Issues Paper

Value of Network Resilience 2024

May 2024

AUSTRALIAN ENERGY REGULATOR

Inquiries about this publication should be addressed to:

Australian Energy Regulator
GPO Box 3131
Canberra ACT 2601
Tel: 1300 585 165

AER reference: 16677721

Amendment record

Version	Date	Pages
1	8 May 2024	26

Contents

1 Introduction 1

2 Background 6

2.1 VCR and other outages 6

2.2 AER guidance note on network resilience 8

2.3 Recent network proposals and AER decisions 9

2.4 Extreme weather events, jurisdictional response and the ECMC request 11

3 Approaches to VNR 12

3.1 Characteristics, unserved energy, information sources and assessment criteria 13

3.2 Identified potential approaches 14

3.3 Option 1 - Using rational alternatives as a limit 15

3.4 Option 2 - Using a multiple of the VCR for standard outages 16

3.5 Option 3 - Extrapolating the VCR for standard outages beyond 12 hours 17

3.6 Option 4 - Conducting follow-up surveys to actual prolonged outages 18

3.7 Option 5 - Using modelling to estimate a value 19

3.8 Option 6 - Exploring other cost data 20

4 Review engagement plan 22

5 Summary of questions 23

Glossary 26

1 Introduction

Electricity networks face growing challenges from the increasing frequency and severity of extreme weather events. Resilient networks effectively withstand and recover from disruptions including extreme weather events. The Australian Energy Regulator (AER) has previously engaged with Network Service Providers (NSPs) and their customers about how the regulatory framework supports investments in network resilience. This review process furthers that engagement.

Energy and Climate Change Ministerial Council request

On 1 March 2024, the Energy and Climate Change Ministerial Council (ECMC) asked us to extend our current review of Value of Customer Reliability (VCR) to establish a value of customer resilience associated with long duration outages. While this Issues Paper commences our process for responding to this request, we also intend to leverage the work and engagement the AER has already completed in relation our guidance on network resilience expenditure and valuing High Impact Low Probability (HILP) events.

Our understanding of the context for the ECMC request is linked to the increasing frequency and severity of extreme weather events affecting energy system resilience and the Victorian government's proposed Rule change to take greater account of resilience in network regulatory proposals.

2024 five-yearly VCR methodology review

We review and update the VCR methodology every five years; with our 2024 methodology review and VCR update currently underway and due for completion by 31 December 2024.

While VCR covers most types of outage events, there is a subset of events that are not fully captured. These are less frequent compared to other outages but can have significant effects on customers and the community when they do occur. We have investigated alternatives, including a macroeconomic modelling approach, in the past as part of our work on widespread and long duration outages (WALDO). However, it was not incorporated into the 2019 VCR methodology due to a lack of robust stakeholder support.

In December 2023, we commenced our five-yearly review of the VCR methodology and established a concurrent additional workstream valuing prolonged outages and other HILP events.

The purpose of any value in this context is to signal market participants to consider appropriate investment to meet or manage a forecast need, in this case, damage to infrastructure created by extreme weather events. Our intention is for this review to:

- focus on the primary use case for this value – to support NSPs and their stakeholders make more informed decisions about resilience driven investment, and
- be completed no later than 18 December 2024.

We have adopted the term value of network resilience (VNR) as a reflection of the core purpose of this review.

AER Network Resilience – note on key issues

In April 2022, the AER published guidance to help networks and consumer groups understand how resilience investments are assessed under the National Electricity Rules (NER). The guidance outlines how the AER regulates NSPs amid climate change and uncertainty.[1]

The guidance defines network resilience as a performance characteristic of a network and is the network's ability to continue to adequately provide network services and recover those services when subjected to disruptive events.[2]

The guidance also notes the close relationship between resilience and reliability. While improved reliability is generally referred to as the service level outcomes from a more resilient network, other service-level outcomes like maintenance of safety and network security can also be affected.[3]

The guidance highlights the related, but distinctly different, concept of collective community resilience. A resilient electricity network can assist in building community resilience. But many different entities, including government bodies and critical infrastructure operators (beyond electricity networks), have a role in supporting communities to withstand and recover from the effects of natural disasters.[4]

The guidance provides cost-benefit analysis (CBA) framework and was applied in the recent revenue determination processes, in which Ausgrid, Essential Energy and Endeavour each proposed resilience driven investments. As part of our final decisions for these processes, the AER included approximately $270 million in expenditure forecasts related to network resilience, with the AER's resilience guidance note used as a basis for proposals and our assessment. Importantly, the guidance acknowledges that the AER's current VCR for standard outages (unplanned localised outages of up to 12 hours in duration) should be applied to assess network investments addressing unplanned localised outages of up to 12 hours in duration. This may not be appropriate to estimate the value that customers would place on avoiding or reducing the probability and/or duration of a prolonged outage (greater than 12 hours) caused by damage to the network from severe weather events.[5]

Review timing

The forthcoming Victorian reset process requires Victorian Distribution Network Service Providers (DNSPs) to submit their proposals by 31 January 2025. We have liaised with the Victorian DNSPs to ascertain the timeframe in which any value(s) developed as part of this review could reasonably be integrated into their respective revenue determination proposals. Victorian DNSPs indicated that having an approach to valuing resilience available no later than September 2024 will allow the DNSPs time to review and apply the value(s) into their proposals, particularly as some DNSPs noted that resilience investment would be a key feature of their proposals. We also note and Energex and Ergon Energy (Energy

[1] AER, *Network Resilience – A note on key issues*, April 2022.

[2] Ibid., p. 6.

[3] Ibid.

[4] Ibid., p. 7.

[5] Ibid., p. 10.

Queensland) and SA Power Networks (SAPN) will have had draft determinations by September 2024 and this timing would provide them with the opportunity to consider the VNR in submitting their revised proposals in late November 2024.

Scope and context

We will work with stakeholders as part of this review to establish an initial VNR that:

- is attributable to the benefit network consumers 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 weather event that is likely to lead to a prolonged outage, and
- supports network investments driven by a network's ability to:
    - withstand events; for example, hardening investments (e.g. composite poles, areal bundled cables, undergrounding), network topology (i.e. supply path redundancy), design standards, and Stand Alone Power Systems (SAPs)[6]
    - recover from events; for example, standby mobile substations and generators, contingency standby crews, network automation, design standards (e.g. design for repairability) and communications with customers before and during outages.

We recognise this scope represents a subset of the broader scope of the AER's work program considering HILP events. Stakeholders will continue to be engaged on that broader work program beyond 2024.

Our engagement process

The AER will undertake a number of engagement activities to inform our draft position including:

- seeking stakeholder feedback via the issues paper on potential approaches to valuing network resilience, including specific questions summarised in section 4. We also welcome stakeholder views on any of the broader themes of network resilience, particularly the outage characteristics (such as duration) on which this review should focus.
- hold a deliberative forum to talk to customers with lived experience of the recent prolonged outages to better understand the costs they incurred.[7,8]
- assemble a stakeholder reference group (the VNR2024 SRG) comprised of experts and key stakeholders to provide additional insight and guidance throughout the

[6] A stand-alone power system is an electricity supply arrangement that is not physically connected to the national grid.

[7] In its submission to the VCR 2024 review, Energy Networks Australia noted its preference for deliberative forums/reference groups. Refer ENA, *Submission on the AER draft determination on the VCR methodology*, April 2024, p.1.

[8] In its submission to the VCR 2024 review, CitiPower, Powercor and United Energy encouraged meaningful engagement and consultation. Refer CPU, *Submission on the AER draft determination on the VCR methodology*, April 2024, p.5.

engagement process including on the deliberative forum parameters and assessing outcomes.[9]

We will use feedback from this engagement and written submissions to inform our Draft Decision, which we plan to release for consultation in July 2024.

We will comprehensively engage further with stakeholders on our Draft Decision before making our Final Decision in September 2024.

As discussed above, the proposed timing of this review process has been driven by the need to establish an initial VNR for the purposes of the Victorian distribution revenue determination. This timing also gives Energy Queensland and SAPN an opportunity to consider the VNR in forming any revised proposal to the AER after the AER's draft determinations. Where scope permits, we invite stakeholders to share their insights and value suggestions on possible longer-term refinement of the approach to calculating VNR as part of the AER's ongoing work program.

Table 1 Indicative timeline - VNR 2024

Milestone	Date
Issues Paper	13 May 2024
Submissions due	10 June 2024
Draft Decision	July 2024
Final Decision	September 2024

Have your say

We're planning to host a deliberative forum in late May or early June to gain insights into customer experiences during prolonged outages and the importance of network resilience to customers. Event details will follow.

Written submissions on the potential approaches are due, **10 June 2024**.

Submissions should be sent electronically to vnr2024@aer.gov.au. Alternatively, you can mail submissions to:

Kris Funston
Executive General Manager
Australian Energy Regulator
GPO Box 3131
Canberra ACT 2601

We ask that all submissions sent in an electronic format are in Microsoft Word or other text readable document form.

[9] Ibid.

We prefer that all submissions be publicly available to facilitate an informed and transparent consultative process. We will treat submissions as public documents unless otherwise requested. All non-confidential submissions will be placed on the AER's website.

We request parties wishing to subject confidential information:

- clearly identify the information that is the subject of the confidentiality claim
- provide a non-confidential version of the submission in a form suitable for publication.

For further information regarding the AER's use and disclosure of information provided to it, see the ACCC/AER Information Policy.

2 Background

Valuing resilience and reliability is a dynamic, changing area. This section explores some of work the AER and others have developed to date and context for this review, including:

- AER development and review of VCR methodology, including the ongoing HILP work program
- AER guidance provided to networks and their stakeholders on our assessment of resilience investment under the NER, including a summary of how this guidance has been applied in the most recent revenue determination processes
- the Victorian Electricity Distribution Network Resilience review in response to recent storm events, the Victorian Government's response and draft proposed Rule change and the ECMC request.

2.1 VCR and other outages

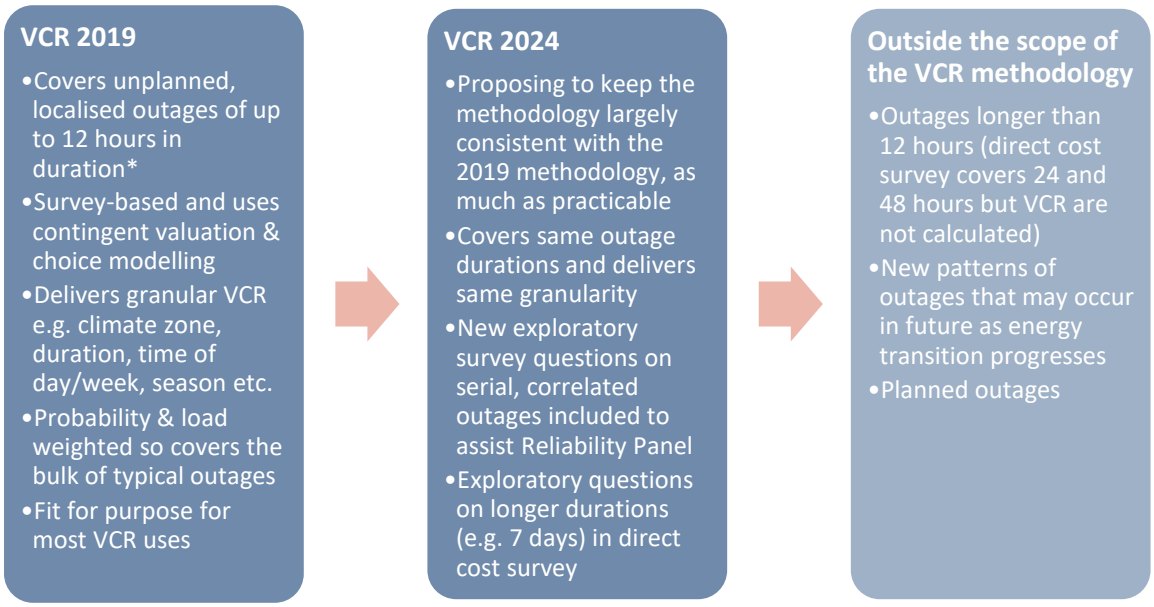
As part of our ongoing work program, we produce VCR for standard outages (unplanned localised outages of up to 12 hours in duration). VCR seek to reflect the value different types of customers place on reliable electricity supply under different conditions. VCR serves an important role in ensuring customers pay no more than necessary for reliable energy by helping energy businesses identify the right level of investment to deliver reliable energy services to customers.

We review the VCR methodology and update the VCR every five years. We established the VCR methodology as part of our 2019 VCR review and are currently reviewing that methodology and updating the VCR as part of our 2024 VCR review.

We have proposed minor updates to the VCR methodology for 2024, aiming to maintain consistency where feasible. Both iterations cover unplanned, local outages lasting up to 12 hours, applying survey-based techniques like contingent valuation and choice modelling. They provide detailed VCR data, considering factors like climate zone, duration, and timing. In 2024, there is an addition of exploratory survey questions addressing serial, correlated outages and longer durations, such as 7 days, aimed at assisting the Reliability Panel.

However, certain aspects remain outside the scope of the VCR methodology. Outages exceeding 12 hours, although covered in direct cost surveys for 24 and 48-hour durations, are not factored into VCR calculations. Additionally, the evolving landscape of the energy transition may introduce new outage patterns not currently accounted for. Lastly, planned outages are excluded from VCR considerations. An overview of the VCR methodology and its scope is provided in Figure 1 below.

Figure 1: Overview of VCR methodology and scope



We are aware there is a subset of outages that fall outside the scope of the VCR which are less frequent but have significant impacts on customers and the community when they do occur. Given those impacts, we consider this subset of events warrants further consideration and we have been investigating other approaches to valuation including computable general equilibrium (CGE) modelling, revealed preferences[10] and direct cost surveys.

We commenced this work in 2019 with our exploration of WALDO where we examined a macroeconomic modelling approach to deriving a value for these outage events. However, it was removed from the 2019 VCR methodology due to a lack of stakeholder support. Stakeholder concerns about the methodology focused on the estimation of social costs and the extent to which these costs should be included.

We have continued our work on outages that fall outside the scope of the VCR as part of our 2024 VCR review and includes the following four workstreams:

1. Assisting the Reliability Panel with its review of the form of the reliability standard
2. Exploring the inclusion of additional questions about prolonged outages in the VCR direct cost survey
3. Undertaking work on NSP guidance on resilience
4. Developing HILP case studies.

The AER's engagement on these workstreams will continue beyond 2024. We will leverage the work we have done to date on workstream 3 to inform this current review on VNR. Following this review, we intend to continue to review and refine VNR into the future as part of the AER's broader value of customer reliability work plan.

[10] Revealed preference theory assumes that the preference of consumers can be revealed by their purchasing habits.

2.2 AER guidance note on network resilience

As discussed in section 1, we released a guidance note on network resilience on April 2022, which notes that under the NER, reliability is defined as the probability of a system, device, plant or equipment performing its function adequately for the period of time intended, under the operating conditions encountered.[11] This definition reflects that reliability is about continuous adequate supply of electricity under different conditions. There is a close relationship between resilience and reliability because resilience is an input that contributes to the achievement of reliability – the service level outcome.

The guidance note defines resilience as a performance characteristic of a network and its supporting systems (e.g. emergency response processes, etc.). It is the network's ability to continue to adequately provide network services and recover those services when subjected to disruptive events. Similarly, we note in section 1, we define the scope of the VNR as:

- attributable to the benefit network consumers 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 weather event that is likely to lead to a prolonged outage, and
- supporting network investments driven by a network's ability to:
    - withstand events; for example, hardening investments (e.g. composite poles, areal bundled cables, undergrounding), network topology (i.e. supply path redundancy), design standards, and SAPs
    - recover from events; for example, standby mobile substations and generators, contingency standby crews, network automation, design standards (e.g. design for repairability) and communications with customers before and during outages.

The AER's Service Target Performance Incentive Scheme (STPIS) is intended to balance a network's incentive to reduce expenditure with the need to maintain or improve service quality. The STPIS does this by providing financial incentives to network service providers to maintain and improve service performance where customers are willing to pay for these improvements. However, in calculating the STPIS reward/penalty, certain extreme weather events, known as major event days, are excluded from the calculation. In this regard, the STPIS is not designed to incentivise improvements in managing the effect of unforeseen extreme weather events.

The guidance note also highlights that, in an environment in which the effects of climatic change on the frequency and severity of major events are uncertain, it is important that risk allocation is optimally balanced – between ex ante (revenue proposals) and ex post funding (cost passthroughs) – to maintain service level outcomes so that it is consistent with the needs and preferences of consumers. The guidance note states our expectation that where NSPs propose resilience expenditure, they should demonstrate, within reason:

- there is a causal relationship between the proposed resilience expenditure and the expected increase in the extreme weather events.

[11] NER, Chapter 10.

- the proposed expenditure is required to maintain service levels and is based on the option that likely achieves the greatest net benefit of the feasible options considered.
- consumers have been fully informed of different resilience expenditure options, including the implications stemming from these options, and that they are supportive of the proposed expenditure (willingness to pay).

The guidance highlights the related, but distinctly different, concept of community resilience. A resilient electricity network can assist in building community resilience. But many different entities, including government bodies and critical infrastructure operators (beyond electricity networks), have a role in supporting communities to withstand and recover from the effects of natural disasters.[12]

We note that there are various understandings of the term community resilience. The National Electricity Law (NEL) prescribes an electricity network service as 'a service provided by means of, or in connection with, a transmission system or distribution system.'[13] Some investments associated with building greater levels of community resilience such as the provision of back-up generation to energise a community hub may be captured under the definition. The purpose of this review and establishing a VNR does not at this stage require a definitive statement of whether particular types of resilience investments proposed by networks are appropriately determined to be network services. However, we do highlight that the focus for this review and a VNR is isolated to valuing network resilience.

The benefit of a network resilience proposal is the avoided cost of unserved energy, either through withstanding a disruptive event or recovering from it quickly. We expect an initial VNR established as part of this review will provide the value required to determine the benefit amount to be included within the existing CBA framework and assist NSPs to assess options to invest in resilience related solutions in those parts of their networks identified as the subject of increased risk of damage as a result of extreme weather events.[14]

2.3 Recent network proposals and AER decisions

The guidance provides a cost-benefit analysis (CBA) framework and was applied in the recent revenue determination processes, in which Ausgrid, Essential Energy, Endeavour and TasNetworks (Dx) each proposed resilience driven investments. As part of our final decisions for these processes, the AER included $322.4 million in expenditure forecasts related to network resilience, with the AER's resilience guidance note used as a basis for proposals and our assessment. Further detail about these proposals is outlined below.

We included $41.6 million ($38.4 million in capex, $3.2 million in opex) for resilience investment in our alternative estimate of Ausgrid's total expenditure. This amount included

[12] Ibid., p. 7.

[13] NEL, Part 1, section 2.

[14] This Electricity Distribution Network Resilience Review required distribution businesses to develop a Network Resilience Plan at least every 5 years. The object of the Plan will be to mitigate hazards to the distributor's network that could result in prolonged power outages under a range of scenarios. Victorian Department of Environment, Land, Water and Planning, *Electricity Distribution Network Resilience Review, Final Recommendations Report*, recommendation 2, pp. 13.

network solutions, community resilience (including capex for small mobile generators and minor upgrades of existing community hubs as well as opex for resilience communications, coordination and planning and performance reporting), the build back better program (opportunistic replacement of timber poles with composite poles in bushfire risk areas) and response effectiveness.

For Endeavour and Essential, we made no adjustment to capex forecasts for resilience related projects or programs. The two networks proposed $28 million and $204.8 million for climate resilience respectively. Endeavour proposed covered conductor replacement program targeting high bushfire risk areas and the raising of select feeders in flood-prone areas of the network. Essential proposed composite poles replacement of at-risk poles, underground cables in high-risk areas, microgrid/generation, solar and battery back-up radio sites, stand-alone power systems, community resilience (including domestic, large and medium generators, portable SAPS, portable solar streetlights, communications van/hub and a portable depot) and the relocation of a depot in a floodplain.

TasNetworks (Dx) proposed $48.3 million in climate resilience. This figure included network hardening solutions such as the replacement of timber poles with fire-resistant composite poles and the implementation of covered conductor and aerial bundled cable in bushfire risk areas, The remainder of the proposal was for the replacement of other assets such as switchgear. TasNetworks undertook no climate impact modelling and instead relied on its Bushfire Risk Mitigation Plan for the proposal.

In the absence of an established alternative value of network resilience, all four NSPs instead simply applied the standard VCR when modelling their forecast expenditure, using a weighted VCR at a per feeder level as a proxy. The weighting was based on the feeder's customer composition (residential, business, very large business). We accepted this calculation in our decision-making process. The VNR established by this review will assist with these kinds of proposals in the future by providing NSPs with a value specifically targeting prolonged outages.

Our assessment concluded that the networks did not demonstrate a causal relationship of network impact between the proposed resilience expenditure and the expected increase in the extreme weather events.[15,16,17,18] Further, we concluded that in some instances, inefficient expenditure had been proposed.[19]

SAPN and Energy Queensland have submitted resilience forecasts as part of their 2025-30 revenue determination proposals. SAPN is proposing $8.2 million of expenditure for mobile generators suggesting a driver of community resilience. Additionally, SAPN has proposed unspecified community resilience investments as part of its innovation fund. Energy

[15] AER, Endeavour Energy *2024–29 – Draft Decision – Attachment 5 – Capital* Expenditure, September 2023, p. 17.

[16] AER, Essential Energy *2024–29 – Draft Decision – Attachment 5 – Capital* Expenditure, September 2023, pp. 16-17.

[17] AER, Ausgrid *2024–29* – Final *Decision – Attachment 5 – Capital* Expenditure, April 2024, p. 26.

[18] AER, TasNetworks Electricity Distribution Determination 2024-29, Draft Decision – Attachment 5 – Capital Expenditure p.13.

[19] AER, Ausgrid *2024–29* – Final *Decision – Attachment 5 – Capital* Expenditure, April 2024, p. 26.

Queensland is proposing $107.7 million ($57.6 million Ergon Energy, $50.1 million Energex) of expenditure for mobile generators, bushfire risk solutions (such as cover conductors and pole wrapping) and flooding risk solutions (such as padmounts, pillars and flood switching). Both networks apply standard VCR in their forecasting models. The proposed timing for the VNR review would provide these DNSPs with the opportunity to consider the VNR in submitting their revised proposals in late November 2024.

2.4 Extreme weather events, jurisdictional response and the ECMC request

There have been multiple storm events in Victoria that have triggered reviews into the resilience of its electricity distribution networks.

The Electricity Distribution Network Resilience Review was initiated in response to the 2021 storms.[20] The Victorian Government supported the vast majority of the Review's recommendations including that the relevant Victorian Government department:

- works with the AER to assess customer willingness to pay to avoid wide area, long duration outages,
- proposes a rule change to the NER capex objectives to specifically account for resilience. In supporting this recommendation, the Victorian Government noted that while current rules can, in theory, support investments in resilience, explicitly accounting for resilience in the rules would assist in future projects being favourably assessed by the AER.[21]

A further Network Outage Review has been established by the Victorian Government to investigate the response to the storms that occurred in February 2024.[22] Shortly after, on 9 March 2024 the ECMC asked the AER to extend its current review of the VCR to establish a new value of customer resilience associated with long duration outages. As noted in section 1, we have adopted the term VNR to better reflect the core purpose of the review.

[20] For more information on this review, see https://www.energy.vic.gov.au/about-energy/legislation/regulatory-reviews/electricity-distribution-network-resilience-review.

[21] State of Victoria Department of Energy, Environment and Climate Action, *Victorian Government Response to the Expert Panel's Electricity Distribution Network Resilience Review*, September 2023, p. 11.

[22] This review will cover the operational arrangements and preparedness of network service providers to respond to extreme weather events. The management of the incidents as well as the recovery process and timings will also be reviewed. In addition, there will be an investigation as to whether there were any material opportunities that could have enables a more rapid reconnection of electricity services as well as the quality of the communication with customers during the outage. For more information on this review, see https://www.energy.vic.gov.au/safety/power-outages.

3 Approaches to VNR

As part of considering potential approaches to establishing an initial VNR, we have reviewed several international studies exploring and comparing different methodologies for valuing resilience in electricity networks.

One of the key findings of this research is that estimating a value of resilience is challenging and there is no widely accepted best practice approach. The research also highlights that while the methodologies for valuing prolonged outages are not as well developed as those used to value standard outages (12 hours or less), it is an area of focus for researchers internationally.

The research revealed that a range of different methodological approaches have been used to estimate the resilience value internationally and each approach has its own set of advantages and disadvantages. The methodologies examined were varied, from survey-based approaches through to more complex CGE models (CGE). Some of the research also explored 'hybrid' approaches, which combined methodologies (e.g., surveys and modelling) to value prolonged outages.[23]

Some studies also included case studies on valuing prolonged outages. These case studies were also varied, with differing outage scenarios (e.g., from days to multiple weeks) and causes (e.g., earthquakes, weather-related natural disasters etc.). The case studies highlighted that no two prolonged outages are likely to be the same, with the duration and timing of the outage event, its nature (localised or widespread) and its location impacting on the valuation.[24]

This section discusses the important considerations we should have when assessing approach options, additional information we feel stakeholders can provide us with guidance on and some potential approaches we have identified.

---

[23] Baik, Davis and Morgan, *Assessing the cost of large-scale power outages to residential customers*, Risk Analysis, 2018; Sanstad, Leibowicz, Zhu, Larsen and Eto, *Electric utility valuations of investments to reduce the risks of long-duration, widespread power interruptions, part I: Background*, Sustainable and Resilient Infrastructure, 2023; Murphy, Hotchkiss, Anderson, Barrows, Cohen, Dalvi, Laws, Maguire, Stephen and Wilson, *Adapting existing energy planning, simulation, and operational models for resilience analysis*, National Renewable Energy Laboratory, 2020; Baik, Hanus, Sanstad, Eto and Larsen, *A hybrid approach to estimating the economic value of enhanced power system resilience*, Lawrence Berkeley National Laboratory, 2021; Larsen, Sanstad, LaCommare and Eto, *Frontiers in the economics of widespread, long-duration power Interruptions: proceedings from an expert workshop*, Lawrence Berkeley National Laboratory, 2019; Brown, Lessem, Lueken, Spees and Wang, *High-impact, low-probability events and the framework for reliability in the National Electricity Market*, The Brattle Group, 2019; Zamuda, Larsen, Collins, Bieler, Schellenberg and Hees, *Monetization methods for evaluating investments in electricity system resilience to extreme weather and climate change*, The Electricity Journal, 2019; Macmillan, Wilson, Baik, Carvallo, Dubey and Holland, *Shedding light on the economic costs of long duration power outages: A review of resilience assessment methods and strategies*, Lawrence Berkeley National Laboratory, 2023.

[24] Leibowicz, Sanstad, Zhu, Larsen and Eto, *Electric utility valuations of investments to reduce the risks of long-duration, widespread power interruptions, part II: Case studies*, Sustainable and Resilient Infrastructure, 2023; Sanstad, Zhu, Leibowicz, Larsen and Eto, *Case studies of the economic impacts of power Interruptions and damage to electricity system infrastructure from extreme events*, Lawrence Berkeley National Laboratory, 2020; Anderson, Li, Dalvi, Ericson, Barrows, Murphy and Hotchkiss, *Integrating the value of electricity resilience in energy planning and operations decisions*, IEEE Systems Journal, 2019.

3.1 Characteristics, unserved energy, information sources and assessment criteria

Outage characteristics

As discussed in section 1, the scope of this review is limited to valuing the benefit network customers receive from a resilient network, which is defined as a network's ability to withstand and recover from an extreme weather event that is likely to lead to a prolonged outage.

Within that scope, there is a large range of potential outages that we could consider when placing a value on network resilience, with each outage having its own individual dimensions and effects. To enable us to develop an appropriate value of network resilience, we will need to have a clear understanding of the outage scenarios that are of most concern to stakeholders (e.g., outage location, duration, timing, size of area impacted, etc.). This information will also help inform our decision, as the characteristics of the prolonged outage may influence the option/s that will be most appropriate.

Unserved energy

As is usual practice, we express VCR in dollars per kilowatt hour ($/kWh). Under our VCR methodology, we derive a $/kWh VCR by dividing the dollar value of each outage by an estimate of the unserved energy associated with the outage.

In its submission to our VCR 2024 review,[25] AusNet noted that the high value its customers placed on avoiding prolonged outages was diluted by the large volumes of unserved energy associated with prolonged outages. It suggested that revisions to the method used may be necessary to derive more meaningful values for prolonged outages.

We would welcome any comments or views that stakeholders may have on this issue.

Information sources

We will likely need to obtain information from with network service providers to help inform this review. This information may include detail about the areas of their networks that are at greatest risk of resilience hazards. We intend to engage further with network service providers on this issue, including whether we can leverage regulatory information provided to other bodies to streamline this process.

For example, we are aware that Victorian distribution network service providers worked with the Victorian Government Department of Energy, Environment and Climate Action's developing Energy Resilience Studies, identifying network and geographical areas that are at risk of prolonged power outages.[26] We would be interested to hear from stakeholders, including networks, about further sources of this type of risk assessment information.

We will also likely need information from customers who have recently experienced prolonged outages about the costs they incurred as a result of those outages.

---

[25] AusNet, Submission on the AER draft determination on the VCR methodology, April 2024, p. 5.

[26] DEECA, *Electricity Distribution Network Resilience Review*, May 2022, p. 12

Criteria for assessing potential approaches

We have identified some criteria that may help us assess the potential approaches to determining a VNR and identify the most appropriate option/s:

- Established within the required timeframe – as discussed above, it is important that as part of this review we can establish a VNR capable of being adopted for the Victorian DNSP revenue determination process commencing early 2025. We recognise that it may be the case that the AER determines, in collaboration with stakeholders, that the first-best approach is a more resource and time intensive approach relative to other options and that cannot be completed within this timeframe. Where this is the case, it may be appropriate to adopt a second-best alternative for the purposes of the Victorian revenue determination process and use the ongoing HILP workstream to establish the more methodologically sound approach.
- Suitability of methodology – each potential methodology has its own set of advantages and disadvantages, and some methodologies may be better suited to particular outage scenarios than others. We will need to consider a methodology that has longevity and is appropriate for valuing network resilience, consistent with the scope of this project and that can be used longer term as our understanding develops and evolves.
- Ability to localise the value calculation – the extent to which values can be localised varies across methodologies. We will need to select a methodology that can produce values at level of granularity required.
- Impact on network expenditure proposals – different methodologies are likely to produce different VNR and therefore may have different effects on network expenditure proposals. We will need to have regard to these effects when adopting an approach.

Questions on outage scenarios, unserved energy and criteria for assessing potential approaches

3.1.1 What outage length do you consider is the most important for us to focus on? (e.g., 1 day, 2-3 days, 7 days etc.)? Please explain why you consider this outage length is the most important.

3.1.2 How granular do you think the values need to be (e.g., specific feeders, etc)? Please explain why you consider this level of localisation is important.

3.1.3 Do you have any views on the use of unserved energy to derive a $/kWh value for network resilience?

3.1.4 What are your views on the assessment criteria we have developed for considering the potential methodological options?

3.1.5 Are there any additional assessment criteria we should include? Please explain why.

3.2 Identified potential approaches

For the purposes of this review, we have identified the following as potential approaches to explore with stakeholders:

- Using the costs of backup generation and other non-network solutions as a reference
- Using a multiple of the VCR for standard outages (that is, outages of duration of 12 hours or less)
- Extrapolating the VCR for standard outages beyond 12 hours
- Conducting follow-up surveys to actual prolonged and/or widespread outages
- Using modelling to estimate a value
- Exploring other cost data.

We note that the preferred approach for VNR could involve using a combination of potential approaches, including alternative approaches identified by stakeholders.

Questions on potential approaches

3.2.1 Are there any additional potential approaches, other than those listed above, that we should consider? Why?

3.2.2 Do you have a preferred approach to valuing network resilience? If so, why do you prefer that approach?

3.2.3 Do you have any views on how we might use a combination of approaches?

3.3 Option 1 - Using rational alternatives as a limit

This approach applies an upper bound to any value of resilience. Where an outage is prolonged, we assume a rational consumer is likely to seek out alternatives to fulfil their energy needs. This could be through meeting those needs directly with the purchase of self-generation equipment, or procuring those services that a lack of energy has made unavailable such as booking temporary accommodation.

We consider these types of costs correspond with the upper bound of how much consumers are likely to be willing to pay to avoid prolonged outages. It is unclear to us at which point in the continuum of a prolonged outage this value comes into effect other than at the end as an upper bound. As such, it is unlikely this could be explored as a stand-alone option and should be considered in tandem with other possible approaches.

In terms of the calculation of the upper bound, the least-cost of backup self-generation (plus fuel costs depending on duration of forecast outage) is likely the most objective and easily applied upper bound. Temporary accommodation could be useful as an indication of cost for residential customers. However, it is unlikely to be considered applicable in the context of a small business given the higher friction costs of sourcing alternative shop fronts. An objective value of temporary accommodation could also be difficult to determine depending on the circumstances of a forecast outage. For example, in smaller-remote areas, temporary accommodation may not be available in the immediate area and determining what an appropriate alternative looks like could be difficult. This is similar to the theory applied as part of our VCR methodology for standard outages (12 hours or less), where we place a cap on the open-ended question in our residential survey about willingness to pay to avoid the baseline scenario.

For standard outage VCR, the residential cap is set at the approximate cost of a back-up power system which can supply a household for one hour.[27] The cap was included in our 2019 VCR methodology, as we considered the cost of a reasonable alternative could be regarded as the maximum value one would pay for grid-provided electricity. If grid-provided electricity cost more than this, it would be reasonable to expect the alternative to be favoured instead.

To identify the cap amount, we considered factors such as outage length, cost, commercial availability, seasonality, and consumer utility. Regarding utility, we considered the alternative option should:

- allow for minimal human intervention
- enable a broad range of typical residential activities to continue with minimal disruption
- be of a physical size consistent with the residential environment.[28]

Our initial view is to adopt this approach in combination with other potential approaches, particularly to establish an initial VNR.

Questions on Option 1 - Using rational alternatives as an upper bound

3.3.1 Do you think we should include an upper bound on the costs consumers may be willing to pay to avoid prolonged outages? Please provide reasons for your view.

3.3.2 Can you see any potential challenges in calculating an upper bound on the costs consumers may be willing to pay to avoid prolonged outages?

3.3.3 If we do include an upper bound, do you have a view on the least-cost backup self-generation solutions we should explore?

3.3.4 If we do include an upper bound, do you have a view on which approach (least-cost backup self-generation or temporary accommodation costs) is preferred? Should we explore a combination of these approaches?

3.4 Option 2 - Using a multiple of the VCR for standard outages

This approach would involve using a multiple of VCR for standard outages. This approach assumes prolonged outages place additional burdens on customers, and this justifies an additional 'resilience' premium.

We note recent outages in Victoria have highlighted that prolonged outages can place additional burdens on customers, including food spoilage, inability to operate sewage or septic tank systems, inability to work, and other inconveniences.[29]

An example of applying this in a theoretical context is AEMO's review of possible management options for frequency containment in South Australia. In this review, AEMO did

[27] AER, *AER Statement of methodology for determining values of customer reliability*, September 2020.

[28] AER, *Values of Customer Reliability review*, draft decision, September 2019, pp. 30–31.

[29] Electricity Distribution Network Resilience Review Expert Panel, *Electricity Distribution Network Resilience Review*, final recommendations report, May 2022, pp. 5–6.

a sensitivity analysis using a multiple of the VCR for standard outages (a multiple of 2x) to estimate unserved energy costs. Its rationale for using the multiple of VCR was to account for 'the escalated inconvenience and costs to customers from long duration outages'.[30]

This approach is relatively simple and would leverage the VCR for standard outages. However, it may not be as accurate as other potential approaches. It would also require us to determine an appropriate multiple and this may be difficult to do with confidence. We could potentially leverage AEMO's work or use other research (e.g. network businesses' or our own surveys) to inform any decision on the appropriate multiple.

Questions on Option 2 - Using a multiple of the VCR for standard outages

3.4.1 Is this approach appropriate for outages greater than 12 hours? Please explain why.

3.4.2 Can you see any potential advantages in using this approach?

3.4.3 Can you see any potential challenges in using this approach?

3.4.4 Do you have any views on whether this approach could be implemented, and values produced within the required timeframe?

3.5 Option 3 - Extrapolating the VCR for standard outages beyond 12 hours

This approach would involve extrapolating the VCR for standard outages beyond 12 hours, by using knowledge about how the VCR change as outage duration increases. In addition to our VCR for standard outages, it may be possible to use information on 24 and 48 hour outages from our direct cost survey of very large business customers (we currently ask survey respondents about these outages, but do not produce VCR for them) to inform any extrapolation.

In terms of the suitability of this approach, we note there are limitations to using extrapolation. For example, the observed trends in a data set may not hold for data points that are outside that data set. This is particularly so if the data points being extrapolated are a long way from original data set, that is, how long the outage duration is beyond the 12 hours.

Questions on Option 3 - Extrapolating the VCR for standard outages beyond 12 hours

3.5.1 Do you believe this approach is appropriate to value consumer resilience for outages greater than 12 hours? Please explain why.

3.5.2 Can you see any potential advantages in using this approach?

[30] AEMO, *Separation leading to under-frequency in South Australia*, May 2023, p. 8. AEMO's analysis considered specified scenarios involving the non-credible separation of South Australia from the rest of the National Electricity Market (NEM) power system at five specific separation points. The sensitivity analysis using the multiple of the standard outage VCR produced higher estimated benefits (in terms of the reduction in unserved energy) than the estimates calculated using the standard outage VCR. For example, the option involving constraint on Heywood imports (with no minimum synchronous unit requirement) had an estimated annual net benefit of between ($5 million) and $18 million using the standard outage VCR. Using the multiple VCR, the estimated annual net benefit was between $1 million and $47 million.

3.5.3 Can you see any potential challenges in using this approach?

3.5.4 Do you have any views on whether this approach could be implemented and values produced within the required timeframe?

3.6 Option 4 - Conducting follow-up surveys to actual prolonged outages

This approach would involve conducting follow-up surveys of customers after actual prolonged outages. Customers affected by prolonged outages would be identified and surveyed about the costs they incurred and/or their willingness to pay to avoid similar outages in the future.

This approach would be dependent on outages occurring and it is possible there may not be recent outages for some networks. We are also aware that it can be difficult for respondents to these surveys to distinguish between the costs they have incurred as a result of the electricity outage event and the costs they have incurred as a result of the natural disaster. This may present a challenge to using surveys in this context.

The use of this approach will also depend on our ability to identify and survey affected customers in a timely manner. We note that some DNSPs have undertaken similar surveys of their affected customers following prolonged outages on their networks and there may be scope to leverage this work if we were to use this approach.

Given some DNSPs are already undertaking similar work, we consider it would be important for us to work with them to ensure we were not duplicating each other's work and asking the same cohort of customers for similar information multiple times. While the results may not be able to be generalised, we note that some studies focusing on prolonged outages have found that willingness to pay does not change significantly between customers with experience of prolonged outages and those without.[31]

Our preliminary view is that it may be challenging to develop, undertake and analyse follow-up surveys within the timeframes for this review. As such, this option may be better suited to our longer-term work program to develop a more refined approach to valuing network resilience. We would welcome stakeholder comments on this preliminary view.

Questions on Option 4 - Conducting follow-up surveys to actual prolonged outages

3.6.1 Do you believe this approach is appropriate to value consumer resilience for outages greater than 12 hours? Please explain why.

3.6.2 Can you see any potential advantages in using this approach?

3.6.3 Can you see any potential challenges in using this approach?

[31] Macmillan, Wilson, Baik, Carvallo, Dubey and Holland, *Shedding light on the economic costs of long-duration power outages: A review of resilience assessment methods and strategies*, Energy Research & Social Science, April 2023 p. 4.

3.6.4 Do you have any views on whether this approach could be implemented and values produced within the required timeframe?

3.6.5 Do you have any views on whether residential and/or business survey outcomes from one outage event or network could be used as a proxy for other outage events or networks?

3.7 Option 5 - Using modelling to estimate a value

This approach would involve using a model to estimate the economic outcomes of a specific prolonged outage(s). There are different models that could be used, including input-output (IO) models or CGE models.

IO models are production-function-based approaches and are the simplest macroeconomic models used to estimate indirect economic effects of an outage. IO models use coefficient matrices to capture interdependencies across sectors of the economy. When used to study outages, IO models assume that sectors of the economy become inoperable, preventing their input to other sectors downstream in the supply chain. Using these techniques, the ripple effects of the outage can be simulated, and direct / indirect losses can be computed and compared. IO models do not capture adaptive behaviour, leading to them typically overestimating indirect economic losses.[32] The model used for the AER's residential 2019 WALDO VCR relied on input-output tables.[33]

CGE models can be used to estimate economic effects of a 'shock', such as an electricity outage, including any indirect economic effects. CGE models use a framework of demand and supply equations for various markets in equilibrium. The effects of outages are simulated by changing the relative prices and quantities of goods and services. CGE models can account for behavioural effects, such as price changes and substitution among inputs. Because of this flexibility, CGE models provide more accurate estimates of long-run losses from extreme events that IO models. However, CGE models may understate costs because they assume a frictionless economy and perfectly rational behaviour, which may not be realistic during these types of events and electricity outages. CGE models lead to typically lower (and arguably more accurate) estimates of economic losses than IO models. They are one of the most complex and resource intensive modelling approaches.[34]

Based on our literature review and discussions with academics, there is not a single, individual model that is considered best practice for valuing resilience. Instead, there are

[32] Macmillan, Wilson, Baik, Carvallo, Dubey and Holland, *Shedding light on the economic costs of long duration power outages: A review of resilience assessment methods and strategies*, Lawrence Berkeley National Laboratory, 2023, pp.4-5.

[33] For information on the WALDO model, see https://www.aer.gov.au/industry/registers/resources/reviews/values-customer-reliability-2019.

[34] Macmillan, Wilson, Baik, Carvallo, Dubey and Holland, *Shedding light on the economic costs of long duration power outages: A review of resilience assessment methods and strategies*, Lawrence Berkeley National Laboratory, 2023, pp.5-6.

differing views on the suitability of different types of models for this task and each type of model has its own unique set of advantages and disadvantages.[35]

More generally, using any of these models would be more complex than the other approaches we have identified and potentially require multiple input parameter assumptions. We understand that there are existing models that could potentially be used to undertake this work. However, these models may need to be calibrated and this may require input from energy modellers and NSPs.

Using a model to estimate VNR may produce more accurate estimates for widespread outages and some durations of prolonged outages and would enable the inclusion of indirect economic losses. However, some models may be less accurate for shorter durations of prolonged outages (e.g., CGE models). There may also be limits on the level to which values can be localised, with some models only providing estimates localised to a specific Statistical Area Level (e.g., Statistical Area Level 3 or SA3).

Our preliminary view is that it may be challenging to select a suitable model and undertake calibration within the timeframes for this review. As such, this option may be better suited to our longer-term work program to develop a more refined approach to valuing network resilience. We would welcome stakeholder comments on this preliminary view.

Questions on Option 5 - Using modelling to estimate a value

3.7.1 Do you believe this approach is appropriate to VNR for outages greater than 12 hours? Please explain why.

3.7.2 Do you have any views on which model(s), if any, may be appropriate for estimating a VNR?

3.7.3 Can you see any potential advantages in using this approach?

3.7.4 Can you see any potential challenges in using this approach?

3.7.5 Do you have any views on whether this approach could be implemented and values produced within the required timeframe?

3.8 Option 6 - Exploring other cost data

This approach would involve obtaining and analysing cost data that may provide insights on the costs associated with a prolonged outage. The types of cost data used in this analysis would be dependent on the scope of data available. It is possible data sets may not be

[35] Larsen, Sanstad,. Hamachi LaCommare, and Eto, *Frontiers in the economics of widespread. Long-duration power interruptions: proceedings from an expert workshop*, Berkeley National Laboratory, 2019; Gorman; *The quest to quantify the value of lost load: a critical review of the economics of power outages*, the Electricity Journal, 2022; Sanstad, Zhu, Leibowicz, Larsen and Eto, *Case studies of the economic impacts of power interruptions and damage to electricity system infrastructure from extreme events*, Berkeley National Laboratory, 2020; Baik, Hanus, Sanstad, Eto and Larsen, *A hybrid approach to estimating the economic value of enhanced power system resilience*, Berkeley National Laboratory, 2021; Macmillan, Wilson, Baik, Carvallo, Dubey and Holland, *Shedding light on the economic costs of long-duration power outages – A review of resilience assessment methods and strategies*, Lawrence Berkeley National Laboratory, 2023.

available for all locations affected by prolonged outages and the available data may not provide comprehensive insights.

We would need to undertake further work to identify suitable data sources and determine whether we could obtain the data for our analysis. We consider that we would want to use high frequency and localised data on economic activity to ascertain the impact of an outage event.

Potential sources of cost data could include information from state or territory governments about the costs they incur when a prolonged outage event occurs and/or other data sources. For example, the Australian Taxation Office's Single Touch Payroll datasets and the Australian Bureau of Statistics' integrated datasets could potentially provide useful insights on the impacts of a prolonged outage event.[36] We note research on this type of cost data could be undertaken over time in response to events, using the actual observed response of energy customers to update and refine the VNR methodology.

Our preliminary view is that it may be challenging to identify, obtain and analyse the required data model and undertake calibration within the timeframes for this review. As such, this option may be better suited to our longer-term work program to develop a more refined approach to valuing network resilience. We would welcome stakeholder comments on this preliminary view.

Questions on Option 6 - Exploring other cost data

3.8.1 Do you believe this approach is appropriate to value network resilience for outages greater than 12 hours? Please explain why.

3.8.2 Can you see any potential advantages in using this approach?

3.8.3 Can you see any potential challenges in using this approach?

3.8.4 Are there any data sources that you think would be useful for this type of analysis? Do you know who may be able to supply the data you have identified?

3.8.5 Do you have any views on whether this approach could be implemented and values produced within the required timeframe?

[36] For an overview of some potential data sources, see Gruen, *The rise of big data and integrated data assets*, EY Conference, 2024.

4 Review engagement plan

As noted in section 1, our engagement plan is designed to be comprehensive and inclusive, ensuring that we gather insights from various stakeholders and communities to inform our decisions regarding network expenditure.[37] Central to this approach are deliberative forums, which will provide us with valuable insights into the experiences and perspectives of customers.[38] By engaging directly with customers, we aim to understand their needs, challenges, and priorities, which will serve as crucial context for determining how best to frame the conversation on network resilience.

We will also assemble a stakeholder reference group (VNR2024 SRG) comprised of experts and key stakeholders to provide additional insight, particularly into forum design and outcome evaluation.[39] Importantly, we will draw on the expertise of the VNR2024 SRG to ensure the engagement process is robust.

The nature of this review and the timeline for completion constrains its scope. We will seek to balance considerations of timeliness and longevity when proposing an approach as part of this review. We propose to incorporate updates to the VNR and review our methodology on an ongoing basis. This will form part of our 'business as usual' work program, providing us with the flexibility to make incremental refinements to our approach over time in response to changing circumstances and evolving community needs. By adopting this iterative approach, we can ensure that our decisions remain relevant and effective in addressing the challenges of tomorrow.

The scope of this review does not extend to reviewing and updating our guidance note on network resilience, but we plan to update this guidance in the near future. We intend to use the learnings and insights from the most recent NSW revenue determination process and the forthcoming Victorian process to inform a revision of that guidance note and how to incorporate the VNR established as part of this process. We note this approach is similar to the way our customer export curtailment value was developed separately to our distributed energy resources integration expenditure guidance.[40]

[37] In its submission to the VCR 2024 review, CitiPower, Powercor and United Energy encouraged meaningful engagement and consultation. Refer CPU, *Submission on the AER draft determination on the VCR methodology*, April 2024, p.5.

[38] In its submission to the VCR 2024 review, Energy Networks Australia noted its preference for deliberative forums/reference groups. Refer ENA, *Submission on the AER draft determination on the VCR methodology*, April 2024, p.1.

[39] Ibid.

[40] For more information see: https://www.aer.gov.au/industry/registers/resources/guidelines/customer-export-curtailment-value-methodology.

5 Summary of questions

Topic	Question
Questions on potential approaches, outage scenarios and assessment criteria	**Questions on outage scenarios, unserved energy and criteria for assessing potential approaches** 3.1.1 What outage length do you consider is the most important for us to focus on? (e.g., 1 day, 2-3 days, 7 days etc.)? Please explain why you consider this outage length is the most important. 3.1.2 How granular do you think the values need to be (e.g., specific feeders, etc)? Please explain why you consider this level of localisation is important. 3.1.3 Do you have any views on the use of unserved energy to derive a $/kWh value for network resilience? 3.1.4 What are your views on the assessment criteria we have developed for considering the potential methodological options? 3.1.5 Are there any additional assessment criteria we should include? Please explain why. **Questions on potential approaches** 3.2.1 Are there any additional potential approaches, other than those listed above, that we should consider? Why? 3.2.2 Do you have a preferred approach to valuing network resilience? If so, why do you prefer that approach? 3.2.3 Do you have any views on how we might use a combination of approaches?
Potential Approaches	**Questions on Option 1 - Using rational alternatives as an upper bound** 3.3.1 Do you think we should include an upper bound on the costs consumers may be willing to pay to avoid prolonged outages? Please provide reasons for your view. 3.3.2 Can you see any potential challenges in calculating an upper bound on the costs consumers may be willing to pay to avoid prolonged outages? 3.3.3 If we do include an upper bound, do you have a view on the least-cost backup self-generation solutions we should explore? 3.3.4 If we do include an upper bound, do you have a view on which approach (least-cost backup self-generation or temporary

	accommodation costs) is preferred? Should we explore a combination of these approaches? **Questions on Option 2 - Using a multiple of the VCR for standard outages** 3.4.1 Is this approach appropriate for outages greater than 12 hours? Please explain why. 3.4.2 Can you see any potential advantages in using this approach? 3.4.3 Can you see any potential challenges in using this approach? 3.3.4 Do you have any views on whether this approach could be implemented, and values produced within the required timeframe? **Questions on Option 3 - Extrapolating the VCR for standard outages beyond 12 hours** 3.5.1 Do you believe this approach is appropriate to value consumer resilience for outages greater than 12 hours? Please explain why. 3.5.2 Can you see any potential advantages in using this approach? 3.5.3 Can you see any potential challenges in using this approach? 3.5.4 Do you have any views on whether this approach could be implemented and values produced within the required timeframe? **Questions on Option 4 - Conducting follow-up surveys to actual prolonged outages** 3.6.1 Do you believe this approach is appropriate to value consumer resilience for outages greater than 12 hours? Please explain why. 3.6.2 Can you see any potential advantages in using this approach? 3.6.3 Can you see any potential challenges in using this approach? 3.6.4 Do you have any views on whether this approach could be implemented and values produced within the required timeframe? 3.6.5 Do you have any views on whether residential and/or business survey outcomes from one outage event or network could be used as a proxy for other outage events or networks? **Questions on Option 5 - Using modelling to estimate a value** 3.7.1 Do you believe this approach is appropriate to VNR for outages greater than 12 hours? Please explain why. 3.7.2 Do you have any views on which model(s), if any, may be appropriate for estimating a VNR? 3.7.3 Can you see any potential advantages in using this approach? 3.7.4 Can you see any potential challenges in using this approach? 3.7.5 Do you have any views on whether this approach could be implemented and values produced within the required timeframe?

Topic	Question
	Questions on Option 6 - Exploring other cost data 3.8.1 Do you believe this approach is appropriate to value network resilience for outages greater than 12 hours? Please explain why. 3.8.2 Can you see any potential advantages in using this approach? 3.8.3 Can you see any potential challenges in using this approach? 3.8.4 Are there any data sources that you think would be useful for this type of analysis? Do you know who may be able to supply the data you have identified? 3.8.5 Do you have any views on whether this approach could be implemented and values produced within the required timeframe?

Glossary

Term	Definition
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
Capex	Capital expenditure
CBA	Cost-benefit analysis
CGE	Computable general equilibrium
DNSP or distributor	Distribution network service provider
ECMC	Energy and Climate Change Ministerial Council
HILP	High impact, low probability
IO	Input-output
NEL	National Electricity Law
NEM	National Electricity Market
NER	National Electricity Rules
NSPs	Network service providers
Opex	Operating expenditure
SAPN	SA Power Networks
SAPs	Stand Alone Power System
STPIS	Service Target Performance Incentive Scheme
VCR	Value of customer resilience
VNR	Value of network resilience
VNR2024 SRG	Value of network resilience stakeholder reference group
WALDO	Widespread and long duration outages