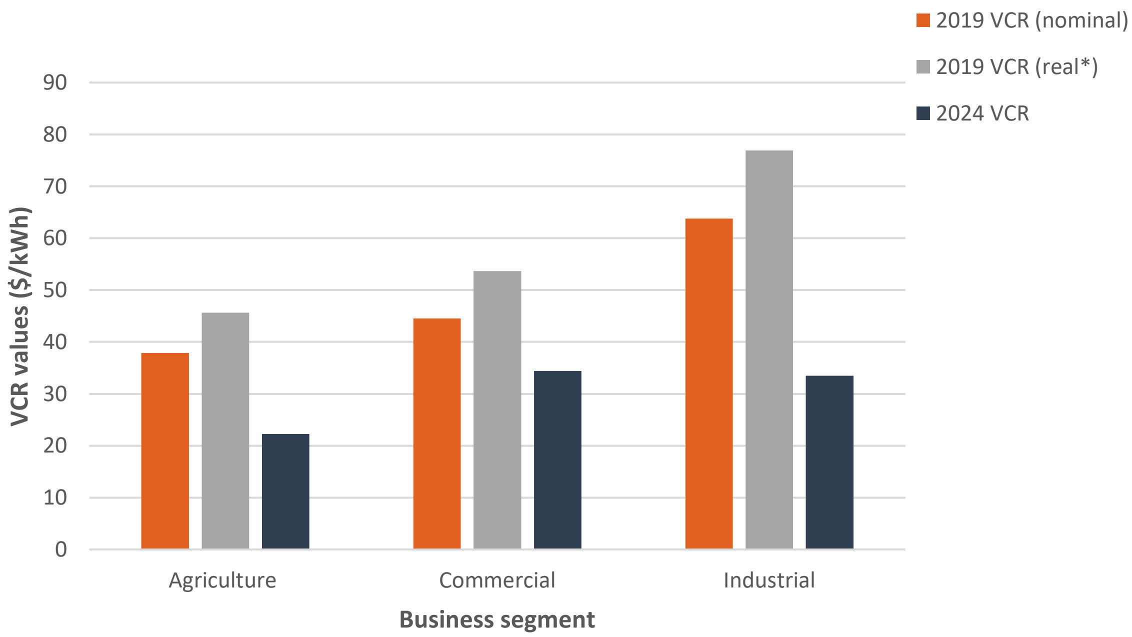
The business VCR values for 2024 are set out in Table 14 by business customer segment. A comparison to VCR values for 2019 values is made further below.

Table 14 Business VCR values

Business customer segment	AER 2024 business VCR ($/kWh)	2019 VCR ($/kWh)	2019 VCR, real* ($/kWh)
Agriculture – Overall	**22.25**	**37.87**	**45.65**
Agriculture – Small and medium	33.15	57.64	69.48
Agriculture – Large	19.45	33.69	40.61
Commercial – Overall	**34.39**	**44.52**	**53.66**
Commercial – Small and medium	52.63	68.29	82.32
Commercial – Large	30.88	39.92	48.12
Industrial – Overall	**33.49**	**63.79**	**76.89**
Industrial – Small and medium	55.96	79.37	95.67
Industrial – Large	32.83	62.86	75.77

Note: The 2019 VCR, real ($2024), have been calculated consistent with our annual adjustment mechanism (nominal 2019 VCR multiplied by a ratio of CPI for September 2024 and CPI for September 2019). The numbers in bold are those reported in the Executive Summary for the relevant customer segment.

Figure 20 Business VCR: comparison to 2019 VCR (nominal) and 2019 VCR (real*)



Note: The 2019 VCR, real ($2024), have been calculated consistent with our annual adjustment mechanism (nominal 2019 VCR multiplied by a ratio of CPI for September 2024 and CPI for September 2019).

5.3 Very large business customers (peak demand ≥ 10 MVA)

The 2024 very large business VCR for three out of four customer segments (industrial, metals and mines) are significantly lower than the 2019 VCR, with only the services segment VCR increasing between 2019 and 2024 (Table 15).

Similar to the business VCR, the varying activities and size of very large businesses, along with changes in the sample composition and characteristics of the business sites that responded in 2024 compared with 2019, make it challenging to draw any conclusions about specific drivers of change in the very large business VCR.

Table 15 Direct cost survey VCR values, $/kWh

Customer segment	2024 VCR ($/kWh)	2019 VCR ($/kWh)	2019 VCR, real* ($/kWh)
Services	33.10	10.54	12.70
Industrial	12.22	117.99	142.22
Metals	5.38	19.86	23.94
Mines	10.63	35.16	42.38

Note: The 2019 VCR, real ($2024), have been calculated consistent with our annual adjustment mechanism (nominal 2019 VCR multiplied by a ratio of CPI for September 2024 and CPI for September 2019).

To calculate the VCR values in Table 15, we first calculated VCR for each outage scenario (10 minutes, 1 hour, 3 hours, 6 hours and 12 hours) for each individual survey respondent. Then, we computed VCR for each segment and for each outage scenario as a weighted average of the VCR of individual respondents in that segment (see Table 16). The weights were based on the respondent’s consumption as a proportion of the total consumption of all respondents in that segment. Finally, to calculate the segment VCR in Table 15, we have computed a frequency-weighted average of VCR for that segment across the 5 outage scenarios (10 minutes, 1 hour, 3 hours, 6 hours, and 12 hours). The outage frequency weights are presented in Table 17.

Table 16 VCR for each outage scenario, $/kWh

Segment	10 min $/kWh	1 hour $/kWh	3 hour $/kWh	6 hour $/kWh	12 hour $/kWh
Services	8.49	11.31	11.82	47.27	188.34
Industrial	114.74	19.32	6.96	3.91	2.41
Metals	9.77	1.94	7.43	3.86	1.98
Mines	41.91	14.10	8.91	7.75	6.70

Table 17 Outage frequency weights

Outage duration	10 min $/kWh	1 hour $/kWh	3 hour $/kWh	6 hour $/kWh	12 hour $/kWh
Weighted frequency in percentage, 2024	4.0%	16.1%	48.4%	24.2%	7.3%

Consistent with 2019, we have grouped the responses into the following segments: services, industrial, metals and mines. We decided on these segment groupings because they corresponded to the segments from which we received survey responses. Although we used the same segments in 2019, the results are not directly comparable to 2019 due to the change in the sample composition and characteristics of the included business sites. A further analysis of these changes is set out in section 5.3.2.

Given the wide differences in the VCR values in the different segments, we would expect that network businesses would undertake their own evaluation of the benefits and costs of future investment to improve the reliability for these large customers, as part of their prudent and efficient business cases.

5.3.1 2024 VCR

There is significant variation in VCR values across the different segments (services, industrial, metals and mines), given that outage costs and the relative importance of outage duration vary greatly depending on the type of business and their reliance on electricity, and the pattern of supply.

The relatively high costs of a 10-minute outage in the mines and industrial segments (see Table 16) reflect the fixed costs of an outage – that is, the unavoidable costs incurred for an outage of any length by some businesses. This suggests that the mines and industrial segments are more sensitive to the initial phase of an outage but experience diminishing $/kWh costs as outage duration increases. For example, procedures undertaken to restart a plant after an outage may take a certain amount of time to execute, possibly exceeding the length of the outage itself. This pattern is particularly pronounced among industrial businesses.

The dynamics for the metals and services segments are somewhat different. As Table 16 shows, $/kWh values for services increase with outage duration, with 12-hour outages being especially costly. The dynamics of the $/kWh values for the metals category suggest that for some businesses, outage costs substantially increase once an outage lasts longer than a certain period of time (3 hours).

Table 18 shows how outage cost for each outage scenario contribute to the overall sector-specific VCR (last column). The $/kWh entries for each outage scenario are a product of the $/kWh values from Table 16 and the corresponding outage frequency weight (Table 17). The last column ('Total of all durations') is the VCR for each sector, computed as a sum of the outage-frequency-weighted $/kWh values across outage scenarios.

Table 18 Outage frequency weighted $/kWh VCR

Segment	10 min $/kWh	1 hour $/kWh	3 hour $/kWh	6 hour $/kWh	12 hour $/kWh	Total of all durations
Services	0.34	1.82	5.71	11.43	13.80	33.10
Industrial	4.62	3.11	3.36	0.94	0.18	12.22
Metals	0.39	0.31	3.59	0.93	0.14	5.38
Mines	1.69	2.27	4.31	1.87	0.49	10.63

Once the effect of outage frequency weighting is factored in, we observe that longer-duration outages (3 hours or more) contribute more to services VCR. For the industrial segment, the impact of shorter-duration outages dominates the result, whereas for mines and metals costs of 3-hour outages contribute the most to the corresponding segment VCR figures.

Sample characteristics

In the financial year 2023–24, around 200 sites met the consumption threshold of 10 MVA peak demand, making them eligible for the survey. We received 64 completed responses, of which 37 met our criteria to be included in the VCR calculations.[63] One of these businesses (of 37) does not operate 24 hours a day. All 37 responses included estimated outage cost data and permission to obtain the sites' consumption information, enabling us to calculate the VCR values. The survey responses were segmented as follows to produce each business segment VCR number:

- Mines: 15
- Metals: 4
- Services: 4
- Industrial: 14.

Outage cost findings

In the survey, we sought to better understand and contextualise the outage costs businesses expect to incur and how they manage them. The main costs reported were for lost production, equipment damage, operational labour and idle labour during an outage.

Backup power installation and use

- 76% of businesses (in our sample of 37) have installed some form of a backup power system, such as a battery or generator. However, only 3% of businesses that have not installed backup power systems plan to do so in the next 5 years. 22% of businesses have no further plans to install any form of a backup power system. Among businesses that have installed a backup power system, 21% use a battery system, while 11% plan

63 Examples of such criteria: the requirement for the responses to be complete and contain respondent's consent for the collection of their consumption data; the requirement that the reported dollar costs for longer duration outages are at least as high as for shorter duration outages; the requirement that the reported costs are direct costs for the relevant electricity user and not for other parties (e.g., do not include broader economic impacts).

to install one in the next 5 years. 25% of businesses have alternative energy sources installed, and 93% have no further plans to install alternative energy sources.

- The primary reasons for using a backup power system reported by survey respondents were to protect essential equipment from damage during outages and to safely wind down operations. A smaller proportion of businesses use backup power systems to maintain normal operations.

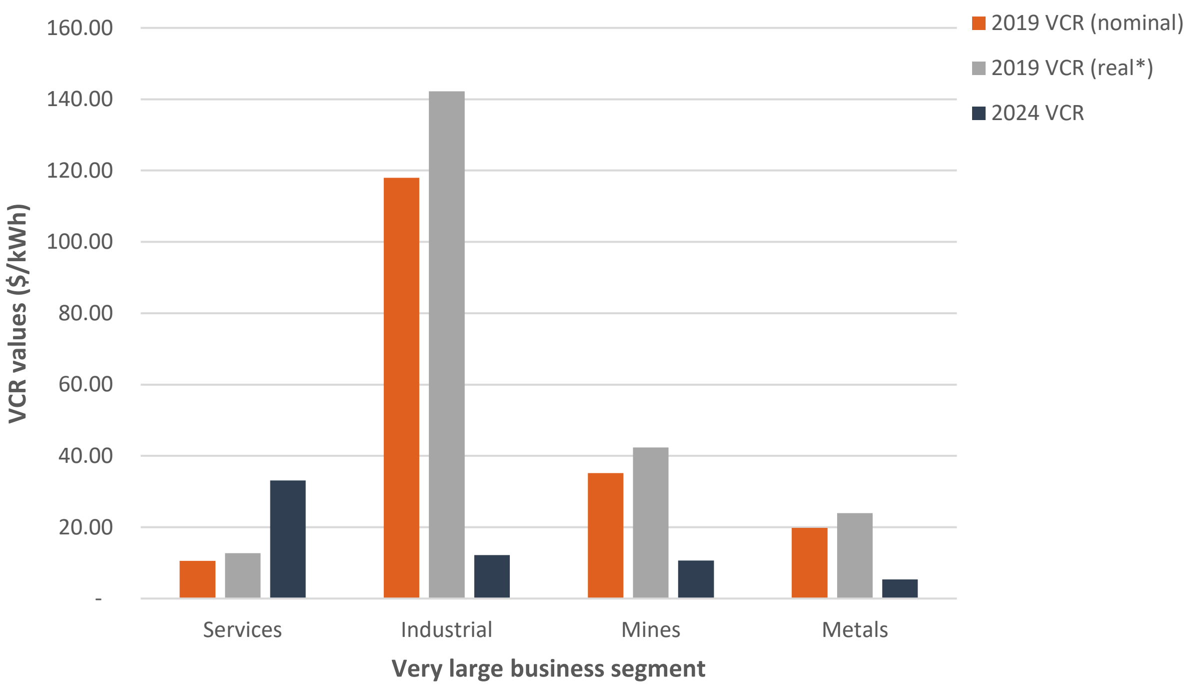
Outage incidents

- 27% of businesses reported that they did not experience an outage lasting 10 minutes or more in the past 12 months. Of the remaining 73%, 8 businesses reported receiving information about the outages they experienced, which helped them manage or reduce outage costs.

5.3.2 Variations from AER's 2019 direct cost survey results

We have used the same calculation method as we did in our 2019 review to calculate direct cost survey VCR values, which was used by AEMO in 2014.

Figure 21 Very large business VCR: comparison to 2019 nominal and VCR 2019 (real*)



Note: The 2019 VCR, real ($2024), have been calculated consistent with our annual adjustment mechanism (nominal 2019 VCR multiplied by a ratio of CPI for September 2024 and CPI for September 2019).

The differences between our 2019 and 2024 very large business VCR have been driven by a number of factors. While we have a similar sample size in 2024 to the 2019 sample size, the sample composition for each segment in 2024 is substantially different from 2019. The reported outage costs and consumption levels have also changed, including for the respondents that participated in both 2019 and 2024 surveys. Changes in our estimates of outage frequencies also contributed somewhat to the differences, as the relative frequency weights of 3-hour and 6-hour outages are higher and the relative weight of 1-hour outages is lower in 2024 than in 2019.[64]

While the 2024 VCR values are not directly comparable with those from 2019, we observed that overall results were lower, with the exception of the services segment, which showed a higher VCR. Several factors may explain these differences.

General observations

- The survey sample composition has differed significantly between 2019 and 2024, with only around 20% of the respondents in the 2024 sample also included in 2019 sample.
- Further, inputs for those respondents that participated in both surveys have also changed. Those users generally have higher consumption in 2024 (much higher in some cases) and most of them have reported lower outage costs. This has contributed to lower overall 2024 VCR results. This effect was particularly stark for the industrial segment. For those large businesses that took part in both the 2019 and 2024 survey, in some instances we found evidence that patterns of usage and redundancies to deal with outages have developed considerably over the last five years.
- Average annual electricity consumption per respondent has also increased compared to 2019, across the entire 2024 sample, as well as within each segment other than mines. This increase generally dominated the change in reported costs and has further contributed to lower VCR (other than for the services segment).
- Some of the respondents that had a large impact on the 2019 VCR outcomes are not in the 2024 sample.
- Outage frequency weights in 2024 have shifted away from 1-hour outages and towards 3-hour and 6-hour outages relative to 2019. If the weights were the same as in 2019, the industrial, services and mining sector VCR would have been slightly higher and metals VCR – slightly lower.

Segment-specific insights

- **Services segment:** This segment reported much higher estimated costs and annual energy consumption than in 2019, largely due to a more diverse sample size. Notably, the inclusion of transport services – which was not part of the 2019 results – contributed to the higher reported costs because these businesses typically incur significant expenses during outages.
- **Industrial segment:** This segment included manufacturers and diverse businesses with highly variable costs, some reporting substantial fixed costs regardless of outage duration. Similar to 2019, businesses in this sample were recorded as having average energy consumption less than 10% of the average for metals businesses. The combination of high costs and lower energy consumption contributed to a relatively high VCR value. The changes in the industrial segment VCR between 2019 and 2024 are driven by both differences in sample composition and large changes in inputs for the respondents that were part of both 2019 and 2024 samples.

---

64 Please see section 4.3.3 for more detail on how we estimated the outage frequencies.

- **Metals segment:** Relatively higher energy consumption compared with reported costs resulted in a relatively low VCR. The 2024 VCR decreased compared with 2019 and the sample size is half that of 2019. This included some respondents that had a large impact on the 2019 VCR for metals no longer being part of the sample in 2024.
- **Mines segment:** The VCR values decreased in 2024 due to a largely different sample composition. Unlike 2019, where both transmission-connected and distribution-connected businesses were included, the 2024 sample contained only distribution-connected sites. Additionally, the average consumption per respondent also decreased from 2019, reflecting smaller-scale operations in the current sample. There were also fewer respondents with relatively high fixed costs in the 2024 sample. Therefore, the shift in both composition and cost structure helps explain the observed differences.

5.3.3 Transmission-connected and distribution-connected customers

To calculate the transmission and distribution VCR values (Table 19), we calculated the load weighted average of VCR for the transmission-connected respondents and distribution-connected respondents, respectively, following a similar process to that for calculating segment-specific VCR.

Table 19 Transmission and distribution VCR values

Segment	$/kWh VCR values
Distribution	10.88
Transmission	7.04

Note: These values were calculated using load weighted average.

5.4 NEM-wide and regional VCR

We calculate the NEM and regional VCR, which are developed to reflect a broader range of customers in the NEM or within a particular state/territory. Our aggregate VCR are set out in Table 20.

Table 20 NEM-wide and regional VCR

NEM region	AER 2024 VCR ($/kWh)	2019 VCR ($/kWh)	2019 VCR, real* ($/kWh)
New South Wales + Australian Capital Territory	30.93	42.12	50.77
Victoria	35.78	41.21	49.68
Queensland	25.75	40.03	48.25
South Australia	33.32	43.23	52.11
Tasmania	18.99	32.16	38.76
NEM	30.00	40.99	49.41

Note: The 2019 VCR, real ($2024), have been calculated consistent with our annual adjustment mechanism (nominal 2019 VCR multiplied by a ratio of CPI for September 2024 and CPI for September 2019).

5.5 Annual adjustment

Our VCR methodology must include a mechanism for annually adjusting the VCR between VCR updates.[65] As this mechanism forms part of the VCR methodology, we must review it and, if required, update it before we update the VCR.[66] This means we had to finalise the annual adjustment mechanism for the 2024 VCR before we had the opportunity to consider the 2024 VCR outcomes and compare the movements in the VCR between 2019 and 2024.

We have considered the annual adjustment mechanism and sought stakeholder views on it as part of our review of the VCR methodology, which we completed on 30 August 2024. This included seeking stakeholder feedback on:

- what approach to annual adjustment might better reflect the ongoing changes in the energy sector and the broader economy
- how we can implement such an approach in practice
- whether conducting VCR reviews more frequently may be preferable to making changes to the current annual adjustment mechanism.

Many stakeholders supported incorporating electrification-related factors (such as EV or rooftop solar ownership, reliance on gas, etc.) into our annual adjustment mechanism.[67] On the other hand, Ergon Energy and Energex supported the current CPI annual adjustment mechanism, noting it was transparent, replicable and most importantly cost effective to carry out. They noted that a more refined annual adjustment mechanism would make little difference to the VCR and the preferred option in a regulatory investment test (RIT)

---

65 NER, Rule 8.12.

66 NER, Rule 8.12.

67 AusNet, Submission on revised draft determination [letter], 2024; Ausgrid, Submission on revised draft determination [letter], 2024; CitiPower, Powercor and United Energy, Submission on revised draft determination [letter], 2024; Evoenergy, Submission on revised draft determination [letter], 2024; SA Power Networks, Submission on revised draft determination, 2024.

assessment because the adjustment would likely be immaterial and would be used consistently across all possible RIT options.[68] Several stakeholders (SAPN, Ausgrid, EUAA, JEC and Bartley Consulting) stressed the importance of stakeholder consultation in developing an annual adjustment mechanism and more broadly.[69]

We carefully considered available alternative annual adjustment approaches, taking into account stakeholder feedback, but did not identify a feasible alternative that would improve accuracy of the resulting VCR or be more fit for purpose.[70] As such, we decided to use the same annual adjustment mechanism as was in the 2019 VCR methodology but removed the X factor from the 2024 VCR methodology rather than setting it at 0. This mechanism involves adjusting the published VCR values on an annual basis by the Consumer Price Index (CPI).

Our rationale for adjusting the VCR by CPI was that it ensures, in economic terms, that the real values of VCR are maintained between VCR reviews. However, the construction of annual adjustment mechanism in this way means it will not capture other changes that may drive movements in the VCR over time.

As we have largely kept our 2019 methodology unchanged for the 2024 VCR update, we can now make observations on how the 2024 updated VCR for different customer categories compare to the 2019 VCR. These include:

- For residential customers, the 2024 VCR by segment are all higher than the 2019 CPI adjusted result, with one exception (Climate Zone 3 and 4 regional)
- For business customers, the 2024 VCR are significantly lower than the 2019 CPI adjusted result in all cases
- For very large business customers, the 2024 results are significantly lower than 2019 CPI adjusted, with the exception of the services segment.

This means that while the annual adjustment maintained the value of these aggregate 2019 VCR, the 2024 VCR results show that business and very large business customers' actual aggregate VCR have fallen in real terms over that period.

While such ex-post analysis does not imply that the same dynamics would reoccur in the future, it shows the issue of annual indexation warrants further consideration. In early 2025, we intend to engage with stakeholders to reflect on the learnings from our 2024 update and to identify some key themes for future research. These themes may include exploring the trends in unserved energy over time and the use of different annual adjustment mechanisms for different components of the VCR (for example, willingness to pay and unserved energy). Once we have developed our understanding further and explored this issue with stakeholders, we will consider the implications for our forward VCR work program, including the timing of the next VCR review.

---

68 Ergon Energy and Energex, Submission on revised draft determination [letter], 2024.

69 Meeting with Energy Users Association of Australia (EUAA) and Bartley Consulting on 19 June 2024; meeting with Ausgrid on 24 June 2024; meeting with SA Power Networks on 2 July 2024; and meeting with Justice and Equity Centre (JEC) on 10 July 2024.

70 AER, *Values of customer reliability methodology - final determination*, Australian Energy Regulator, 2024.

6 Validation and robustness of results

This chapter outlines the different methods employed to sense check the VCR inputs and results, including:

- cognitive testing of the survey questionnaires
- survey recruitment and data collection
- data validation and cleaning
- validity checks
- quality assurance
- sample demographic checks against general population statistics.

6.1 Cognitive testing

Our consultant, Lonergan Research, undertook face-to-face cognitive testing on the residential pilot survey questionnaire. Participants were asked to describe what they were thinking as they answered each survey question as well as what they considered when forming their response. Further, each question and block of text in the survey was given a score out of 10 based on comprehension and ease of answering.[71]

Taking into account feedback, we made some small edits to the surveys. This testing helped us to ensure that the questions were measuring what we intended to measure and that there were no difficulties with respondents' comprehension.

6.2 Survey recruitment and data collection

Data collection for the residential and business VCR surveys was conducted via online surveys. Lonergan Research used a mixed methodological approach to recruit respondents for the surveys, which used both online panels and computer-assisted telephone interviewing (CATI).

The online panel agencies used for recruitment were Pureprofile, WALR and Octopus Group, all of which are Australian-based, while CATI recruitment was done by Lonergan Research.

Panel members were recruited based on location parameters for the residential survey and within industry type for the business survey. As standard practice with research panels, all participants recruited received an incentive for completion.

Fieldwork for the residential and business surveys were conducted between 3 September and 9 October 2024.[72]

---

[71] More information on the cognitive testing validation and the pilot surveys is provided in Lonergan's pilot survey report, AER Values of Customer Reliability 2024 – Pilot: Methodology report.

[72] For more information, see Lonergan's main survey report, *3233 AER Values of Customer Reliability 2024: Methodology report*, which is available on the AER's VCR webpage.

6.3 Data validation and cleaning

The panel providers were aware of each other, enabling them to exclude respondents that appeared across multiple panels. Before entering the survey, respondents to both residential and business surveys were pre-validated by the panel providers. This validation process involved double opt-in email verification, as well as digital fingerprinting to identify fraudulent data based on location, language and device.

Further to this, in-survey digital fingerprinting and cookie capture were used to ensure the validity of respondents. Data quality checks were performed after soft launch of the residential and business surveys to confirm correct programming and ensure validity and quality.

Lonergan Research also cleaned the data, consistent with our instructions, to remove:

- incomplete responses
- fast responders (that is, respondents who completed the survey in under 3 minutes)
- responses identified as duplicate responses.

Prior to analysis we also removed respondents who failed an internal to the survey quality assurance question.

6.4 Quality assurance

We undertook extensive quality assurance on our VCR results, calculations, code and input data. This included:

- internal cross checking of calculations, code and input data
- specialist advice and quality assurance provided by our consultants, Lonergan Research and Synergies/CaPPRe.

6.5 Validity checks

We also considered whether the data from the residential survey had ‘face validity’ or made sense.[73] We compared the willingness to pay of different residential electricity customers to see whether the survey results were consistent with what we might reasonably assume.

Broadly, we found these comparisons were consistent with our expectations, and we consider this lends face validity to our survey data. For example, residential owners of electric vehicles and those who live more comfortably are willing to pay more for reliability than other customers.[74]

6.5.1 Electric vehicle status

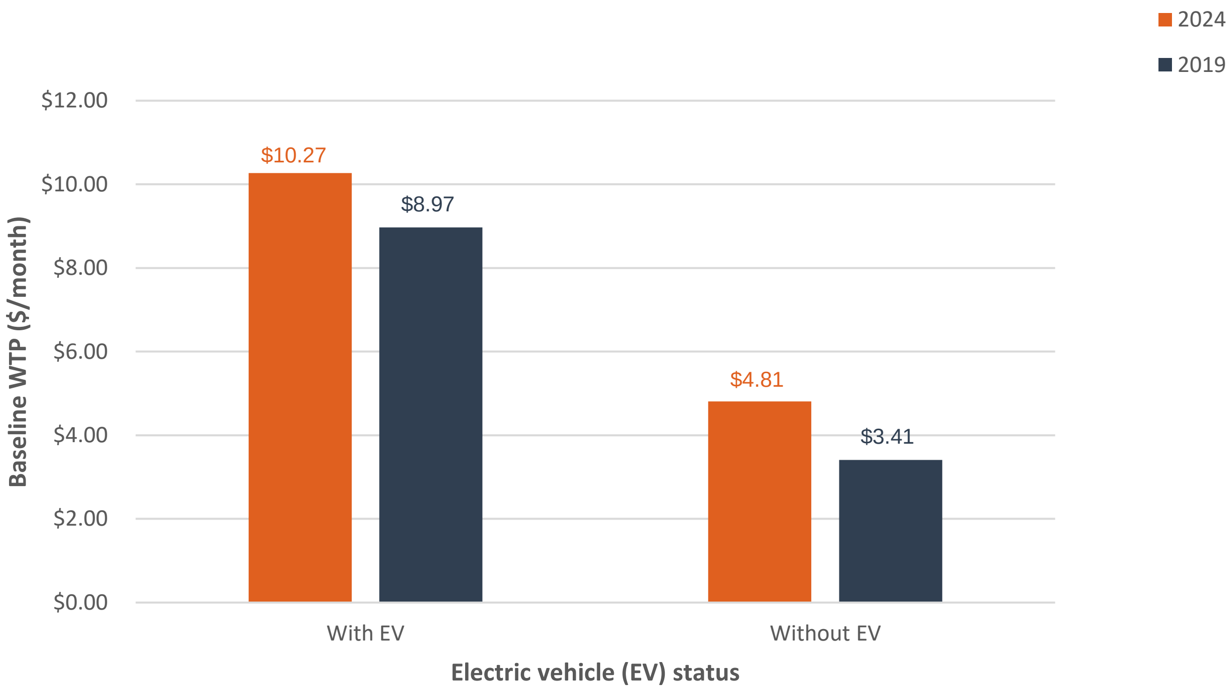
Our analysis of the willingness to pay results found that residential customers with electric vehicles had a higher willingness to pay than those who did not own an electric vehicle. This result may reflect that residential customers who have an electric vehicle are likely to be

73 Face validity is a term used in the survey industry to test whether a survey result accords with reasonable expectations of a likely result.

74 Exact figures from the charts presented in section 6.5 can be found in Appendix D.

more reliant on a reliable electricity supply for some of their transport needs than residential customers who do not have electric vehicles. However, it is also possible customers with electric vehicles may have a higher willingness to pay for other reasons too (such as socioeconomic status).

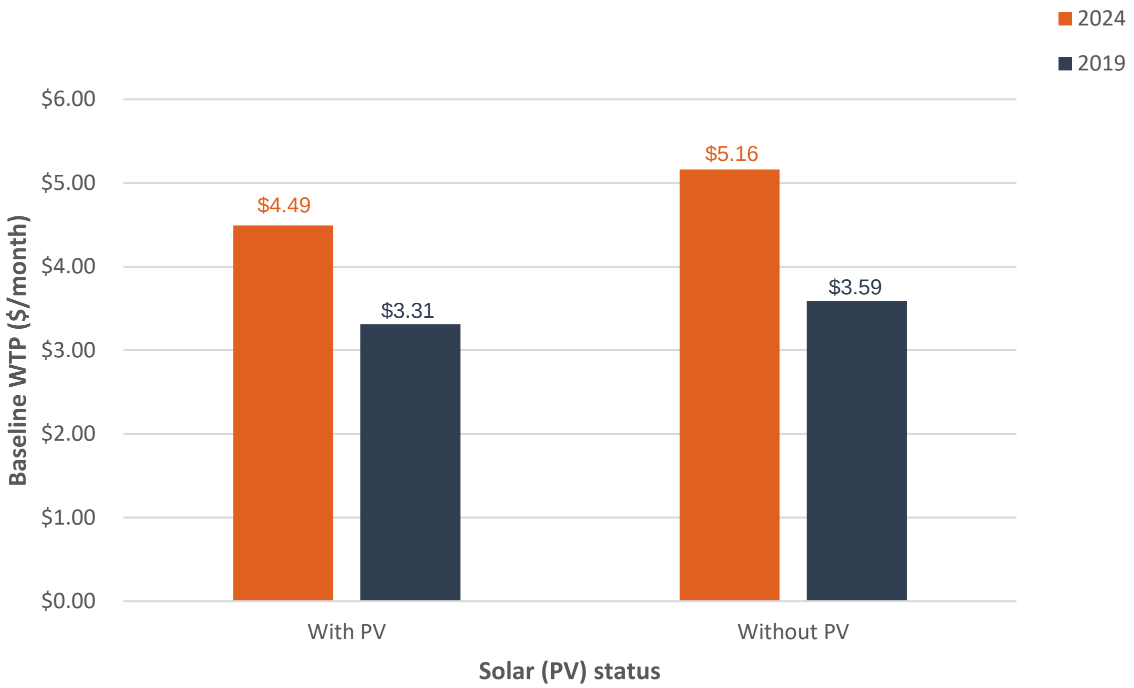
Figure 22 Electric vehicles (residential customers) willingness to pay ($/month, nominal)



6.5.2 Solar PV status

We found that customers without solar PV had a higher willingness to pay than customers with solar PV. This may reflect that some customers with solar PV may not be aware that many solar PV systems do not work when there is an electricity outage. As such, these customers are less willing to pay to avoid an outage as they think their solar PV system will still work and that they will have access to some electricity during an outage.

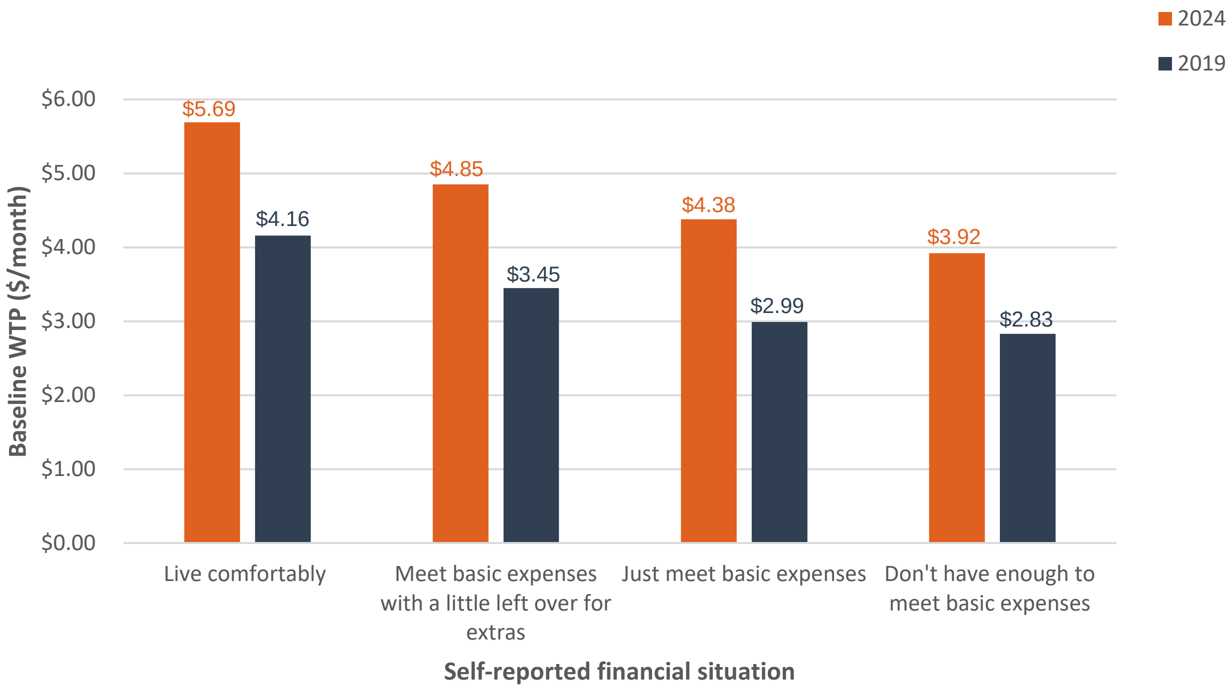
Figure 23 Solar PV status (residential customers) willingness to pay ($/month, nominal)



6.5.3 Current financial situation

We found those who reported that they lived comfortably had a higher willingness to pay than those who reported that they did not have enough to meet basic needs.

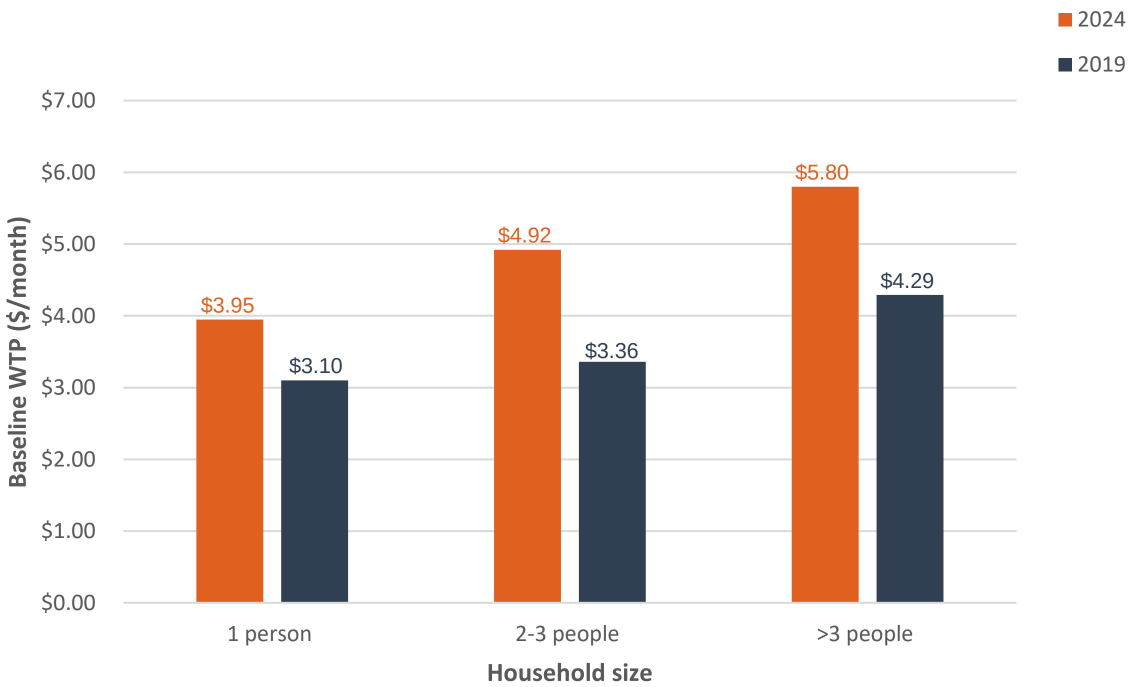
Figure 24 Current financial situation (residential customers) willingness to pay ($/month, nominal)



6.5.4 Household size

We found willingness to pay tended to increase with household size.

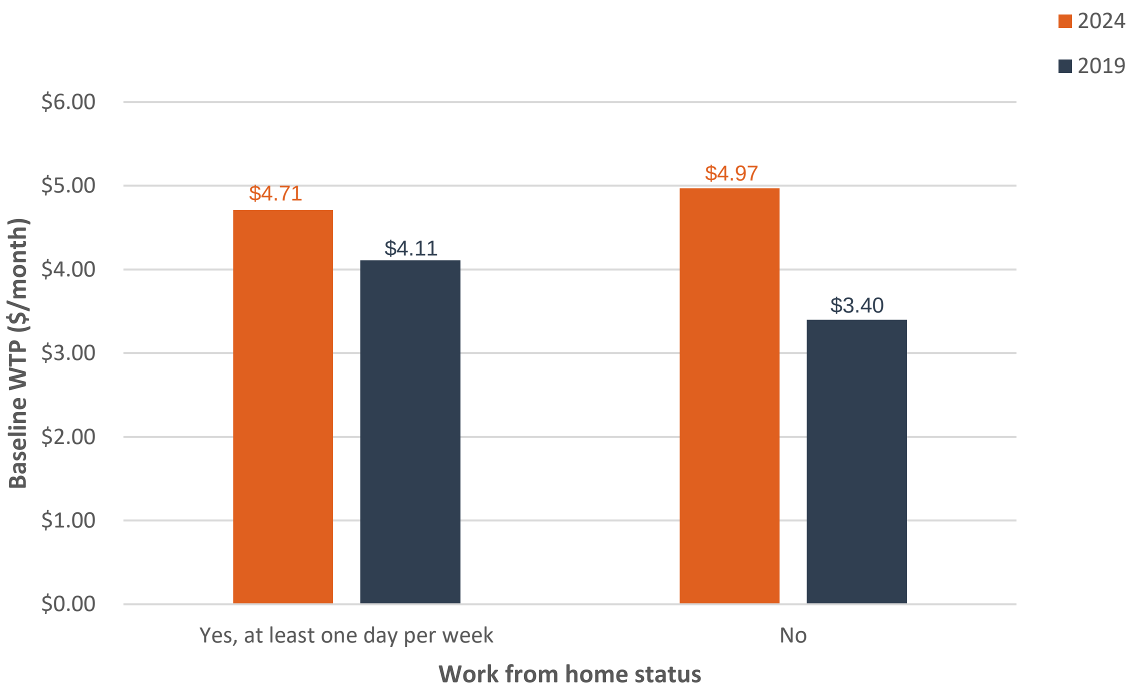
Figure 25 Household size (residential customers) willingness to pay ($/month, nominal)



6.5.5 Work from home status and frequency

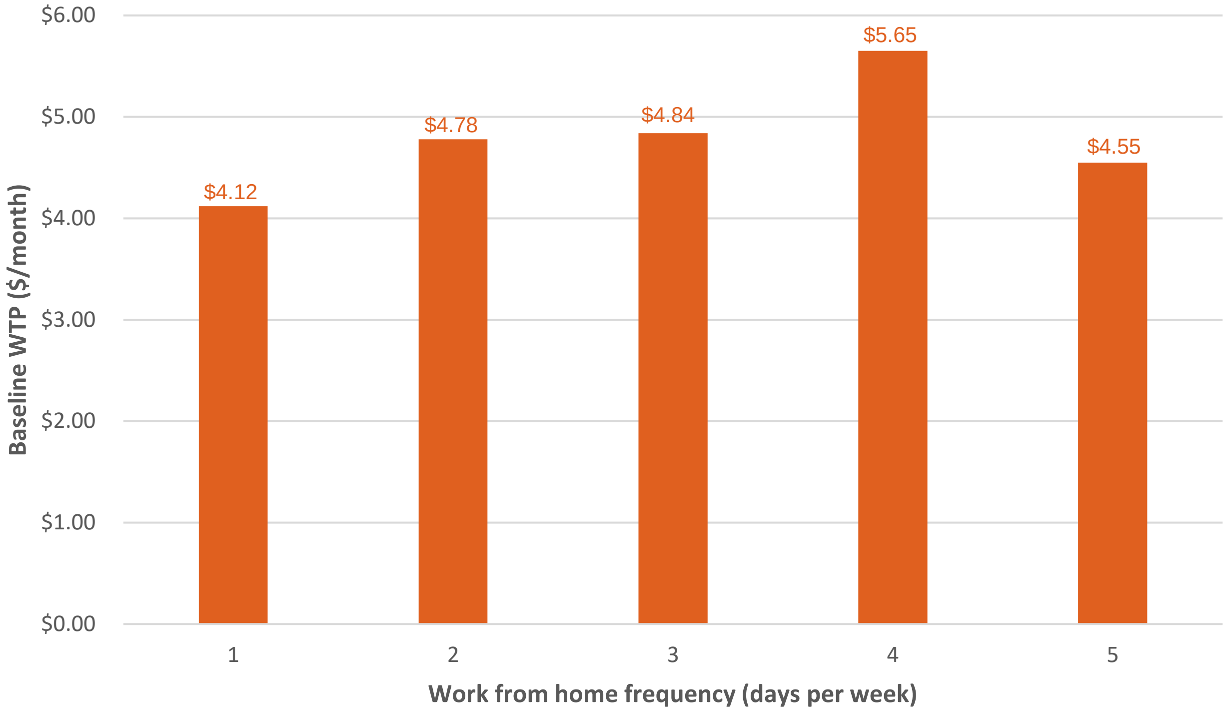
We found people who did not work from home at all had a higher willingness to pay than people who worked from home at least one day per week. The difference in willingness to pay between these two cohorts may reflect the inclusion of a broader range of customers in the 'not working from home' cohort including people who do not work (retirees, unemployed people and other people who are not active in the workforce). It is possible some of these customers may place a higher value on reliability than customers who work, but never from home.

Figure 26 Work from home status (residential customers) willingness to pay ($/month, nominal)



Of the customers who worked from home at least one day per week, we found those who worked from home more frequently generally had a higher willingness to pay than those who worked from home less frequently.

Figure 27 Work from home frequency (residential customers) willingness to pay ($/month, nominal)



Note: This was a new question in 2024 so there is no 2019 data.

7 Next steps

Our reliability and resilience work will continue following the completion of the 2024 VCR review and the 2024 VNR Review (which focused on a subset of prolonged outages that fall outside the scope of the VCR).

Developing the VCR methodology has been an iterative process since AEMO developed the first VCR methodology for the NEM in 2014. In 2019 we developed a VCR methodology that built on AEMO's methodology and in 2024 we reviewed and updated the VCR methodology to make further improvements.

The estimates we have published are the best available that are consistent with largely maintaining the methodology between the two reviews in 2024 and 2019.

We are now in a better position to review how the methodology could be improved to be more robust over time, particularly given the significant changes underway in wider trends in electricity consumption and the opportunities to install backup power in the form of onsite generation and storage. We expect that changes in consumer attitudes and preferences are also changing, with respect to the value of grid supplied electricity.

There is also greater attention being paid to estimation techniques, given the importance of efficient investment during the energy transition.

In 2025, we will commence further work on the VCR and this work will focus on:

- examining the learnings from our 2024 VCR review, including the impacts of changes in sampling composition in the business surveys
- the annual adjustment mechanism
- the additional work and analysis that may need to be undertaken in advance of the next VCR review, to understand trends in increased reliance on electricity, the opportunities and barriers to self-generation and backup power and drivers of willingness to pay and how this informs future methodologies such as using surveys, modelling approaches and deliberative forums
- the frequency of further updates to the VCR.

We will consult with stakeholders as necessary on these issues.

Glossary

Term	Definition
ABS	Australian Bureau of Statistics
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
ANZSIC	Australian and New Zealand Standard Industrial Classification
CaPPRe	Community and Patient Preference Research
CBD	Central business district
CPI	Consumer Price Index
kWh	Kilowatt hour
MVA	Megavolt ampere
NEL	National Electricity Law
NEM	National Electricity Market
NEO	National Electricity Objective
NER	National Electricity Rules
NSP	Network service provider
RIN	Regulatory information notice
Solar PV	Solar photovoltaic
Synergies	Synergies Economic Consulting
VCR	Values of customer reliability
WTP	Willingness to pay
$/kWh	Dollars per kilowatt hour

Appendices A to C, E and F

For appendices A to C, E and F please refer to the separate files uploaded on our website.

Appendix	Content
Appendix A	VCR values – Residential
	VCR values – Business
Appendix B	Detailed VCR – Residential
	Detailed VCR – Business
	Outage frequencies – Residential
	Outage frequencies – Business
	Consumption – Residential
	Unserved energy – Residential
	Consumption – Business
	Willingness to pay – Residential and Business
	Choice experiment – Residential
	Choice experiment – Business
	Load weightings – Residential and Business
Appendix C	Survey sample – Residential
	Survey sample – Business
Appendix E	Residential VCR by Postcode
Appendix F	Map of residential VCR segments

Appendix D – Climate zone and remoteness mapping

Mapping climate zones to postcodes

The ABCB has mapped climate zones to each LGA in Australia and we have used this mapping as the starting point for mapping climate zones to postcodes. For our mapping, we made two key changes:

- Climate Zone 8 (alpine) was incorporated into Climate Zone 7 (cool temperate).
- LGAs that were assigned 2 different climate zones by the ABCB were assigned the climate zone that occupies the majority of the area within the LGA.

This approach resulted in each LGA being assigned to one of 7 climate zones.

We then used an ABS coding index that maps postcodes to LGAs to assign a climate zone to each postcode. This approach resulted in each postcode located within the National Electricity Market being assigned one of 7 climate zones.

We also made a small number of further manual adjustments to climate zone designations for some postcodes reflecting that some postcodes in the NEM:

- are unincorporated and do not have an LGA
- do not appear in the ABS coding index.

For these postcodes we assigned the same climate zone as the neighbouring postcodes in a manner that is most consistent with the ABCB Climate Zone mapping.

Mapping remoteness to postcodes

We used ABS data to map remoteness to postcodes. This data provides the proportion of land within each postcode falling into one or more of 5 remoteness categories. These remoteness categories are based on the Accessibility and Remoteness Index of Australia (ARIA+) produced by the Hugo Centre for Migration and Population Research at the University of Adelaide. The remoteness categories are Major Cities of Australia, Inner Regional Australia, Outer Regional Australia, Remote Australia and Very Remote Australia. Where a postcode has areas falling into multiple remoteness categories, we assigned the postcode to the remoteness category where most of the households resided. We have subdivided the Major Cities of Australia remoteness category into CBD and suburban subcategories and have designated particular postcodes with the CBD category based on discussions with network service providers and feeder location data provided by NSPs.

Differences between the 2019 and 2024 mapping approaches

Because neither climate zones nor remoteness areas are originally constructed from postal areas, some postcodes cross multiple climate zones and remoteness areas. In 2019, we allocated these postcodes based on the ‘lowest’ applicable of each; in effect, this was the warmest climate zone and least remote classification. This rule was based on the method used in the source for estimating unserved energy in 2019 (ACIL Allen’s electricity consumption benchmarks for residential customers).

For 2024, we have used a slightly different method, allocating a postcode to the segment where that postcode has the highest number of its dwellings.[75] For example, if a postcode has 200 dwellings, with 50 in climate zone 5, 70 in climate zone 6 and 80 in climate zone 7, it was allocated to climate zone 7. The same process was used for classifying remoteness.

75 ABS ASGS census count data was used to determine the number of dwellings.