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energy market consulting associates

Essential Energy 2024 to 2029 Regulatory Proposal

REVIEW OF ESSENTIAL ENERGY'S PROPOSED EXPENDITURE FOR CLIMATE-DRIVEN NETWORK RESILIENCE

Report prepared for:

AUSTRALIAN ENERGY REGULATOR

August 2023

Preface

This report has been prepared to assist the Australian Energy Regulator (AER) with its determination of the appropriate revenues to be allowed for the prescribed distribution services of Essential Energy from 1st July 2024 to 30th June 2029. The AER's determination is conducted in accordance with its responsibilities under the National Electricity Rules (NER).

This report covers a particular and limited scope as defined by the AER and should not be read as a comprehensive assessment of proposed expenditure that has been conducted making use of all available assessment methods nor all available inputs to the regulatory determination process. This report relies on information provided to EMCa by Essential Energy. EMCa disclaims liability for any errors or omissions, for the validity of information provided to EMCa by other parties, for the use of any information in this report by any party other than the AER and for the use of this report for any purpose other than the intended purpose. In particular, this report is not intended to be used to support business cases or business investment decisions nor is this report intended to be read as an interpretation of the application of the NER or other legal instruments.

EMCa's opinions in this report include considerations of materiality to the requirements of the AER and opinions stated or inferred in this report should be read in relation to this over-arching purpose.

Except where specifically noted, this report was prepared based on information provided to us prior to 16th June 2023 and any information provided subsequent to this time may not have been taken into account. Some numbers in this report may differ from those shown in Essential Energy's regulatory submission or other documents due to rounding.

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ABBREVIATIONS

Term	Definition
ABC	Aerial Bundled Conductor
AEMC	Australian Energy Market Commission
AER	Australian Energy Regulator
BAU	Business-as-usual
BCR	Benefit to cost ratio
BoM	Bureau of Meteorology
CBA	Cost Benefit Analysis
CB's	Circuit Breakers
CCT	Covered Conductor Thick
CFI	Case for Investment
CoF	Consequence of failure
CSIRO	Commonwealth Scientific Industrial Research Organisation
DNSPs	Distribution Network Service Providers
DT	Dead-tank
EAC	Equivalent Annualised Cost
ECL	East Coast Low
ESCI	Electricity Sector Climate Information
FFDI	Forest Fire Danger Index
GCMs	Global Climate Models
LGA	Local Governance Authority
NARCLiM	NSW and Australian Regional Climate Modelling
NEM	National Electricity Market
NER	National Electricity Rules
next RCP	2024-2029 regulatory control period
NPV	Net Present Value
NSP	Network Service Provider
NSW	New South Wales
PoF	Probability of failure
RCMs	Regional Climate Models
RCP	Regulatory Control Period
RCP	Representative Concentration Pathway
RIT-D	Regulatory Investment Test for Distribution

Term	Definition
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SAPS	Stand-alone Power Systems
SCADA	Supervisory Control and Data Acquisition
SCW	Severe Convective Winds
STPIS	Service Target Performance Incentive Scheme
the Royal Commission	Royal Commission into National Natural Disaster Arrangements
VCR	Value of Customer Reliability
WALDO	Widespread and Long Duration Outages

1 INTRODUCTION

The AER has asked us to review and provide advice on Essential Energy's proposed allowance for climate change-related network resilience capital expenditure for the 2024-29 Regulatory Control Period (next RCP). Our review is based on information that Essential Energy provided and on aspects of the National Electricity Rules (NER) relevant to assessment of expenditure allowances.

1.1 Purpose of this report

1. The purpose of this report is to provide the AER with a technical review of aspects of the proposed climate-driven network resilience capex forecast included in the revenue proposal for Essential Energy for the 2024-29 regulatory control period (next RCP).
2. The assessment contained in this report is intended to assist the AER in its own analysis of the proposed capex allowance as an input to its Draft Determination on Essential Energy's revenue requirements for the next RCP.

1.2 Scope of requested work

3. The AER is seeking a technical review of aspects of the capex forecasts proposed to be included in each of the NSW DNSPs[1] distribution revenue allowance for the next RCP, and which was submitted to the AER in January 2023.[2]
4. The scope of this review will include advice to the AER on the investment cases and cost benefit analysis provided in support of the proposed capital expenditure for climate change driven network resilience, where the term network resilience is defined in the AER guidance note.[3]
5. In Figure 1.1 we provide the scope of services requested by the AER for Essential Energy.

Figure 1.1: Scope of services[4]

A targeted review

The consultant is required to undertake a targeted review on certain aspects of the NSP's expenditure proposals. These proposals were submitted in January 2023. A targeted review is required on Essential Energy's capex and opex forecast for Climate/Network resilience.

Work requirements

A(i) Climate/Network resilience

To assist the AER in its assessment as to whether Essential Energy's forecast expenditure for climate/network resilience is prudent and efficient consistent with clause 6.5.7 of the NER, the consultant is required to provide advice to the AER on

1 Ausgrid, Essential Energy and Endeavour Energy

2 As described in the RFQ, AER order for services issued to EMCa and subsequent advice received by email clarifying the scope of works

3 AER guidance note 2022, Network resilience – a note on key issues

4 The scope of expenditure that we have been asked to review was updated following clarification from each DNSP, and is presented in section 3 of this report

the investment cases and cost benefit analysis provided in support of this expenditure. In particular, the consultant must consider:

- *Whether Essential Energy has sufficiently demonstrated a causal relationship between the proposed expenditure and the expected increase in extreme weather events; and*
- *Whether 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.*

The consultant is required to assess the projects/programs associated with the proposed expenditure of $229 million quoted in Essential Energy's proposal.

As part of the assessment, the consultant is also required to:

- *Identify any overlap with other proposed expenditure; and*
- *Flag any proposed expenditure associated with community resilience that would require further review.*

Other requirements

The consultant will be provided with all material Essential Energy has provided to the AER in support of their expenditure proposals. The consultant is to have regard to this information and any other information it has available to it in coming to its advice.

Separate face-to-face workshops with Essential Energy to deep dive into aspects of their proposals.

The consultant will set out its advice and findings in draft and final reports. This advice must be in sufficient detail to enable the AER to interpret and apply the NER.

The consultant is to provide its reasons in the report and provide any relevant workings to the AER.

The consultant is to engage with the NSPs including any information requests, through the AER.

Source: AER Order for Services issued to EMCa (extract of items related to this report)

6. In discussions with the AER, the focus of the review is on the proposed capex forecast related to climate-change driven network resilience. The AER is not seeking us to form a view on the reasonableness of Essential Energy's overall capex forecast or, where proposed, for capex that it has proposed for network resilience that is not presented as being driven by climate change nor for climate change-related expenditure that is not to provide network resilience (such as for 'community resilience'). Where we refer to network resilience or climate resilience in this report, we do so with reference to this definition of our scope.

7. In preparing our findings, we are required to have regard to the AER's role under s.6 of the NER and the AER's forecast assessment guidelines.

1.3 Our review approach

1.3.1 Approach overview

8. In conducting this review, we first reviewed the regulatory proposal documents that Essential Energy had submitted to the AER. This includes a range of appendices and attachments to Essential Energy's regulatory proposal and certain Excel models, and which are relevant to our scope.

9. We next collated some information requests. AER combined these with information request topics from its own review and sent these to Essential Energy.

10. In conjunction with AER staff, our review team met with Essential Energy at its offices on 19 April 2023 including team members via teleconference. Essential Energy presented to our team on the scoped topics and we had the opportunity to engage with Essential Energy to consolidate our understanding of its proposal.

11. Essential Energy provided AER with responses to information requests and, where they added relevant information, these responses are referenced within this review. We also participated in follow-up discussions with the AER and with Essential Energy on 10 May to clarify information provided.

12. We have subjected the findings presented in this report to our own peer review and QA processes and we presented summaries of our findings to AER prior to finalising this report.

13. The limited nature of our review does not extend to advising on all options and alternatives that may be reasonably considered by Essential Energy, or on all parts of the capex forecast. We have included additional observations in some areas that we trust may assist the AER with its own assessment.

1.3.2 Conformance with NER requirements

14. In undertaking our review, we have been cognisant of the relevant aspects of the NER under which the AER is required to make its determination.

Capex Objectives and Criteria

15. The most relevant aspects of the NER in this regard are the 'capital expenditure criteria' and the 'capital expenditure objectives.' Specifically, the AER must accept the Network Service Provider's (NSP's) capex proposal if it is satisfied that the capex proposal reasonably reflects the capital expenditure criteria, and these in turn reference the capital expenditure objectives.

16. We have taken particular note of the following aspects of the capex criteria and objectives:

- Drawing on the wording of the first and second capex criteria, our findings refer to efficient and prudent expenditure. We interpret this as encompassing the extent to which the need for a project or program has been prudently established and the extent to which the proposed solution can be considered to be an appropriately justified and efficient means for meeting that need;
- The capex criteria require that the forecast '*reasonably reflects'* the expenditure criteria and in the third criterion, we note the wording of a '*realistic expectation'* (emphasis added). In our review we have sought to allow for a margin as to what is considered reasonable and realistic, and we have formulated negative findings where we consider that a particular aspect is outside of those bounds;
- We note the wording '*meet or manage'* in the first capex objective (emphasis added), encompassing the need for the NSP to show that it has properly considered demand management and non-network options;
- We tend towards a strict interpretation of compliance (under the second capex objective), with the onus on the NSP to evidence specific compliance requirements rather than to infer them; and

- We note the word '*maintain*' in capex objectives 3 and 4 and, accordingly, we have sought evidence that the NSP has demonstrated that it has properly assessed the proposed expenditure as being required to reasonably maintain, as opposed to enhancing or diminishing, the aspects referred to in those objectives.

17. The NER's capex criteria and capex objectives are reproduced below.

Figure 1.2: NER capital expenditure criteria

NER capital expenditure criteria

(c) The AER must:

*(1) subject to subparagraph (c)(2), accept the forecast of required capital expenditure of a Distribution Network Service Provider that is included in a building block proposal if the AER is satisfied that the total of the forecast capital expenditure for the regulatory control period reasonably reflects each of the following (**the capital expenditure criteria**):*

(i) the efficient costs of achieving the capital expenditure objectives;

(ii) the costs that a prudent operator would require to achieve the capital expenditure objectives; and

(iii) a realistic expectation of the demand forecast and cost inputs required to achieve the capital expenditure objectives.

Source: NER 6.5.7(c) Forecast capital expenditure, v200

Figure 1.3: NER capital expenditure objectives

NER capital expenditure objectives

*(a) A building block proposal must include the total forecast capital expenditure for the relevant regulatory control period which the Distribution Network Service Provider considers is required in order to achieve each of the following (**the capital expenditure objectives**):*

(1) meet or manage the expected demand for standard control services over that period;

(2) comply with all applicable regulatory obligations or requirements associated with the provision of standard control services;

(3) to the extent that there is no applicable regulatory obligation or requirement in relation to:

(i) the quality, reliability or security of supply of standard control services; or

(ii) the reliability or security of the distribution system through the supply of standard control services,

to the relevant extent:

(iii) maintain the quality, reliability and security of supply of standard control services; and

(iv) maintain the reliability and security of the distribution system through the supply of standard control services; and

(4) maintain the safety of the distribution system through the supply of standard control services.

Source: NER 6.5.7(a) Forecast capital expenditure, v200

1.3.3 Technical review

18. Our assessments comprise a technical review. While we are aware of consumer and stakeholder inputs on aspects of what Essential Energy has proposed, our technical assessment framework is based on engineering considerations and economics.

19. We have sought to assess Essential Energy's expenditure proposal based on Essential Energy's analysis and Essential Energy's own assessment of technical requirements and economics and the analysis that it has provided to support its proposal. Our findings are therefore based on this supporting information and, to the extent that Essential Energy may subsequently provide additional information or a varied proposal, our assessment may differ from the findings presented in the current report.

20. We have been provided with a range of reports, internal documents, responses to information requests and modelling in support of what Essential Energy has proposed and our assessment takes account of this range of information provided. To the extent that we found discrepancies in this information, our default position is to revert to Essential Energy's regulatory submission documents as provided on its submission date, as the 'source of record' in respect of what we have assessed.

1.4 About this report

1.4.1 Report structure

21. The following sections of our report are structured as follows:

- In section 2, we present relevant context to our review;
- In section 3, we present what Essential Energy has proposed for network resilience, as the basis for our assessment; and
- In section 4, we describe our assessment of Essential Energy's proposed capex allowance, and our findings on the prudency and efficiency of that allowance for network resilience.

22. In Appendix A, we provide a comparison of the key assumptions applied for the proposed network resilience expenditure for each of the NSW DNSPs that we have been asked to review.

23. We have taken as read the material and analysis that Essential Energy provided, and we have not sought to replicate this in our report except where we consider it to be directly relevant to our findings.

1.4.2 Information sources

24. We have examined relevant documents that Essential Energy has published and/or provided to AER in support of the areas of focus and projects that the AER has designated for review. This included further information at virtual meetings and further documents in response to our information requests. These documents are referenced directly where they are relevant to our findings.

25. Except where specifically noted, this report was prepared based on information provided by AER staff prior to 16 June 2023 and any information provided subsequent to this time may not have been taken into account.

26. Unless otherwise stated, documents that we reference in this report are Essential Energy documents comprising its regulatory proposal and including the various appendices and annexures to that proposal.

27. We also reference information responses, using the format IR#XX being the reference numbering applied by AER. Noting the wider scope of AER's determination, AER has provided us with IR documents that it considered to be relevant to our review.

1.4.3 Presentation of expenditure amounts

28. Expenditure is presented in this report in $2024 real terms, to be consistent with Essential Energy's regulatory proposal unless stated otherwise. In some cases, we have converted to this basis from information provided by the business in other terms.

29. While we have endeavoured to reconcile expenditure amounts presented in this report to source information, in some cases there may be discrepancies in source information provided to us and minor differences due to rounding. Any such discrepancies do not affect our findings.

2 RELEVANT CONTEXT

Our review is conducted in the context that climate change is a global issue with localised impacts. Recent extreme weather events and more broadly trends in a changing climate are being experienced in Australia and felt at a local level by communities. This is occurring against a backdrop of the energy transition.

For electricity networks, this creates a prima facie case for considering the need to build resilience and adaptation to climate change into the provision of their network services.

We have necessarily undertaken our review in accordance with the current planning and regulatory framework that applies to electricity networks. We also provide a summary of the AER guidance provided on climate resilience, and which we have taken into account as a part of our assessment.

In assessing the need and justification for expenditure to mitigate the impacts of climate change, there is a need to make use of available climate change models, and to be able to justifiably deduce from this the potential impacts on the relevant electricity network and the services it provides. It is then necessary to identify potential interventions that may mitigate the impact on network services and to assess to what extent such solutions might be justified, taking account of the timeframe over which such impacts are best addressed.

These models, and the information on the impact of a changing climate on which they rely, continue to mature. This raises the significant possibility of later regret, from overinvestment in the short term predicated on assumptions regarding uncertain long-term impacts that could potentially be addressed more effectively on a more progressive basis. In the face of such uncertainty, there is an option value to undertaking investment progressively and of being able to adapt risk mitigation responses as both the climate impacts on the network and the efficacy of particular intervention solutions, become better understood. We have therefore focussed our assessment on the extent to which the NSP has justified its proposed mitigation measures against its assessment of a projected increase in climate related risks to its network assets, for expenditure in the next RCP.

Finally, we summarise the implications of the material factors we have identified in the assessment of the proposed capex for the categories of expenditure we have been asked to review.

2.1 Climate change and the regulatory landscape

30. In Australia, there have been a number of recent natural disaster events that had a significant negative impact to our communities and economy, disrupting lives, and threatening our environment – namely bushfires and floods. Weather patterns appear to be increasingly variable.

31. The commonwealth government has established a clear strategic response to climate change which includes the climate impacts, risks and challenges Australia faces, and what actions the Government is taking and is committed to taking. In addition to a set of policy

measures for emissions reduction, there are a range of climate change agencies responsible for adapting to climate change.[5]

32. As noted in Australia's first annual climate statement[6] published in 2022, Australia's national adaptation efforts are underpinned by nationally agreed roles and responsibilities, built on the foundation that risks are dealt with most effectively by empowering those who are best placed to manage them.

2.1.1 Australian climate trends

33. According to both the Bureau of Meteorology (BoM) and the Commonwealth Scientific Industrial Research Organisation (CSIRO) Australia will experience ongoing future climate changes.

34. It is widely acknowledged that weather has an impact on Australia's energy system. As the climate changes, this impact is likely to increase.

35. In response the emerging risks to the National Electricity Market (NEM), the Electricity Sector Climate Information (ESCI) project[7] was launched to improve climate and extreme weather information for the electricity sector. According to the government website,[8] the ESCI project provides information for the electricity sector on likely future climate change scenarios. This is described as being to assist the NEM in being more resilient to climate change and extreme weather events.

36. Specifically, the project has delivered climate and weather information to support electricity sector resilience to climate change and extreme weather events.

2.1.2 Impact to communities of natural disasters and extreme weather events

37. A number of inquiries have looked into responses to natural disaster events, such as the NSW Bushfire Inquiry and the Royal Commission into National Natural Disaster Arrangements (the Royal Commission). As noted by the AER in its guidance note, recommendations from these inquiries focus on actions to address future preparedness for, response to, and recovery from, natural disasters. These inquiries highlighted the importance of "community resilience"– the ability of communities to withstand and recover from the impacts of natural disasters – and the role that different entities need to play to support community resilience.

38. More recently, Resilience NSW and the National Recovery and Resilience Agency have also been set up to assist in supporting communities affected or likely to be affected by natural disasters.

39. In 2022, the electricity distribution businesses in NSW/ACT/TAS/NT commissioned a report titled NSW/ACT/TAS/NT Electricity Distributors, Network Resilience - 2022 Collaborative Paper on Network Resilience. The objective of this report was to understand how DNSPs can best support the communities served in adapting to a changing climate over the next 10 years and the increased community reliance on reliable electrical networks.

40. Community-led approaches to disaster preparedness is critical, adopting a collaborative approach to building resilience. The role of NSPs in supporting network resilience is a collaborative one, shared with government, critical infrastructure operators, individuals and communities who all play a role in supporting community resilience.[9]

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5 https://www.dcceew.gov.au/climate-change/strategies

6 https://www.dcceew.gov.au/sites/default/files/documents/annual-climate-change-statement-2022.pdf

7 The ESCI project is a collaboration between CSIRO, the Bureau of Meteorology and the Australian Energy Market Operator. The Department of Industry, Science, Energy and Resources provided funding for the project.

8 https://www.energy.gov.au/government-priorities/energy-security/electricity-sector-climate-information-esci-project

9 This was emphasised also in the Royal Commission into National Natural Disaster Arrangements, Final Report, 2020, p. 230.

2.1.3 Industry in transition

Network investments and the transition to renewables and storage

41. In addition to responding to the need to build greater resilience, the NEM is experiencing a significant transition away from reliance on thermal generation towards renewable generation and storage. This is supported by the Powering Australia Plan including reducing emissions by boosting renewable energy.

42. As a result, the location of these larger renewable energy sources is also shifting to be more geographically distributed and diverse. This will require a substantial investment in transmission infrastructure to enable connection of these new technologies and to facilitate benefits for consumers by way of a lower cost of electricity.

43. At the same time, there has been significant growth in distributed energy resources led by roof-top solar. Customers are now more engaged with their energy system, which is demanding different services in terms of their ability to supply, consume and trade energy. This has implications for investments in energy infrastructure, and digital applications and infrastructure to support changes in how the energy system is used.

44. Adaptation to climate change is a key driver of the energy transition. Not only will this result in investments in new technologies, but there is also likely to be an increasing level of investment required to build resilience of the energy system, to mitigate the negative impacts of changes to the climate on existing infrastructure.

45. We recognise the importance of the energy transition, the need to build resilience and adaptation to climate change and the role of all participants including the network service providers. We have necessarily undertaken our review in accordance with the current planning and regulatory framework. Nevertheless, to the extent that benefits are based on an assessment of a future energy systems, or a projection of a future climate scenario, it is necessary to consider the likelihood of continuing changes to technologies and also changes to the regulatory and planning framework that may affect justification for projects of this type.

Taking account of uncertainty

46. Given the factors described above, and the reality that network investments tend to be both capital-intensive and attract long technical / economic lives, it is particularly necessary to consider option value in assessing deep investments into the electricity network.

47. Considerations of option value and the timeframe over which benefits are adequately able to be modelled, can help to ensure that any network investment is prudent and efficient in accordance with the regulatory objectives. This in turn helps in meeting the objective of ensuring that consumers do not end up paying the risk costs of projects that are developed earlier than required or which become stranded or 'regretted' due to changes in the electricity market, energy system, climate and the technologies deployed there.

48. While we have considered the factors described above, we also caution that these matters are best assessed as part of a regulatory investment test for each investment. No inference from our assessment should be drawn on the need for or benefit of projects generally or their role in facilitating the transition to renewables or adaptation to climate change.

2.2 Relevant AER Guidelines

2.2.1 Network resilience guidance note

49. In April 2022, the AER released its guidance note on the key issues of network resilience.[10]

[10] AER guidance note 2022, Network resilience – a note on key issues. Accessed on 1 June 2023 at https://www.aer.gov.au/system/files/Network%20resilience%20-%20note%20on%20key%20issues.pdf

50. The AER has described the purpose of this guidance note to:[11]

> *'..support broader discussions around network resilience, the AER is publishing a note to assist Network Service Providers (NSPs), consumer groups and advocates understand how resilience-related funding would be treated under the NER.'*

Defining network resilience and community resilience

51. The AER has defined network resilience as:[12]

> *'..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.'*

52. The AER has described the relationship between network resilience and community resilience as:[13]

> *'Network resilience has sometimes been used interchangeably with community resilience. These are different but related concepts. A resilient electricity network can assist in building community resilience. But many different entities have a role in supporting communities to withstand and recover from the impacts of natural disasters. Government bodies, individuals themselves and several critical infrastructure operators (beyond electricity networks) have a role to support community resilience.'*

Assessment under the NER

53. In the guidance note, the AER states that it will have regard to the following factors when assessing any funding for network resilience:[14]

- future network needs may not be the same as they are today.
- there is uncertainty as to what the future network needs are.
- there is also uncertainty from other related areas like changes in demand and energy mix as well as technological advances.
- consumer and community preferences will be very important in our consideration.

54. The focus of network resilience is typically to improve service level outcomes that the network provides to consumers. One of the methods available to assess the benefits of proposed expenditure is by measuring the value customers place on reliable electricity. Others may extend to the value of safety and security of the network. In its guidance note, the AER acknowledges the limitations in the application of the Value of Customer Reliability (VCR) for Widespread and Long Duration Outages (WALDO) to accommodate longer unplanned outages with localised impacts.[15] The AER encourages NSPs to demonstrate consumer preferences for proposed resilience-related expenditure using other supporting evidence.

55. The AER nominated a framework for evidence to support resilience expenditure as being prudent and efficient to achieve the expenditure objectives, to demonstrate, within reason, that:[16]

1. there is a causal relationship between the proposed resilience expenditure and the expected increase in the extreme weather events.
2. 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.

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11 AER guidance note 2022, Network resilience – a note on key issues, page 4

12 AER guidance note 2022, Network resilience – a note on key issues, page 6

13 AER guidance note 2022, Network resilience – a note on key issues, page 7

14 AER guidance note 2022, Network resilience – a note on key issues, page 9

15 AER guidance note 2022, Network resilience – a note on key issues, page 10

16 AER guidance note 2022, Network resilience – a note on key issues, page 11

3. 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.

2.3 Implications for our review

As consultants to the AER, our assessment reflects our scope of review including the AER's definition of network resilience

56. Resilience of an electricity network may extend beyond climate change or weather-related risks to also encompass system strength and under-frequency related risks and can also extend to business continuity and cyber security risks. However, the focus of our review aligns with our terms of reference, which ask us to focus on resilience to any increase in risks related to climate change.

57. Furthermore, resilience-related funding is considered to be accommodated by the NER even though it is not explicitly mentioned in the NER.

Climate change is a global issue with localised impacts

58. Our scope of review does not extend to review of the supporting evidence of the science behind climate change or climate change projections. However, to determine its network resilience response and propose network resilience expenditure we expect the NSP to have had regard to evidence of climate change and climate change projections and to have established a causal link between a projected increase in extreme weather events and its proposed expenditure. For this purpose, we have considered the evidence relied upon by the NSP.

59. Factors that determine future climate change include scenarios for future greenhouse gas (GHG) emissions. We have not reviewed, nor have we been requested to review, the methods and tools used to make projections of climate, impacts and risks, and their development by the Intergovernmental Panel on Climate Change (IPCC) of the UN. Global climate models (GCMs) and Earth System Models (ESMs) provide the large-scale picture of the climate and the climate change signal as well as interactions between the components of the global earth system. However, lower resolution models are required to determine resilience and adaptation options at a local level.

60. Regional climate models (RCMs) are climate models in spatially limited domains, and which are developed based on GCMs with enhanced grid resolution that allows for a more realistic regional climate response.

61. To understand the likely impacts of changes to the climate, as a result of increasing levels of greenhouse gases to the atmosphere, NSPs have made reference to the greenhouse gas concentration trajectory adopted by the IPCC referred to as Representative Concentration Pathways (RCP). RCPs represent the range of GHG emissions established by other studies. They include a stringent mitigation scenario (RCP2.6) which is generally considered a low scenario; two intermediate scenarios (RCP4.5 and RCP6.0), and one scenario with very high GHG emissions (RCP8.5).

62. The impacts identified by these models have the potential to profoundly affect the provision of network services and have direct impact to communities that these networks serve at a local level. In the past, the localised impacts of changes in climate have been linked to severe bushfires, storms and floods.

Recognising the uncertainty of available climate models

63. The future is inherently uncertain and these uncertainties are inherent in the available climate models, climate impact modelling and modelling of potential mitigation interventions that NSPs may adopt. Importantly, the available models provide future scenarios and are not a single-path prediction of the future.

64. In our review, we have sought to understand the steps taken by the NSP to take account of the uncertainties of the available models and model outputs and to explore system sensitivities and vulnerabilities, to identify appropriate low-regret resilience options and their timing to be tested against the requirements of the NER.

65. Accordingly, our review considers the extent to which the NSP has demonstrated that the proposed expenditure reflects prudent and efficient investment to prevent or mitigate risks and/or their consequence to the network, associated with adverse outcomes of extreme weather events for consumers.

Evolving nature of climate models and their projections

66. The methods and tools used to make projections of climate, impacts and associated risks are evolving rapidly. We expect that as the models improve, there can be greater confidence in the ability to more accurately understand the nature of impacts and the efficacy of risk mitigation options.

67. We understand that climate models are reasonably accurate at simulating temperature. However, our understanding is that the accuracy is much less for the simulation of rainfall and windstorm and becomes still less accurate the more granular the locality being considered. Recognition of current levels of uncertainty regarding specific impacts at a local level, and the likelihood of their improvement, speaks to the need to carefully consider option value and potential regret in assessments of proposed investments in the short to medium term, where these are predicated on assumed long-term impacts.

We have assessed the classification of network resilience as proposed by the NSP

68. In the guidance note, the AER acknowledges that:[17]

> *'..NSPs play an important role in the provision of essential services to communities in the leadup to, during and after a natural disaster. There are regulatory and statutory requirements that prescribe minimum service levels or standards to ensure continued supply and restoration of services following unplanned outages. It is important to note that the role of NSPs in supporting network resilience is a collaborative one with other responsible entities.'*

69. As noted in the guidance note, we have considered the delineation of roles that different entities may have in supporting network resilience as a part of our assessment of the proposed resilience capex, and its relationship with community resilience expenditure. Our scope of review does not extend to assessment of expenditure proposed for community resilience.

We have had regard to the assessment framework included in the guidance note

70. The guidance note includes reference to four factors to take account of as a part of the assessment of proposed network resilience funding. We have also taken account of the framework proposed by the AER in the guidance note for supporting evidence.

71. Our assessments comprise a technical review. While we are aware of consumer and stakeholder inputs on aspects of what Essential has proposed, our technical assessment framework is based on engineering considerations and economics.

[17] AER guidance note 2022, Network resilience – a note on key issues, page 14

3 WHAT ESSENTIAL ENERGY HAS PROPOSED

Essential Energy has proposed climate-related network resilience expenditure totalling $127 million (capex) over the next RCP, to mitigate the effects of what it envisages as an increase in network service-related risks due to climate change. Two-thirds of the proposed amount is proposed to replace a larger number of poles than it has allowed for under its repex program, with a view to offsetting increased bushfire-related risks. Almost all of the remainder of its proposed investment is to provide for undergrounding and for standby generation at selected radio sites that are part of its infrastructure, to improve resilience of its network and mitigate the projected increase in risks from extreme weather events.

3.1 Overview

72. Essential Energy has proposed climate-related resilience expenditure in the next RCP of $229 million,[18] however this is inclusive of overheads. We have based our assessment on the direct costs only.

73. We also identified an issue with reconciliation of what was stated as resilience expenditure in Essential Energy's regulatory proposal and the capex model provided by Essential Energy. We understand the investment cases are noted by Essential Energy to be in mid-year $FY24 and this has accounted for some of the differences.

74. The AER has provided an updated version of the capex model submitted by Essential Energy in response to information request IR029, and we have relied on this for our assessment. This includes capex of $127.0 million for climate-driven network resilience and this is the subject of our assessment. Essential Energy has proposed a further $14.4 million being for 'community resilience'.

75. The breakdown of the forecast capex for network resilience is as shown in Table 3.1. Essential Energy has allocated the proposed capex to each of the RIN expenditure categories as shown.

Table 3.1: Total network resilience capex for next RCP by year ($m real 2024)

Expenditure by category	2024-25	2025-26	2026-27	2027-28	2028-29	Total RCP
Repex	20.5	20.5	20.7	20.9	21.0	103.6
Augex	4.7	3.6	5.8	3.4	5.8	23.4
Total	**25.2**	**24.1**	**26.5**	**24.4**	**26.8**	**127.0**

Source: Essential Energy – Capex Model – 20230526 provided with IR029

76. The list of proposed projects that comprise Essential Energy's forecast capex for network resilience is as shown in Table 3.2.

[18] Essential Energy - –Regulatory Proposal, page 70

Table 3.2: Total network resilience capex by project for next RCP by year ($m real 2024)

Project expenditure	2024-25	2025-26	2026-27	2027-28	2028-29	Total RCP
RP14 - Poles - Resilience	16.8	16.9	17.0	17.3	17.3	85.3
RP21 - Underground Cables - Resilience	3.7	3.7	3.7	3.7	3.7	18.3
Resilience - Solar & battery backup radio sites	0.3	0.3	0.3	0.3	0.3	1.7
Resilience - Microgrid / generation	3.4	2.3	4.5	2.2	4.5	16.9
Resilience - Mobile strategic spares	1.0	1.0	1.0	1.0	1.0	4.8
Total	**25.2**	**24.1**	**26.5**	**24.4**	**26.8**	**127.0**

Source: Essential Energy – Capex Model – 20230526 provided with IR029

3.2 Summary of the basis for Essential Energy's proposed expenditure

77. As a new program for the next RCP, there is no separately identified expenditure for 'resilience' in the current RCP. Essential Energy recognises in their submission, and in discussions with the AER, that 'resilience' has been historically built into repex and augex, however the standards to which this has been achieved implicitly assumed no increasing negative impacts associated with climate change relative to historical levels.

78. Essential Energy has claimed adherence to the AER guidance note and we have reviewed these claims as a part of our assessment.

Identified need

79. Essential Energy has claimed that the change in climate will (unless mitigated) result in an increasing level of risk to supply interruptions to customers. Essential Energy states that the proposed program is aimed at mitigating the increase in climate-related risk compared with current levels.

80. Essential Energy claim that the 'lived experience' of consumers across Australia has demonstrated an increase in climate events. Essential Energy specifically refers to major incidents that have occurred in 2007, 2015, 2020 in Essential Energy's network area.

Forecasting of requirements

81. Essential Energy engaged Risk Frontiers and KPMG to model the expected impact of climate change on network assets and the customer experience[19]and which we understand resulted in the development of several models:

- Climate model – Climate data is collected by Risk Frontiers and this data is used as inputs to its proprietary models to produce input data for catastrophic loss and climate parameters to the risk assessment.
- Climate/network impact model – the results of the climate risk impact assessment by KPMG of the climate futures on Essential Energy's network.
- Economic models – the CBA models[20] developed by Essential Energy providing the costs and benefits of each of the proposed resilience investments.

[19] Essential Energy - 6.02 Resilience Plan 2024–29 - Jan 2023, page 12

[20] Also referred to as NPV models

82. KPMG and Risk Frontiers has provided a forecast of the impacts of climate change on network assets and supply reliability to Essential Energy. Essential Energy has included projects to address bushfire, windstorm and flood impacts. Essential Energy describes the application of the climate impact modelling as follows: [21]

> *'The severity and frequency of bushfires, floods and windstorms due to climate change is factored into investment benefit calculations to ensure network resilience is considered for composite poles and undergrounding at this stage.'*

83. The climate impact assessment has considered the impacts of Representative Concentration Pathway RCP4.5 and RCP8.5 scenarios, however its projects appear based on its assumed central case of RCP4.5 with 100% weighting.

Proposed solutions

84. Essential Energy proposes a range of solutions as shown in Table 3.3 below.

Table 3.3: Solutions included in network resilience expenditure

Program	Benefits and net present value (NPV)	Proposed capex ($m FY24)	Volume
Resilience risk based pole replacement	Reduced outage frequency and impact of major weather events. NPV +$67.4M	85.3	10,000 – 11,000 pole replacements [with composite pole technology]
Resilience undergrounding high-risk locations	Reduced outage frequency and impact of major weather events. NPV +$37.7M	18.3	40km OH assets undergrounded
Portable switchboards and transformers	Reduced outage time for customers and community services following natural hazard events. NPV +$7.8M	4.7	1x portable switchboard 2x 66/33/11kV 5-8MVA ZS 2x 66kV DT CBs 145kV DT CB 2x 33kV 4 recloser switch rooms
Radio sites solar and batteries	More reliable communications to assist in restoration of electrical network and improved staff safety. NPV +$15.1M	1.7	50 radio sites [with solar back-up]
Microgrids	Reduced outage duration and impact from major weather events. NPV as per individual business cases.	16.6	6 microgrid sites [with diesel standby gensets]

Source: IR014 – Resilience Capex. We note that the proposed capex included in this response differs slightly with the updated information included in IR029. Additional commentary has been added by EMCa as denoted by the square brackets

[21] Essential Energy - 6.02 Resilience Plan 2024–29 - Jan 2023, page 21

4 REVIEW OF ESSENTIAL ENERGY'S PROPOSED NETWORK RESILIENCE EXPENDITURE

For its proposed expenditure on poles and undergrounding, we consider that Essential Energy has not adequately demonstrated that its proposed volume is prudent, and that its need is not addressed by its underlying replacement programs. For the remaining programs of microgrids, radio sites and mobile spares, the driver appears to be primarily related to general reliability improvement, with a secondary benefit of providing improved resilience.

Components of the proposed expenditure do not reasonably satisfy the criteria for definition as 'climate resilience' as defined in AER's guideline as it has not been presented as being based on a causal relationship with increasing extreme weather events. These components may be more reasonably assessed by the AER as a part of other categories of expenditure.

Our assessment suggests that Essential Energy's proposed expenditure for network resilience does not reasonably satisfy the capex objectives of the NER and represents a considerable overstatement of prudent and efficient expenditure requirements.

4.1 Overview

85. We have reviewed the information provided by Essential Energy to support the proposed network resilience capex included in its climate resilience program, including its investment cases and relevant supporting information as outlined in section 3. Our focus is to assess the extent to which the forecast expenditure is likely to meet the NER criteria and the relevant AER guidance material.

86. In this section, we have considered:

- The investment need – to review the extent that Essential Energy has demonstrated a causal relationship between the proposed resilience expenditure and the expected increase in the extreme weather events, including the reasonableness of the assumptions of any risk modelling; and
- The economic modelling – to review (as relevant) the reasonableness of the approach taken by the business to model the benefits of the proposed program, including consideration of alternate options and option value.

87. We have included additional observations to assist the AER with its review, where issues we have identified may extend beyond the scope of our review and require further review by AER staff.

88. As requested by the AER, we have also considered the justification for specific investment cases where included by Essential Energy.

4.2 Our assessment

4.2.1 Investment need

The investment need for the portfolio of proposed expenditure is not clear

89. Essential Energy describes the drivers of its resilience expenditure as:[22]
    - Increasing impact of Major Event Days due to bushfires (FY20) and floods (FY21 & 22).
    - Customers concerned by impact of climate change on reliability of electricity in the future.
90. In its response to an information request (IR025) Essential Energy also stated that:[23]

    'During our extensive customer engagement program the topic of resilience to extreme weather events was covered at length with customers, who strongly supporting [sic] investments in initiatives aimed at reducing their exposure to these typically long duration outages...'

91. Essential Energy identified a number of investment options including the use of composite poles, undergrounding, standalone power systems, microgrids and improving community resilience. In turn, consumers were consulted on these options to test their respective investment appetite.
92. As outlined in section 2, we interpret the NER capex criteria as firstly encompassing the extent to which the need for a project or program has been prudently established and then determining the extent to which the proposed solution (or solutions) can be considered to be an appropriately justified and efficient means for meeting that need.
93. It is unsurprising, but also not particularly insightful, that customers supported investments that would reduce exposure to long duration outages. However, we consider that the early selection of discrete investment solutions with indicative volumes of work undermined the identification and justification of the extent of such need. Accordingly, absence of a clearly justified network need hindered the prudent and efficient selection of the scope and timing of the investment solution.

Modelling of increasing climate risk has been relied upon for two programs, which comprise the majority of the proposed expenditure

94. We understand that the modelling approach adopted by Essential Energy for each of the proposed climate resilience programs has been based on various data and models dependent on the type of expenditure:
    - The asset replacement resilience programs including at risk pole replacement and undergrounding are based on Essential Energy's standard asset Probability of Failure / Consequence of Failure (PoF/CoF) models. In addition to the standard PoF/CoF models, climate modelling has been used to modify the PoF forecasts for specific asset types. Standard CoF models have not been modified from the original calibrated standard models.
    - For the microgrid projects, the analysis has been based on reliability improvement using a combination of: (i) historical network reliability data for the areas of investment, and (ii) industry-based failure rates for diesel gensets.
    - For the radio site projects, the analysis is described as being based on application of Essential Energy's Value Framework and Network Risk Management to determine the value of lost operation through lost power to site. Individual sites were assessed based on history of having access impacted through Bushfire and/or Flood.[24]

[22] Essential Energy onsite presentation

[23] 1 Essential Energy - IR025 Resilience Capital Expenditure - 20230517 – Public, page 10

[24] As noted elsewhere in our report, we were not able to independently verify the modelling approach

- For the mobile spares, Essential Energy describes the development of its forecast using SME input to identify suitable portable equipment to 'make the network more resilient'. The benefits are assumed to arise from avoided unserved energy due to the shorter deployment time of mobile spares.

95. Climate risk impact modelling was undertaken by Essential Energy to support the need to invest in network strengthening options. The modelling focussed on three key perils related to those experienced by its customers being (i) Bushfire, (ii) Floods and (iii) Windstorm.

96. We sought to better understand how Essential Energy had applied the climate risk impact modelling to develop its proposed network resilience capex. We asked Essential Energy to describe how the outputs of the climate risk impact modelling were used to identify the programs. Essential Energy stated:[25]

> *'The modelling outputs provided us with a view of the changing risk profiles for each peril and the corresponding forecast asset functional failures expected to occur. These forecast functional failures (by location) were then utilised to assess a number of intervention options based on their effectiveness in addressing the specific failure modes.'*

97. In a subsequent response,[26] Essential Energy clarified that climate impact modelling had been limited to investments associated with (i) composite poles transition, (ii) risk based pole replacement, and (iii) undergrounding of high-risk spans. This accounts for the majority of the proposed climate resilience expenditure included for the next RCP.

Drivers of expenditure extend beyond increasing impact of climate risks

98. We understand that Essential Energy drew largely from what it described as the 'lived experience' of its customers from recent major weather events and from historic exposure to climate related failure modes to investigate potential solutions to address this exposure.

99. Whilst identified following extreme weather events, Essential Energy's forecasting approach for the programs that it describes as not based on its climate impact modelling, appear based on providing a reliability benefit to the affected customers.

100. We sought to understand the relationship of the proposed resilience capex programs to the proposed expenditure included in the capex portfolio for each relevant asset class, including other repex programs. Amongst other things, this information would assist us to understand how programs to improve resilience were prioritised against other programs in Essential Energy's capex forecast.

101. In response, Essential Energy replied that:[27]

> *'Essential Energy approached the forecast from a holistic perspective to achieve overall risk outcomes for the entire portfolio. Based on customer engagement, risk objectives were set (as per 6.03.04) for total portfolio outcomes. Resilience program outcomes/benefits have been included in the total portfolio outcome and thus have impacted the optimisation of other asset classes to meet the overall objectives.*
>
> *Resilience based microgrids pose a potential overlap to other reliability improvement programs such as poor performing feeders. Essential Energy has calculated the expected improvements and translated these into STPIS target adjustments, for details please refer to previously supplied 8.04 STPIS Approach – Jan 23 – Public.docx.'*

102. Essential Energy excluded microgrids and strategic spares programs from the presentation of total risk reduction for network risk (reliability) provided to us, to demonstrate how Essential Energy has 'maintained' the level of network risk.[28] However, Essential Energy describe the 'main risk constraint being managed' for its microgrid project as being network

25 Essential Energy - IR014 Resilience Capex - 20230412 – Public, question 3

26 1 Essential Energy - IR025 Resilience Capital Expenditure - 20230517 Public, question 3

27 Essential Energy - IR014 Resilience Capex - 20230412 – Public, page 4

28 1 Essential Energy - IR025 Resilience Capital Expenditure - 20230517 – Public, page 7

risk (reliability), based on historical reliability performance and industry failure rates. Instead, Essential Energy states that these programs have been included in reductions of Service Target Performance Incentive Scheme (STPIS) targets for the 2024-29 regulatory period. We are of the view that these programs – microgrid and strategic spares – reflect drivers of reliability improvement and should be considered alongside other reliability driven augex programs, including the impact of STPIS. We nonetheless have considered these drivers here for consideration of a broader review of augex by the AER.

Calibration of forecast asset failures appear to align with occurrence of the respective climate peril

103. Essential Energy describes its forecast of asset failures as follows:[29]

> *'To forecast the expected number of asset failures, the exposure was multiplied with a vulnerability coefficient depending on the severity of the peril and asset class*
>
> *- Initial asset class vulnerability values were derived by SME engineering judgement and informed by historical experience during past fire, flood and windstorm events*
>
> *- These values were calibrated such that the forecast asset failures for each peril and asset class were consistent to historic average (within reason given data/ assumption limitations)*
>
> *- Observation period of FY16 – FY21 (six years) was used as the calibration observation period with good data quality and what was believed to be a representative total network sample of 'current conditions'.'*

104. Bushfire modelling made use of burn rates and burn rate scaling:

- Burn Rates: The burn rates were used to determine whether an asset failed due to a bushfire. The burn rates were formulated based on the judgement of external and Essential Energy's engineers. The burn rates increased with the classification of the Forest Fire Danger Index (FFDI).
- Burn Rate Scaling: A burn rate scaling assumption was used to adjust the burn rates based on the density of the number of poles within a 1 km grid cell. This assumption assumed that the density of number of locations was a proxy for population and hence bushfire suppression effectiveness. The burn rate scaling assumptions were selected based on discussions with other NSW DNSPs.

105. For flood, the asset vulnerabilities were developed based on an assessment of flood depth (above ground level) before which an asset would fail (i.e. are electrically switched off) due to a flood. The flood replacement thresholds are the flood heights at which an asset is assumed to be damaged and required replacement.

106. For windstorm, asset vulnerability curves were initially derived from work done by other DNSPs globally. These were adjusted to calibrate the results to historical average and better reflect Essential Energy's assets and operating environment.

107. This suggests to us that the forecast of asset failures, is a factor of the occurrence of a peril, and which is what we would expect.

We have identified instances where the assumptions may lead to overstatement of the climate impact risk

108. Our review of the modelling has identified instances where the assumptions may be higher than would otherwise be assumed in Essential Energy's operating practices. For example:

- Essential Energy generally include failures of poles and pole-top assets as a single failure, as is represented in their historical failure data. However, in the model this is treated as two failures.

[29] Essential Energy presentation to AER and EMCa

- The calculation of the number of customers without supply and therefore energy at risk or value of un-served energy (VoUSE) doesn't account for staged restoration.

109. We reviewed the calibration methods, and we consider that the application by Essential Energy is likely to overstate the level of risk required to be addressed. We considered the extent to which this may be present as a part of our assessment of the economic analysis presented by Essential Energy and in the individual investment cases.

4.2.2 Economic analysis

CBAs have been provided for review

110. Essential Energy has provided an economic model for each of its resilience programs for our review.

111. For its at-risk pole replacement program, it uses Spotfire analysis that is uploaded into Copperleaf for portfolio optimisation. As we do not have access to either of these systems Essential Energy developed a spreadsheet which mimics the Spotfire analysis to assist our review of the proposed expenditure.

112. For other programs such as undergrounding associated asset models were not analysed by Essential Energy within Copperleaf, however the benefits of each program were included for the residual (outcome) risk profile within Copperleaf.

Assessment periods vary between CBAs

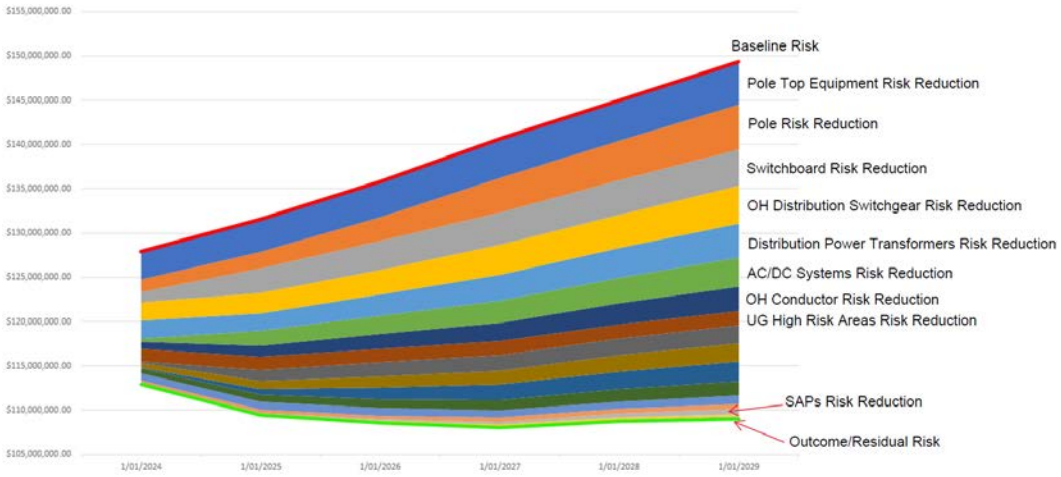
113. Essential Energy has claimed a positive NPV result for the projects and programs included in its proposed climate expenditure capex. This includes an assessment period based on the life of the assets proposed, including the life of options put forward for consideration. For example, the assessment period assumed for at-risk poles is undertaken over a 60-year period, based on a 60-year life for composite poles whereas for microgrids the assessment period is 40 years and for radio sites the assessment period is 20 years.

114. We generally consider that shorter investment periods are prudent given the high degree of uncertainty associated with network investments and the prudent application of option value and minimum regret strategies for a network to progressively undertake the necessary investments over such timeframes. As a minimum, we would expect to see, and did not see, evidence of sensitivity analysis around different assessment periods to be undertaken and presented in the business case.

The determination of an optimised portfolio and relationship to the proposed resilience program was not clear

115. Essential Energy has provided an illustration the Network Risk value component for the Network Risk (reliability) and the contribution of various programs to the achieve the final outcome/residual risk profile in Figure 4.1. This is based on the cumulative effect of reductions to the baseline risk shown by the red line.

Figure 4.1: Network risk profile by program ($ monetised risk)



Source: Information request IR025 Resilience Capital Expenditure

116. We understand that the baseline risk has been modified to include climate change risk increases for bushfire related pole failures, and therefore increases at a rate above that contributed by age and condition of the asset population.

117. As shown above, the majority of this risk is identified by the BAU asset replacement programs. We were not able to isolate the risk and programs for climate resilience only from this data, nor were we able to determine how the programs were optimised between asset replacement and climate resilience (where relevant).

118. As noted above, several of the resilience programs were not included in this process.

119. We understand from Essential Energy's system capital risk and value-based investment methodology (Attachment 6.03.04) that several portfolio optimisation scenarios were undertaken, and which considered variations of risk-based constraints. We consider the scenarios and sensitivity analysis by investment case further in this report.

120. We did not see evidence of the results from application of these scenarios to the proposed climate resilience expenditure, or the interaction between the repex, augex and climate resilience expenditure from the portfolio optimisation process more generally.

Optimisation has reduced the proposed volume of at-risk pole replacement

121. For at risk pole replacement, the scenarios presented by Essential Energy also considered fiscal and delivery constraints. [30]

> *'At the time of the draft plan Essential Energy was yet to complete climate change modelling and its impact on Essential Energy assets. As such Essential Energy had included the customer driven volumes as part of the draft proposal. Climate change modelling along with deliverability constraints drove changes in the volume of pole replacements in the portfolio. The decision to reduce was in line with outcomes of the risk valuation of the program which showed reduced value for the draft volumes once finalised climate change modelling was included. To ensure the prudency of the program the number of assets was reduced in line with the fiscal benefits being derived from the program.'*

122. We understand that the process described by Essential Energy led to a reduction of the proposed volume of its at-risk pole replacement from an initial volume of 25,000 to 15,000, and then subsequently reduced to approximately 11,000 poles as the basis of the volume that it has subsequently included with its regulatory proposal. We review the claimed prudency of the proposed volume of the at-risk pole replacement program in the following section.

30 1 Essential Energy - IR025 Resilience Capital Expenditure - 20230517 – Public, page 6

4.2.3 Investment cases

At risk pole replacement

The at-risk pole replacement forms part of a larger pole management program

123. Essential Energy has included an investment case for transition to composite poles and at risk pole replacement using composite poles. There are two components to its capex forecast for pole refurbishment and replacement:[31]

- Pole replacement totalling [redacted]. The total includes a network-wide transition to the use of composite poles totalling [redacted],[32] being the incremental costs associated with composite poles over continuing to use timber poles.
- At risk pole replacement totalling capex of $85.3 million in the next RCP for targeted pole replacement using composite poles of between 10,000 and 11,000 poles.

124. The above projects have been included as part of the repex RIN category, with only the at-risk pole replacement included as a part of its proposed climate resilience program. In context, the 10,000 at risk pole replacements represent approximately 17.5% of the total 57,000 poles proposed to be replaced in the next RCP, with a further 12,000 poles proposed to be reinforced.

Forecasting method does not adequately account for the impact of other programs

125. Essential Energy's modelling approach includes the following key modelling steps:

- recalculation of the Weibull parameters for pole failure with particular climate perils removed.
- calculation of its predicted failure rate using the modelled failures, and deriving an annual probability by dividing the number of projected failures from its climate impact modelling over the timber pole population only (i.e. attributing these failures to timber only).
- calculating a linear step change in PoF per year across each asset and adding the linear step increase to the base Weibull PoF calculated for timber assets.
- CoF modelling/values have remained unchanged from its original analysis.

126. Based on our review of the model provided by Essential Energy,[33] we have not seen adequate consideration of the counterfactual case, to confirm that the forecasting method adequately excludes failures addressed by other programs.

127. Specifically, we observe that the modelling assumes a failure rate and associated risk cost for poles as part of the baseline. The baseline risk cost applied in the model, and from which the increasing risk costs is calculated is hard-coded. We assume this comes from the climate risk impact modelling, however we are unable to confirm its derivation. This suggests to us that the model is targeting total risk cost, and not the incremental risk associated with climate change or extreme weather and may be being addressed by business-as-usual (BAU) programs.

Analysis provided by Essential Energy is not sufficiently robust

128. The assessment period of 60 years results in a material size of the program having a positive net present value (NPV) without considering any changes arising from the modelling of the network risk impact of climate change. There are two potential interpretations of this: (i) either that the work is required today, and is independent of climate risk, or (ii) that the methodology results in an overstatement of benefits.

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31 Based on our analysis of information provided with IR029

32 Essential Energy - 10.02.24 Composite Poles Transition Business Case - Nov22 – Confidential, page 4

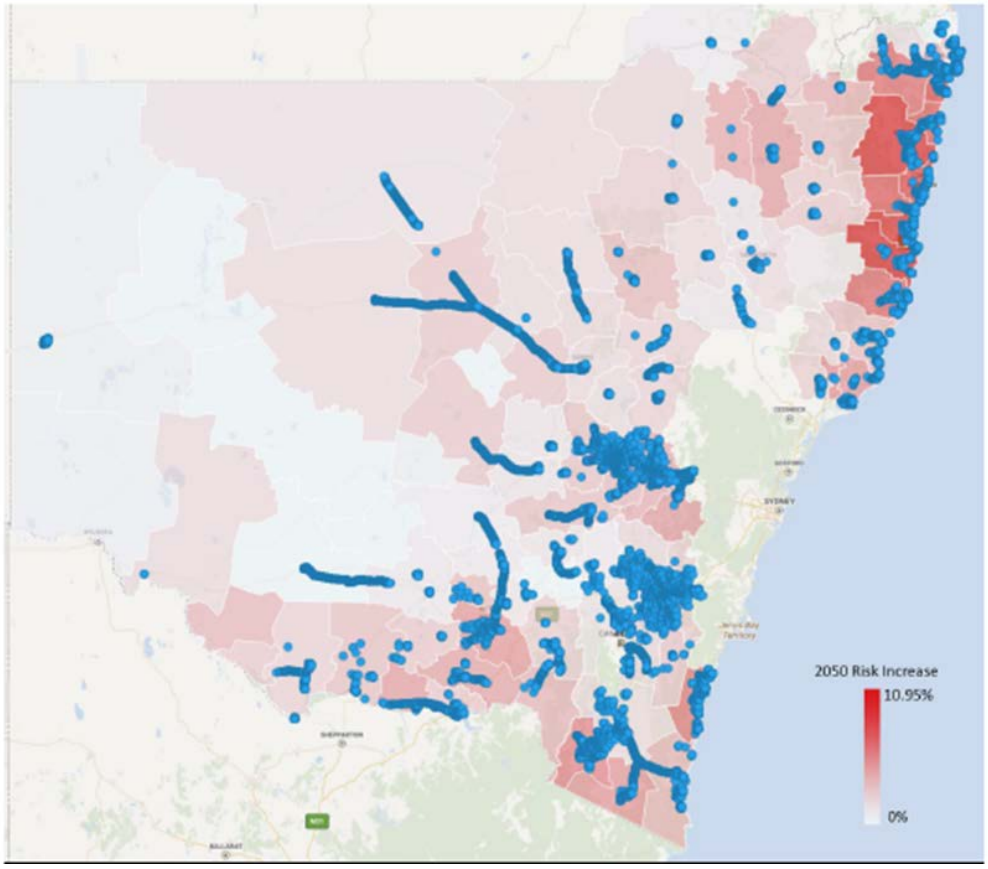
33 Essential Energy, Spotfire Simulation Spreadsheet – Poles provided with IR025

129. We also observe that at the time of investment, it is assumed that the primary and increasing risk costs associated with loss of supply are 100% mitigated for the life of the pole, being 60 years. A much smaller risk cost is included for a new pole, increasing with age. However, we are unable to confirm the reasonableness of the estimate of the risk cost of a new pole from the information provided.

Lack of alignment with increasing extreme weather risk

130. We also reviewed the alignment of Essential Energy's selection of poles, as determined from its modelling, with the highest areas of increase in bushfire risk as identified from its climate risk impact modelling. We expected to see some alignment with the highest areas of risk growth, however as seen in Figure 4.2 below there is no clear relationship between these factors. This too therefore demonstrates that the proposed program is only minimally related to increasing climate risk and that the modelled benefits are either overstated or suggest that the replacements proposed under 'climate resilience' should be done but have been conflated with Essential Energy's repex program.

Figure 4.2: 2050 bushfire risk areas (RCP 4.5) overlaid with proposed at risk pole replacement locations



Source: Essential Energy – 6.02 Resilience Plan – Jan 23

Consideration of alternative options has not been adequately demonstrated

131. Whilst alternative options including like-for-like replacement, and SAPS are described by Essential Energy, neither option is subject to economic assessment to determine the optimal outcome. Essential Energy states that:[34]

[34] Essential Energy - 10.06.01 Resilience Risk Based Pole Replacement Investment Case - Nov22 – Public, page 13

'Whilst replacing the poles like for like (timber) would reduce age risk it would not meet customer expectation regarding resilience as demonstrated during engagement for the regulatory proposal.'

132. We consider that absent the economic assessment of options, it is possible that an alternative option (such as pole replacement, or use of CCT) or re-prioritisation of existing programs may represent the prudent and efficient option.

Incremental costs of transition to composite may not be efficient

133. We have not considered the decision to transition to composite poles, as this has been included in the repex forecast and is being considered separately to the climate resilience program. It is important to consider whether the benefits of a composite poles have been sufficiently demonstrated as a replacement to other pole materials, such that they can be applied to all pole installations.

134. Where AER determines that the additional costs of a composite pole have not been demonstrated as efficient, an adjustment to the unit rate assumed for the at risk program may also be required.

Potential for duplication with its proposed repex has not been adequately addressed

135. The forecast capex for network resilience is also affected by other related programs, including undergrounding and deployment of standalone power systems (SAPS) which remove poles in the areas of the network where these investments are planned to occur. We do not consider that Essential Energy has sufficiently demonstrated that there is not duplication of investment over the life of the asset.

Targeted undergrounding

Identification of highest risk assets has not been adequately demonstrated

136. Essential Energy has proposed capex of [redacted] in the next RCP for undergrounding of 40km of Essential Energy's existing overhead network. Essential Energy states that this program will replace high risk assets that will be more prone to future failures due to climate change.

137. Of Essential Energy's 182,000 km of overhead network, Essential Energy states that approximately 350 km (0.19%) of its 182,000 km overhead network meets the criteria for consideration in this program. The criteria includes:

- Positive Equivalent Annualised Cost (EAC) i.e. the in-year risk of the associated overhead network assets exceeds the annualised cost to underground that portion of network.
- The NPV of the section of line is positive for the option to underground.
- There is an increasing probability of failure due to climate change modelling.

138. We have not been provided evidence of this assessment.

Modelling approach likely to inflate asset risk

139. Essential Energy describes the modelling approach as utilising its PoF modelling and consequence models that have been developed and calibrated to actual performance. The value generated from this program of work is predominately through network (or reliability) benefit.

140. The investment case[35] describes a process to remove asset failures resulting from the perils being modelled (e.g. Bushfire) to establish a revised functional failure Weibull task dataset and calibrating to the expected number of failures. Essential Energy has added back the 'modelled' failures from its climate risk model into the overall PoF calculation and calibrated

[35] Essential Energy - 10.06.02 Resilience Undergrounding High Risk Locations Investment Case

it against its baseline scenario. Essential Energy describes this process as providing a greater level of accuracy of its forecast.

141. Essential Energy describes the use of an escalation factor for the increase in bushfire risk from its climate impact modelling.

142. Unlike for poles, Essential Energy has used one set of Weibull parameters to represent the failure of conductors, which are then delineated by conductor type and proximity to the coast.

143. Essential Energy states that the 2050 results of its climate impact modelling from windstorm-related failures were not included in its analysis because of what it describes as the variability of such failures. Instead, Essential Energy has applied a linear trend between 2022 (baseline) and its assumptions for 2070 as the basis for an escalation factor for the increase in windstorm risk.

144. Similar to the at risk pole replacement business case, Essential Energy describes the use of RCP4.5 for its analysis which was then rolled up to a depot level.

145. However, in its response to IR014, Essential Energy states that the adjustments described in its investment case to the PoF values were not applied in the determination of a failure rate:[36]

> *'Unlike pole PoF the Weibull parameters were not adjusted for conductor. The windstorm and fire failures were added to the base Weibull PoF values as a linear function.'*

146. Whilst we were not provided the calculation using this method for our review, based on the reasons described above, we consider this is likely to inflate the corresponding asset risk.

Selection of undergrounding as the prudent option has not been adequately justified

147. The selection of 40km (0.02% of total network length) of undergrounding corresponding with the highest risk value portions of the network has not been explained, other than by reference to the volume included in its consumer engagement.

148. Whilst alternative options for composite poles and SAPS are described by Essential Energy, neither option is subject to economic assessment to determine the optimal outcome. The AER queried whether the alternative of utilising CCT was evaluated as part of the process, and Essential Energy confirmed it was not:[37]

> *'This program was established based on the strong customer appetite for Essential Energy to be providing a form of underground option for investment. Whilst CCT can mitigate the impact of the causal failure data for windstorm there are other risk trade-offs with its utilisation compared to the undergrounding option.'*

149. We did not see evidence of adequate consideration of the 'other risk trade-offs' as alternative options to the proposed undergrounding solution. We do not consider that the selection of the volume of undergrounding has been sufficiently justified.

Claimed benefits of undergrounding have not been adequately justified

150. Essential Energy claims a NPV of $37.3 million for this project. We were not able to open the CBA model provided by Essential Energy to review its analysis.

151. We consider that absent this economic assessment, it is likely that an alternative option (such as pole replacement, or use of CCT) or re-prioritisation of existing programs may present the prudent and efficient option.

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36 Essential Energy – IR014 3b PoF Methodology for Climate Change Modelling – Undergrounding – Apr23 - CONFIDENTIAL

37 Response to Underground Resilience Action Items - April 2023 Site Meetings, 28 April 2023

Radio sites

Proposed expenditure is proposed to strengthen back-up power supplies to 50 radio sites

152. Essential Energy has proposed capex of $1.7 million in the next RCP for solar and battery back-up supplies to Essential Energy's radio communication sites.

153. We understand this is targeted to the highest priority sites. Essential Energy confirmed in discussions that these sites are owned and controlled by Essential Energy as operational sites for the control of the distribution network. Essential also states this project will address outcomes of the Royal Commission into National Natural Disaster Arrangements and the NSW Bushfire Inquiry, as it supports Essential Energy's management of its response to emergencies and maintains its operational coordination capabilities in these events.

154. During our onsite discussion, we confirmed that the radio sites already have a back-up power supply. We understood that the proposed solution is to supplement the existing supply with additional back-up to extend self-supply for a period of 48 hours. We further understood that Essential Energy had used its CBA process to determine the number of sites and timing of the upgrade for each site.

Of the options considered, the proposed solution is likely to be prudent

155. Essential Energy considered the option of solar installation with 48 hr of battery back-up (option 1), or a 72-hour battery back-up (option 2). Option 1 was determined to be the preferred option as it presents additional sustainability and greater safety benefits when compared with option 2.

156. The CBA model provided by Essential Energy for our review did not include functional formulas to allow us to review the analysis. Accordingly, we were not able to review its risk analysis against the counterfactual.

157. Essential Energy describe that the top 70 most critical radio sites were assessed with all sites ranked based upon their criticality. Essential Energy claims that 45 radio sites had a positive NPV in 10 years with a further 5 sites becoming NPV positive over the 20-year life of the asset using a discount rate of 3.54%.

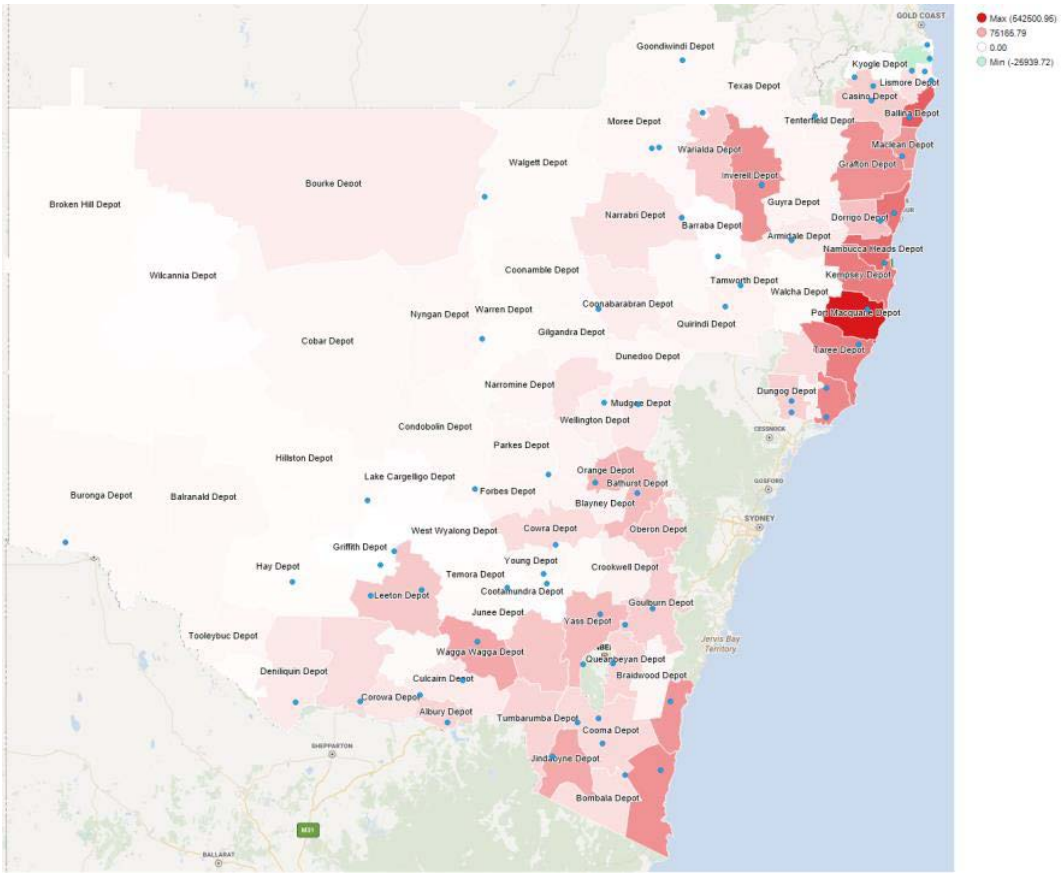
158. On the basis of the claimed $15.1 million NPV for the 50 sites included for the next RCP at a cost of $1.7 million, this is likely to be prudent and, if this result is correct, would appear to be justified without consideration of any worsening risk due to climate change impacts. This is further supported by a description of its process to prioritise its sites.

Projects should be considered alongside reliability driven augex

159. The projects provide a reliability benefit, albeit likely to be small when averaged across the network, as the basis of a favourable CBA. Inclusion of the climate modelling outputs would only increase the positive outcome of the cost benefit analysis undertaken in each of the investment cases, as shown in sensitivity analysis for each investment case. However, these projects are not included to address increasing extreme weather events.

160. In its response to IR025, Essential Energy confirmed that climate modelling was not used to modify forecast probabilities, however, were overlaid with increasing climate risk as shown in Figure 4.3.

Figure 4.3: Radio Site location overlay with climate change modelled changing risk



Source: 1 Essential Energy - IR025 Resilience Capital Expenditure - 20230517 - Public

161. As such, we suggest that these projects are considered as part of broader reliability improvement driven projects included in the forecast expenditure by Essential Energy and which is beyond our scope of review.

Microgrid projects

Microgrids are proposed for six sites to address poor historical reliability

162. Essential Energy has included a summary investment case and CBA model for each of the included microgrid sites. The total capex proposed for microgrids is $16.9 million in the next RCP. The breakdown of the forecast capex for microgrids into each proposed project is as shown in Table 4.1.

Table 4.1: Total microgrid project capex for next RCP by year ($m real 2024)

Project expenditure	2024-25	2025-26	2026-27	2027-28	2028-29	Total RCP
10.06.05 Tibooburra microgrid			■			■
10.06.06 Gresford microgrid		■	■			■
10.06.07 Bonalbo microgrid				■		■
10.06.08 Crookwell microgrid					■	■
10.06.09 Murrurundi microgrid			■	■		■
10.06.10 Lake Cargelligo microgrid	■	■				■
Balancing item	■	■	■	■	■	■
Total	**3.4**	**2.3**	**4.5**	**2.2**	**4.5**	**16.9**

Source: Individual investment cases and Essential Energy – Capex Model – 20230526 provided with IR029. A balancing item was introduced to reconcile with the information provided with IR029

163. The projects have been proposed to improve the 'resilience' of the network for customers at each of these locations, as historical reliability performance is considered unacceptable and outside applicable standards.

Recent changes have been made to jurisdictional reliability targets will likely impact a determination of compliance

164. In 2021, the NSW government requested that IPART reviews the NSW electricity distribution reliability standards to ensure that they reflect the needs and preferences of the people of NSW. Specifically, IPART was asked to make recommendations that would result in lower network prices and deliver savings to NSW electricity consumers.

165. As part of the recommendations,[38] IPART suggested removal of reliability standards that duplicate national arrangements and which increase minimum standards for individual feeders and direct connections that better reflect efficient long term level of reliability. If adopted, they will be implemented in mid-2024.

166. The report refers directly to impacts of climate change and extreme weather events, and the importance for customers that distributors are ready for and able to promptly recover from MEDs, as a means of becoming more resilient. However, the changes to individual feeder standards defined using the system average interruption duration index (SAIDI) and system average interruption frequency index (SAIFI), have in general, been relaxed. That means that feeder projects deemed to fall outside the existing compliance requirements, may fall within the new limits.

167. We observe that Essential Energy's historical performance has at times exceeded the historical jurisdictional target, and for some feeders will be increased as above. Essential Energy has not confirmed which limits apply to these feeders, and whether Essential Energy considers whether these projects are required for compliance with the new jurisdictional reliability targets.

Solutions are based on providing diesel back-up similar to existing Urbenville location

168. The proposed solutions consist of a diesel back-up genset, based on a previous installation at Urbenville as an alternative to a network solution, and which includes the following design and control elements:

- auto-changeover schemes.
- load steps.

[38] https://www.ipart.nsw.gov.au/sites/default/files/cm9_documents/Final-Report-Electricity-Distribution-Reliability-Standards-May-2021.PDF

- controller wiring.
- controller supervisory control and data acquisition (SCADA) communication.
- protection and extensive commissioning.

169. The microgrid installation at Urbenville is shown in Figure 4.4.

Figure 4.4: Urbenville microgrid project

Source: Essential Energy AER EMCa Onsite Day 1 Confidential v3_Redacted – provided 26 April 2023_AER REDACTED

170. Essential Energy describes the advantages for the site located at Urbenville and which include: (i) mitigation of the impact of network outages,[39] and (ii) providing time for field staff to patrol the line under more favourable weather conditions.

Projects include a positive NPV based on reliability benefits

171. Essential Energy claim that all projects provide a positive NPV, and that the diesel solution presents the lowest cost of evaluated solutions.

172. We reviewed the supplied NPV models and tested the model sensitivity to the assumptions provided. We have assumed that the location of the solution will provide 100% of the reliability benefit assumed by Essential Energy, and that the solution provides a 'bumpless' supply. Whilst we found some anomalies in the analyses provided to us, we find that correction of those anomalies and reasonably plausible adjustments to the assumptions do not materially change the conclusions that can be drawn from the results.

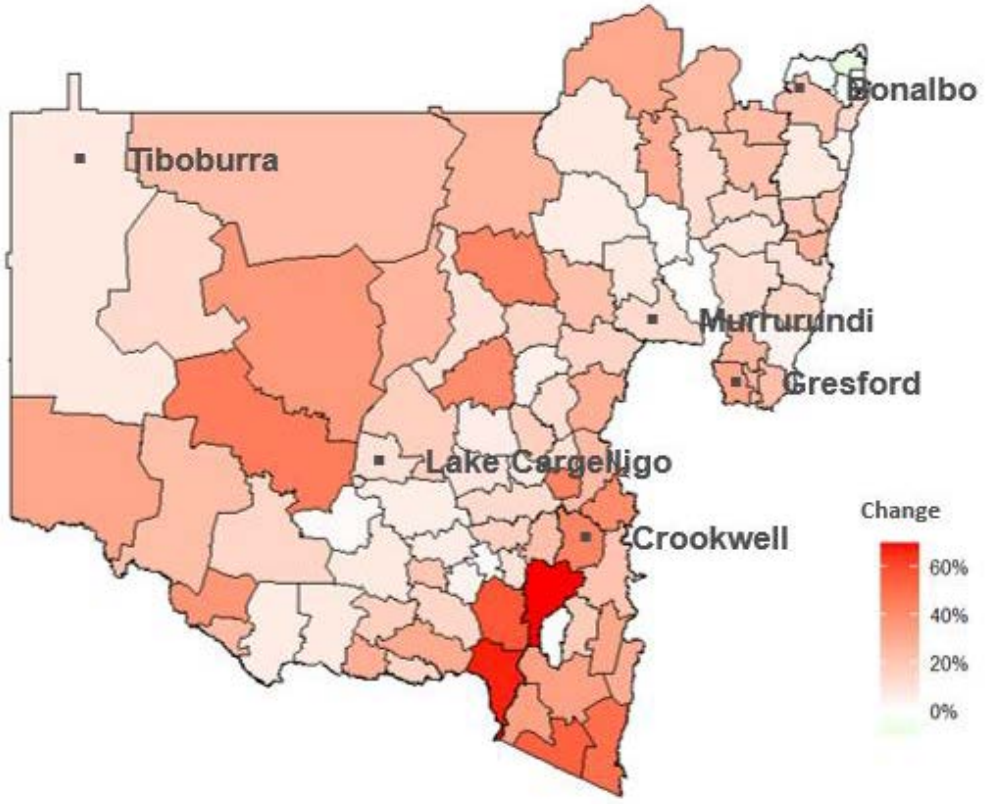
Projects should be considered alongside reliability driven augex

173. The projects provide a reliability benefit to the customers on the nominated feeders, on the basis of historical performance. Inclusion of the climate modelling outputs would only increase the positive outcome of the cost benefit analysis undertaken in each of the investment cases, as shown in sensitivity analysis for each investment case. However, these projects are not included to address an increase in extreme weather events.

[39] This site experiences approximately 4 outages per annum averaging 6 hours in duration

174. In its response to IR025, Essential Energy confirmed that climate modelling was not used to modify forecast probabilities, however the proposed project locations were overlaid with increasing climate risk as shown in Figure 4.5.

Figure 4.5: Microgrid site location overlay with climate change modelled changing risk



Source: Essential Energy – 6.02 Resilience Plan – Jan 23

175. As such, we suggest that these projects are considered as part of broader reliability improvement driven projects included in the forecast expenditure by Essential Energy, with consideration of the changes to jurisdictional standards, and which is beyond our scope of review.

Procurement of additional mobile strategic spares

The identified need is reasonably described

176. Essential Energy has proposed capex of $4.38 million in the next RCP for mobile spares to supplement the existing spares holdings.

177. Essential Energy describes the need as procuring a solution to allow 4-6 hours to commission portable zone substation equipment (not including travel time) compared to days or sometimes months to source spares and replace equipment. This would apply to each of its 37 Zone Substation sites which are classed as single transformer sites, and where there is no ability to restore supply quickly to these sites without portable equipment options.

A key driver has been a review of the response to recent flood events in the Lismore area

178. We understand that the primary reason for the proposed project is to allow improved response to major incidents, specifically highlighted in the post incident review following

recent floods in the Lismore area where the current holdings were deemed insufficient to respond to large events:[40]

> *'Following the event a post mortem was undertaken by staff involved in the response which identified a number of improvements, it also identified certain items of portable/mobile substation equipment that would make a similar response, easier and more effective in future.'*

179. During discussions with Essential Energy we requested a copy of the incident review following the Lismore floods referred to above, specifically to understand the linkage between the proposed project and any recommendations that had been made. Essential Energy provided details of the incident and assets impacted, along with a summary of the emergency works undertaken at the time. A photo of the South Lismore zone substation impacted by the floods is provided in Figure 4.6. Flood waters inundated the South Lismore 66kV ZS and Lismore Switching Station on the 28th February 2022, resulting in a loss of supply to the majority of the Lismore distribution network.

Figure 4.6: South Lismore zone substation 28th February 2022

Source: 1 Essential Energy - IR025 Resilience Capital Expenditure - 20230517 - Public

180. Items of portable zone substation equipment were also identified and which we observe closely align with the proposed scope of this project.

Relocation of the Lismore substation is not included in resilience program

181. We note that the relocation of the South Lismore zone substation to higher ground was recommended to remove the potential for a similar incident at this site. We note that Essential Energy has proposed the relocation of Lismore Depot in its regulatory proposal. In response to the AER's question in relation to whether the depot relocation was included in resilience-related expenditure, Essential Energy stated:[41]

> *'The Lismore Depot Relocation Investment Case is part of our property expenditure and was not part of the resilience expenditure consulted on with customers. The decision to relocate the depot is a business-as-usual action that a prudent and efficient network operator would take for safety and reliability of supply, and is based on a positive cost benefit analysis, it is not considered a new category of expenditure.*

40 1 Essential Energy - IR025 Resilience Capital Expenditure - 20230517 – Public, page 12

41 Essential Energy - IR029 Capex model and Community resilience - 20230531 - Public

Major flooding events at the current Lismore site are expected as frequently as 1 in 6 years (based on a historical 9.5m level flood data for Lismore Council) (see Appendix 4 Options Analysis supplied with the updated Property business case to the AER 31 May 2023), noting that the 2022 floods reached 14.4m at that site.'

182. Accordingly, as the relocation of the South Lismore zone substation project was not included in the proposed resilience program we have not included this within our scope of review. We note however, that similar to other projects that Essential Energy did include in its proposed climate resilience program, it is addressing a current identified risk rather than a risk associated with increasing extreme weather events.

Current level of strategic spares are not considered adequate

183. We also requested that Essential Energy provides details of its current Strategic Spares strategy to support its proposed expenditure. In response, Essential Energy provided an overview of its current strategic spares inventory, which included:[42]

- 1 x 66-33/33-11, 5/8MVA Tap changing Transformer, currently deployed.
- 4 x 66KV dead-tank (DT) circuit breakers (CB's) in stock for emergency spares. However, they are not loaded on skids, nor do they have on board protection.
- 2 x 145KV DT CB's in stock for emergency spares. However, they are not loaded on skids, nor do they have on board protection.

184. Essential Energy also stated that:[43]

'Of note, that [sic] while we do have 6 CB's in stock for emergency spares, the time difference in installation for these is significantly longer without having the onboard protection. For example, a CB that needs to be installed from scratch would take around 3-4 days to be commissioned and in service, compared to the one listed above with onboard protection on a skid which would take approximately 6hrs.'

185. We also understand from discussions with Essential Energy that its current stock of spares are already deployed at other sites, and not available for use.

186. Whilst we have not undertaken, nor been asked to undertake a review of the minimum level of spares holdings, we accept that following a review of recent operational experience the current level of spares was not considered adequate. However, we would expect Essential Energy to develop and maintain a strategic spares policy, which considers risk mitigations including emergency spares holdings, inventory and other emergency response strategies.

187. We consider that the introduction of skid mounted spares with on-board protection and secondary systems will provide a superior solution and complement the existing equipment to improve the response times for major events.

Options considered by Essential Energy appear reasonable

188. The assessment for this project has included consideration of three options:

- Continue with current minimal allocation of portable zone substation equipment (will not deliver to customer expectations in relation to resilience and reliability outcomes).
- Spare zone substation and protection equipment up to [redacted] (not economically feasible).
- Portable zone substation equipment totalling $4.7 million.

189. On the basis of the claimed $7.8 million NPV for this project, given the potential for benefits from avoided unserved energy, this is likely to be prudent. However, we note that the NPV model includes a cost of [redacted], and not the $4.7 million stated in Essential Energy's documentation.

42 1 Essential Energy - IR025 Resilience Capital Expenditure - 20230517 – Public, page 11

43 1 Essential Energy - IR025 Resilience Capital Expenditure - 20230517 – Public, page 11

190. The staging of procurement to deliver coverage of the proposed mobile spares at the earliest time (2025) followed by procurement of additional/secondary items mid regulatory period (2027) appears reasonable.

Proposed expenditure is likely to be lower

191. As a part of its response to IR025, Essential Energy provided a cost breakdown of the included components which also summed to [redacted], and we expect this lower amount is the accurate forecast.

Benefits relate primarily to improved reliability outcomes

192. The benefits expected by Essential Energy relate primarily to improved reliability due to the ability for faster restoration times following a major event. Inclusion of the climate modelling outputs would only increase the positive outcome of the cost benefit analysis undertaken in each of the investment cases, as shown in sensitivity analysis for each investment case.

4.3 Additional observations

4.3.1 SAPS

SAPS promoted to customers as response to climate risk

193. Whilst review of this expenditure is not within our scope of review, we were subsequently requested by the AER to provide some observations in relation to the SAPs program to assist the AER with its review of the proposed expenditure.

194. The climate resilience program totaling $127 million excludes expenditure for SAPS and community resilience. Despite being separate, the extension of Essential Energy's SAPS program was promoted in its documentation as being a part of its climate resilience package and contributing towards improvement of climate resilience.

195. We noted that whilst the SAPS program is presented as resilience in page 49 of the regulatory proposal, it doesn't appear to be included in the proposed $229 million (gross capex) of resilience capex in page 70 of the proposal. Along with the AER, we sought confirmation of our understanding in which Essential Energy stated that:[44]

> *'That is correct, SAPS is treated financially as Repex. Although SAPS will contribute to improved resilience it is not the primary driver for our investment.'*

SAPS provide additional optionality to network solutions, and assists build resilience of electricity supply

196. Based on our review, we do not consider there is a material overlap between the network resilience projects proposed by Essential Energy and those separately included as SAPS. We agree that the capex associated with SAPS is categorised in accordance with its primary driver.

197. As has been identified by Essential Energy, the main area of potential overlap between the network resilience projects and the SAPS program is the at-risk pole replacement program. Essential Energy has not proposed any reductions to the at-risk pole program on the basis that the two programs have different drivers[45] and did not present a material overlap prior to optimisation of the capex program.[46]

198. We consider that the SAPS being proposed are targeted to remote areas of Essential Energy's network, where the cost to serve is high. In these areas, the exposure for bushfire

[44] Essential Energy - IR029 Capex model and Community resilience - 20230531 - Public

[45] primary driver of SAPs installations being maintenance savings and bushfire start risk

[46] Essential Energy - IR014 Resilience Capex - 20230412 – Public, page 5

risk is likely to also be higher. The use of SAPS provides greater optionality in alternatives to traditional electricity supply arrangements for customers and improves the resilience of the electricity supply in the event of bushfire. If the NPV is sufficiently positive, as Essential Energy has submitted, the SAPS installations are likely to provide improved services to consumers.

199. Whilst we have not undertaken a review of the SAPS expenditure, we provide the following observations for consideration by the AER in its review of the associated expenditure:

- The proposed units appear to have a high capital cost and would benefit from an assessment of the market-based testing that Essential Energy has undertaken to determine the efficient level of cost, and to ensure that competitive tension is maintained.
- The proposed increase in installations from 40 to 120 units per year in the next RCP, from a base of 5 in FY23 should provide an opportunity to achieve economies of scale, reflected in lower costs per unit.
- The design and deployment of SAPS is an emerging area for NSPs that should continue to be monitored by NSPs and regulators alike.

4.3.2 Relationship to BAU capex program

Extent of overlap with other parts of Essential Energy's program has not been ascertained

200. Essential Energy has acknowledged the overlap of the proposed climate resilience capex with other repex programs and included a calculation of the overlap in information provided to the AER, with a request to the AER to provide feedback on amendments to its proposal. The overlap appears limited to the at-risk pole replacement program:[47]

> *'Essential Energy has not yet removed potential duplication between the risk-based pole replacements and the conditional based replacement program (repex). Essential has undertaken analysis to assess the magnitude of the relationship/overlap between the two programs and has put forward two options to be considered by the AER as shown on Slide 43 of attachment Essential Energy AER EMCa 10_5_23_Resillience_IR25.pptx*
>
> *It is Essential Energy's intention to apply the greater of these options, i.e. with risk based poles removed from the condition based volume assessment, in a change in forecast pole replacements as part of its revised regulatory proposal.'*

201. We were not able to confirm the basis for Essential Energy's calculation of the potential for overlap from the information provided and suggest this similarly cannot be undertaken separate to a review of the broader pole replacement and refurbishment program. As highlighted in our assessment, we consider that this is an area that requires AER staff to consider as Essential Energy's BAU capex program appears to be directed at addressing similar risks.

202. We note the intention by Essential Energy to resubmit its plans in its RRP with any overlap between its proposed programs removed. We would further encourage Essential Energy to take account of the issues we have identified in our review, specifically as they relate to isolation of the benefits to be delivered to consumers through the proposed expenditure.

4.3.3 Impact on reliability

Reliability improvement needs to be separately assessed

203. We asked Essential Energy to describe the relationship of the proposed resilience capex programs to the proposed expenditure included in the capex portfolio for each relevant asset class, including other repex programs.

[47] 1 Essential Energy - IR025 Resilience Capital Expenditure - 20230517 – Public, page 8

204. In response Essential Energy stated that:[48]

> *'Essential Energy approached the forecast from a holistic perspective to achieve overall risk outcomes for the entire portfolio. Based on customer engagement, risk objectives were set (as per 6.03.04) for total portfolio outcomes. Resilience program outcomes/benefits have been included in the total portfolio outcome and thus have impacted the optimisation of other asset classes to meet the overall objectives.*
>
> *Resilience based microgrids pose a potential overlap to other reliability improvement programs such as poor performing feeders. Essential Energy has calculated the expected improvements and translated these into STPIS target adjustments, for details please refer to previously supplied 8.04 STPIS Approach – Jan 23 – Public.docx.'*

205. We refer the AER to consider the impact of the microgrid and mobile spares programs in its assessment of STPIS targets for the 2024-29 regulatory period.

4.3.4 Application of Regulatory Investment Test

Proposed expenditure is subject to a future RIT-D assessment

206. In its documentation, Essential Energy refers to application of a Regulatory investment Test for Distribution (RIT-D) for its at-risk pole replacement program. We asked Essential Energy to advise the current stage of the RIT-D for the pole investment case noting that Essential Energy intends to perform a RIT-D to further justify this business case prior to commencement of the program.

207. In response, Essential Energy stated that it will await the outcome of the 2024-29 determination process to commence the RIT-D process for proactive pole replacements.

208. Accordingly, we have focussed our review on the materials provided as a part of its regulatory submission only.

4.3.5 Community resilience programs

We do not consider there to be a material overlap between Essential Energy's proposed community resilience expenditure and the network resilience expenditure that we have reviewed

209. While Essential Energy's proposed community resilience expenditure was not within the scope for our review, AER requested that we provide any observations on it. In particular, AER asked that we identify any overlap with other proposed expenditure (including the network resilience expenditure that we have reviewed).

210. Based on our review of the climate driven network resilience capex, we do not consider there is a material overlap between the network resilience projects proposed by Essential Energy and those separately included as community resilience. Essential Energy has proposed expenditure primarily for the purposes of providing back-up supply capability to communities in the form of generators, solar trailer and a communications hub to assist during and after major events.

211. As requested by the AER, we offer the following further observations:

- We are inclined to the view that the role of NSPs in providing for community resilience is a collaborative one, shared with government, critical infrastructure operators, individuals and communities. Accordingly, review of community resilience should include consideration of whether the NSP is best placed to manage the identified risk and deliver the proposed service.

[48] Essential Energy – IR014 Resilience capex – 20230412 - Confidential

- Review should necessarily consider whether the proposed expenditure is required for the delivery of direct control services to which the revenue determination applies and meets the requirements of the NER.
- Review should consider the extent to which the proposed expenditure reflects consumer and community preferences, and that consumers have been fully informed of the expenditure options and their implications.

4.4 Our findings and implications

4.4.1 Summary of our findings

The investment need for the proposed portfolio is not clear

212. The early selection of discrete investment 'options' with indicative volumes of work by Essential Energy undermines the identification and justification of the investment need. As outlined in section 2, we interpret the NER capex criteria as encompassing the extent to which the need for a project or program has been prudently established and the extent to which the proposed solution can be considered to be an appropriately justified and efficient means for meeting that need.

213. Accordingly, absence of a clear investment need hinders the prudent and efficient selection of the scope and timing of the investment.

Forecasting methods applied for determining its resilience expenditure are not sufficiently justified

214. We do not find sufficient justification to support the proposed projects that may be reasonably attributed to increases in extreme weather events within the next regulatory period, particularly when accounting for benefits of other related projects.

215. Essential Energy has not sufficiently justified the level of its proposed climate resilience capex, with additional projects to be considered alongside reliability driven augex. We have identified a number of areas that we consider the AER needs to take into account in its assessment of related expenditure, primarily repex and augex.

The proposed at risk pole replacement has not been adequately justified, due to inadequate analysis of options and potential for duplication with other programs

216. The $85.3 million proposed for the at-risk pole replacement program is in addition to $333.0 million for the management of its poles and represents approximately 17.5% of the total 57,000 poles proposed to be replaced in the next RCP, with a further 12,000 poles proposed to be reinforced.

217. The base case for pole replacement assumes an immediate and material improvement to services outcomes (risk mitigation) and which suggest that the proposed program is not based on the impact of an increase of extreme weather-related events or risk. As such we find insufficient basis for the expenditure for at risk pole replacement.

The undergrounding program has not adequately demonstrated that this represents a prudent option, or prudent volume of work

218. We identified evidence that the modelling approach by Essential Energy is likely to inflate asset risk. The selection of undergrounding as the prudent option to address the identified risk, and the selection of the proposed volume of 40km has not been adequately justified. It is more likely than not, that any identified increase in risk reasonably attributed to increases in extreme weather events within the next regulatory period is addressed by other related projects.

The proposed microgrid projects are included based on improvements to reliability and not increase to extreme weather events

219. Essential Energy has proposed six microgrid sites based on addressing historical poor reliability performance, using a recently developed solution. The nominated projects should be considered alongside reliability driven augex and not as part of proposed climate resilience investment.

220. Whilst failure of the line assets identified in the microgrid projects resulting from extreme weather events will likely exacerbate the impact to consumers at these locations, should the line assets fail during this time, the projects cannot be reasonably attributed to increases in extreme weather events within the next regulatory period.

Essential Energy has included additional expenditure to reduce the impact of extreme weather events by strengthening strategic spares and supplies to radio sites

221. The remaining components of the climate resilience program included for mobile spares and radio sites, have a stronger link to development of resilience to extreme weather events. In relation to the issues we identified, we consider that on balance that these projects are more likely representative of prudent expenditure.

222. We did identify a correction by Essential Energy that decreases the proposed expenditure for strategy spares to [redacted].

223. Similar to the reasons provided for the microgrid projects, these projects provide an improvement in reliability to the areas where they are deployed and cannot be reasonably attributed to a projected increase in extreme weather events within the next regulatory period.

4.4.2 Summary of adherence to AER resilience guidance note

224. We have reviewed the relevant factors of the framework for evidence to support resilience expenditure as being prudent and efficient to achieve the expenditure objectives.

Essential Energy has not established an adequate causal relationship between the proposed resilience expenditure and the expected increase in the extreme weather events

225. We find that Essential Energy has presented materials that reflect the impact to consumers of recent weather events, and that this impact has been exacerbated by extended outages of electricity supply.

226. The expenditure targets underlying network and safety risks, that if mitigated will likely provide a benefit to consumers. However, the expenditure proposed by Essential Energy targets network resilience beyond the impact of extreme events, and in doing so has overstated the expenditure requirements.

Essential Energy has not effectively demonstrated that 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

227. We find that Essential Energy's assessment options provided in support of its proposed expenditure are limited, that its assessment of risk cost overstates the likely benefit provided by the options it has assessed and does not sufficiently demonstrate that it is required to maintain service levels in the face of ***increasing*** climate impact.

228. We have identified a number of projects that are driven by improvements to reliability and which should be considered as part of broader reliability improvement driven projects included in the forecast expenditure by Essential Energy and which is beyond our scope of review.

4.4.3 Implications of our findings for proposed expenditure

229. We consider that the proposed expenditure does not reasonably satisfy the capex objectives of the NER and represents a considerable overstatement of prudent expenditure requirements.

APPENDIX A – COMPARISON OF ASSUMPTIONS APPLIED BY NSW DNSP

230. In this appendix, we provide a comparison of the assumptions applied for each of the NSW DNSPs in the development of its climate-driven network resilience capex proposed for the next RCP. This covers:

- Comparison of proposed capex;
- Climate impact modelling assumptions;
- Projected asset failures; and
- Projected total financial cost.

A.1 Comparison of proposed capex

A.1.1 Proposed capex

231. In Table A.1 we provide a comparative analysis of the proposed capex included for network resilience.

Table A.1: Comparison of proposed capex for network resilience

Metric	Ausgrid[49]	Essential Energy	Endeavour Energy
Proposed capex ($m, real 24)	193.7	127	28
Average number of customers	1,837,757	969,252	1,225,827
Average route line length (km)	40,588	180,640	30,976
Capex / customer ($)	105	131	23
Capex / route km ($)	4,772	703	904

Source: EMCa analysis of information provided by Ausgrid, Essential Energy and Endeavour Energy

232. The customer numbers and route length are based on reported information in the Reset RIN for each NSW DNSP, using the average of the forecast over the next RCP.

233. From Table A.1 we observe that:

- Essential Energy has the highest proposed capex per customer of the NSW DNSPs, with approximately half the customers of Ausgrid, and lower than Endeavour Energy.
- Ausgrid has the highest proposed capex per route km of network of the NSW DNSPs. This is likely to be higher if the route length was limited to overhead network only.

234. These metrics are not intended to be used exclusively or form the basis of our assessment. For example, the metrics do not include other factors that may further differentiate the operating environment for each NSW DNSP, and which include urban versus rural networks, overhead versus underground networks etc.

[49] The updated information provided by Ausgrid on 17 July includes a lower proposed capex, however does not materially change the results of the comparison between NSW DNSPs

235. Further, these metrics should not be relied upon to review a category of the proposed capex without considering the remainder of the capex forecast, and interaction with the opex forecast to meet service standards. We have not undertaken, nor were we asked to undertake or to review, comparative benchmarking analysis of DNSPs whose network prices are subject to the AER's regulation.

A.1.2 Source of proposed capex

236. In Table A.2, we provide a summary of the primary sources of proposed capex included by each of the NSW DNSPs for the next RCP. Our focus is on comparing the primary network solutions proposed to be applied to address local impacts of extreme weather events.

Table A.2: Summary of primary sources of network resilience capex by NSW DNSP

Sources of expenditure	Ausgrid[50]	Essential Energy	Endeavour Energy [51]
Proactive pole replacement		☑	
Undergrounding	☑	☑	
Covered conductor (or similar)	☑		☑
Switching / sectionalising	☑		
Conductor raising			☑

Source: EMCa analysis of information provided by Ausgrid, Essential Energy and Endeavour Energy

237. From Table A.2, we observe that:

- Two DNSPs have included solutions of CCT and undergrounding, being the dominant sources of expenditure.
- The remaining solutions have been adopted by a single DNSP only.

[50] The updated information provided by Ausgrid on 17 July introduces additional sources of capex associated with its 'Whole of Network solutions' proposal

[51] IR011, Endeavour Energy state that where projects have not been cost justified (for example, the proactive replacement of in service timber poles with alternates), these have not been part of its Proposal

Table A.3: Summary of perils responded to by NSW DNSP

Included drivers of network expenditure	Ausgrid[52]	Essential Energy	Endeavour Energy
Extreme heat	☑		
Bushfire	☑	☑	☑
Windstorm	☑	☑	
Flood		☑	☑
Coastal inundation			

Source: EMCa analysis of information provided by Ausgrid, Essential Energy and Endeavour Energy

238. From Table A.3, we observe that:

- All three DNSPs have included the increased risk from bushfire as a driver of network resilience capex.
- Two DNSPs have included the increased risk from windstorm and flood as drivers of network resilience capex.
- One DNSP has included the increased risk from extreme heat as a driver of network resilience capex.

239. We have assessed each of these drivers in our reports for each DNSP.

240. Despite having considered multiple potential perils, it is notable that:

- Almost all of Ausgrid's proposed network resilience capex is proposed as mitigation for assumed increase in windstorm impacts.
- Essential Energy's and Endeavour Energy's dominant proposed network resilience capex is against assumed increase in bushfire impacts. Of these, Essential Energy's bushfire related programs target exogeneous fire starts and Endeavour Energy's bushfire related program targets fire starts from the network.

A.2 Climate impact modelling assumptions

241. In Table A.4, we provide a summary of the assumptions applied for each of the NSW DNSPs in development of its climate impact modelling.

[52] The updated information provided by Ausgrid on 17 July introduces responses to all climate perils, when considering the additional sources of expenditure (capex and opex) associated with its 'Whole of Network solutions' proposal

Table A.4: Summary of model input assumptions by NSW DNSP

Input assumption	Ausgrid	Essential Energy	Endeavour Energy
Climate impact 'peril' addressed by capex	Bushfire, windstorm, flood, heatwave	Bushfire, windstorm, flood	Bushfire, flood
Climate impact modelling undertaken	Yes	Yes	Yes
Climate impact model relied upon for capex forecast	Yes, fully	Yes, partly	Yes, partly
Dominant climate impact 'peril' driving capex	Windstorm	Bushfire	Bushfire
Climate projection assumed for determination of its proposed capex	Weighted approach: 15% RCP 2.6, 70% RCP 4.5, and 15% RCP 8.5	100% RCP 4.5	100% RCP 4.5
Projection scenarios developed	2050, 2070 ,2090	2050, 2070, 2090	2050, 2090

Source: EMCa analysis of information provided by Ausgrid, Essential Energy and Endeavour Energy

242. From Table A.4, we observe that:

- All three DNSPs have developed and relied upon in some form climate impact modelling to develop the proposed capex forecast.
- However, the climate impact (or perils) modelled differ considerably across the DNSPs, with Ausgrid including a higher incidence of climate impacts.
- Similarly the climate projections assumed and projected scenarios differ across NSW DNSPs, and may impact the rate of increase in climate risk, amongst other things.
- The climate impact of increasing bushfire risk was the dominate climate impact driving capex for two of the three NSW DNSPs.

243. While it is to be expected that climate change will impact different networks differently, we consider that the extent of the differences between the DNSPs' in their projected impacts also reflects the significant challenges and uncertainties that are inherent in the modelling that they have relied on.

A.3 Climate impact to 2050 for RCP4.5

244. In Table A.5, we provide a summary of the percentage increase in climate impact for RCP4.5 to the year 2050 for each NSW DNSP. This is based on our assessment of the material provided. Where items are left blank, we were not able to identify information on a common basis to include in this table.

Table A.5: Climate impact: Assumed percentage increase to 2050 for RCP4.5 by NSW DNSP

Input assumption	Definition	Ausgrid	Essential Energy	Endeavour Energy
Consecutive hot days – total	The total number of heatwave days (3 or more days > 35 deg C)	103%	-	89%
Consecutive hot days - maximum	The longest run of consecutive hot days > 35 deg C	22%	21%	-
Windspeed maximum	Speed of sustained wind gusts	3%	2.1%	-
Windstorm	Impact of intense East coast low events	23%	10%	-
Very heavy precipitation days	Days with more than 30mm of precipitation linked to flooding	20%	-	-
Flooding	Flood level > 0.6m	-	1.9%	-
Flooding	1 in 20 year extreme rain event	-	-	3%
Very high fire danger days	Days with a forest fire danger index FFDI >25	0%	-	39%
Extreme (and above) fire danger days	Days with a forest fire danger index FFDI > 50	13%	-	-
Bushfire footprint	The number of assets within a bushfire footprint	-	10%	-

Source: EMCa analysis of information provided by Ausgrid, Essential Energy and Endeavour Energy

A.3.1 General observations

Extreme heat

245. In general, all DNSPs are forecasting an increase in heatwaves.

Windspeed & windstorms

246. In general, all DNSPs consider that there is very little change seen to maximum sustained wind speed, however, are projecting a higher number of windy days.

247. The climate modelling includes a projection of the number of East Coast Low Pressure System (ECL) events. DNSPs describe ECLs as often leading to damaging winds and thus increased asset failures from direct impacts and vegetation fall/blow ins.

248. The data relied upon by each DNSP differs materially as shown in Table A.5. For example:

- Essential Energy has made corrections to the climate modelling for windspeed, noting that it peaks in 2050 before reducing in 2070. Accordingly, Essential Energy has adopted a straight-line projection of impacts from 2020 to 2070, to account for overstatement in 2050.
- Endeavour Energy has stated that the advice from climate scientists is that the confidence in current climate modelling is not high. Accordingly, Endeavour Energy has not included or relied on wind exposure modelling into its climate projections until such time that better data becomes available.[53]

[53] Endeavour Energy 10.34 Climate resilience methodology

Flooding

249. In general, all DNSPs are forecasting a minor increase in the frequency of flooding. However, Essential Energy includes an increase in flood severity within its projection.

Bushfire

250. In general, all DNSPs are forecasting a minor increase in the frequency of bushfire exposure.

A.4 Asset failures

251. The asset failures modelled for each of the NSW DNSPs are provided for RCP 4.5, not considering any incremental costs for other RCP scenarios. Values are expressed as the average number of asset failures (units) per year.

Ausgrid

Table A.6: Projected asset failures by year – Ausgrid (units)

Input assumption	2020	2050	2070	2090
Bushfire	303	317	364	410
Windstorm	1623	2074	2698	3323
Flood	22	23	23	22
Total	1948	2414	3085	3755
Increase relative to 2020	-	24%	58%	93%

Source: EMCa analysis of information provided by Ausgrid

252. In addition to the above, Ausgrid nominate feeder replaced expressed in km pa.

253. The dominant driver of asset failure for Ausgrid is windstorms which accounts for 80% of all modelled asset failures.

254. The rate of change is highest for Ausgrid was windstorm followed by bushfires.

Essential Energy

Table A.7: Projected asset failures by year – Essential Energy (units)

Input assumption	2020	2050	2070	2090
Bushfire	491	545	610	685
Windstorm	318	550	400	426
Flood	248	255	257	259
Total	1057	1350	1267	1370
Increase relative to 2020	-	28%	20%	30%

Source: EMCa analysis of information provided by Essential Energy

255. The dominant driver of asset failure for is bushfire, however this accounts for approx. 46% in the baseline asset failures.

256. The rate of change is highest for Essential Energy is bushfires followed by windstorms.

Endeavour Energy

257. Projected asset failure information was not provided. Instead, the increase in exposure risk was used as an escalation factor.

258. Climate modelling commissioned by Endeavour Energy from Deloitte has indicated that across a range of future emission scenarios, localised risks across the network are changing because of climate change. The climate modelling has indicated that risks such as bushfire risk are forecast to increase due to a higher likelihood of bushfire favourable weather in future climatic conditions.

259. The escalation factors make use of risk levels in 2090 for each geographical area.

A.5 Total financial cost

260. The total financial costs modelled for each of the NSW DNSPs are provided for RCP 4.5, not considering any incremental costs for other RCP scenarios. Values are expressed in total financial cost $m per annum, including direct and indirect cost components (such as Value of Unserved energy).

Ausgrid

Table A.8: Projected total financial cost by year – Ausgrid ($m per annum)

Input assumption	2020	2050	2070	2090
Bushfire	22	23	27	31
Windstorm	244	306	560	814
Flood	2	3	3	3
Total	268	332	590	848
Increase relative to 2020	-	24%	120%	216%

Source: EMCa analysis of information provided by Ausgrid

261. A similar relationship exists for financial costs as identified for asset failures.

262. Increases in financial cost for Ausgrid are far in excess of other DNSPs, largely due to its assumed cost (and rate of increase in cost) of windstorms.

Essential Energy

Table A.9: Projected total financial cost by year – Essential Energy ($m per annum)

Input assumption	2020	2050	2070	2090
Bushfire	11.2	12.6	14.1	15.9
Windstorm	3.4	5.8	4.3	4.6
Flood	10.2	10.5	10.6	10.7
Total	24.8	28.9	29	31.2
Increase relative to 2020		17%	17%	26%

Source: EMCa analysis of information provided by Essential Energy

263. A similar relationship exists for financial costs as identified for asset failures.

Endeavour Energy

264. Projected financial costs information was not provided.