Addressing increased customer demand in the Macquarie Park area

FINAL PROJECT ASSESSMENT REPORT

31 March 2023

Ausgrid

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Contents

Executive Summary

This report represents the application of the RIT-D to address an expected capacity constraint at the Macquarie 132/33kV Sub-transmission Substation (STS)

The Macquarie 132/33kV STS is in the Carlingford area of Ausgrid's network. It was commissioned in July 2021 to assist with providing supply to three major customers who were ready to connect at the time.

Two new connection applications from major customers have since been received. Both have requested secured "N-1" supply. The existing spare capacity at the Macquarie 132/33kV STS (i.e., approximately 9MVA) is not sufficient to support the connection of these two new loads.

Ausgrid considers that additional major customer loads are most efficiently met by installing a third 120MVA 132/33kV transformer unit at the Macquarie 132/33kV STS. These two major customers have both committed to make a direct contribution to the investment, to facilitate the timing of the expansion of the STS being brought forward.

As these major customers are expected to utilise nearly 90% of the asset capacity, specific tariff arrangements will be established to recover the majority of the cost of the augmentation from the beneficiaries (i.e., the new major customers), taking into account their share in the capacity added to the network.

Further network investment would be required to accommodate any additional major loads in the Macquarie Park area, as there are site limitations on adding any further transformers at the Macquarie STS. Any further investment would be considered as part of a separate RIT-D process.

The 'identified need' for this RIT-D is to accommodate the connection requests of two new major loads in the Macquarie Park area

The key driver for this RIT-D is the requested connection of load at the Macquarie 132/33kV STS. If action is not taken, there is a significant and increasing forecast supply risk when the combined demand from new and existing customers is near or close to 100% of requested demand, leading to a shortfall of secured substation capacity under both credible contingencies (i.e., transformer outages) and full availability.

Three credible network options have been assessed

While only one credible network option was identified during the network planning stage, the two major customers approached Ausgrid to offer a direct capital contribution, with a view to support development/design work and expedite the investment. Ausgrid has therefore assessed three credible options as part of this FPAR that vary in terms of timing and whether the capital contribution is included or not.

The three credible options we have assessed are summarised below in Table E1.

Table E1 – Credible network options assessed ($2022/23, million).

Option	Description	Capital cost	Commissioning
Option 1	Install a new transformer in 2029	$9.1	2028/29
Option 2	Install a new transformer in 2026 (with capital contribution)	$7.4	2025/26
Option 3	Install a new transformer in 2026 (without capital contribution)	$8.7	2025/26

Non-network options and SAPS are not considered viable for this RIT-D

Ausgrid has considered the ability of non-network and stand-alone power system (SAPS) solutions to assist in meeting the identified need. Specifically, an analysis of non-network options and SAPS considered how demand management could defer the timing of the preferred network solution and whether the estimated unserved energy at risk could be cost effectively reduced. An assessment of demand management options has shown that non-network alternatives would not be cost effective due to the magnitude of the load reduction required.

This result is driven primarily by the significant amount of unserved energy that the identified network option allows to be avoided, compared to the base case, and the cost of demand management solutions. This is detailed further in the separate Options Screening Notice released in accordance with clause 5.17.4(d) of the NER.

Three demand forecast scenarios have been modelled to deal with uncertainty

RIT-D assessments are required to be based on cost-benefit analysis that includes an assessment of 'reasonable scenarios', which are designed to test alternate sets of key assumptions and whether they affect identification of the preferred option.

Ausgrid has assessed three alternative future load demand scenarios– namely:

- a central forecast assuming 84 per cent scaled load from the three existing major loads and the two additional customer loads;
- a low demand forecast assuming 70 per cent scaled load from the three existing major loads and the two additional loads; and
- a high forecast assuming 100 per cent scaled load from the three existing major loads and the two additional loads.

The scenarios only differ by the demand forecasts given this is the key parameter that may affect the ranking of the credible options. How the results are affected by changes to other variables (i.e., the discount rate and capital costs) have been investigated in the sensitivity analysis.

A summary of the key variables in each scenario is provided in the table below.

Table E2 – Summary of the three demand scenarios investigated.

Variable	Scenario 1 – central demand scenario	Scenario 2 – low demand scenario	Scenario 3 – high demand scenario
Demand	Central forecast	Low forecast	High forecast
VCR	$46.9/kWh across all scenarios		
Discount Rate	3.44% across all scenarios		

Option 2 is the preferred option that satisfies the RIT-D

Ausgrid considers that Option 2 is the preferred option that satisfies the RIT-D. Ausgrid is the proponent for Option 2.

While the estimated construction cost of this option is $8.7 million ($2022/23), it also involves a direct contribution from the two major customers of $1.3 million, reducing the effective capital cost to $7.4 million. Annual routine operating costs are assumed to be 0.2 per cent of the estimated capital cost (i.e., approximately $17,500/year).

The timing of commissioning for Option 2 is 2025/26. The RIT-D demonstrates that the increase in costs (in present value terms) resulting from the earlier commissioning date is more than offset by the capital contribution that will be made by the two major customers in the central and high demand scenarios as well as on a weighted basis and is effectively equal in the low demand scenario.

The results of the Net Present Value (NPV) assessment for the three credible options are presented below in Table E3.

Table E3 – Summary of NPV results, weighted across demand scenarios ($2022/23, million).

Option	PV benefits	PV costs	Net benefits	Rank
Option 1	17.4	4.7	12.7	2
Option 2	17.8	4.8	13.0	1
Option 3	17.8	5.6	12.1	3

Option 2 involves installing a third 120 MVA 132/33 kV transformer unit at the Macquarie 132/33 kV STS.

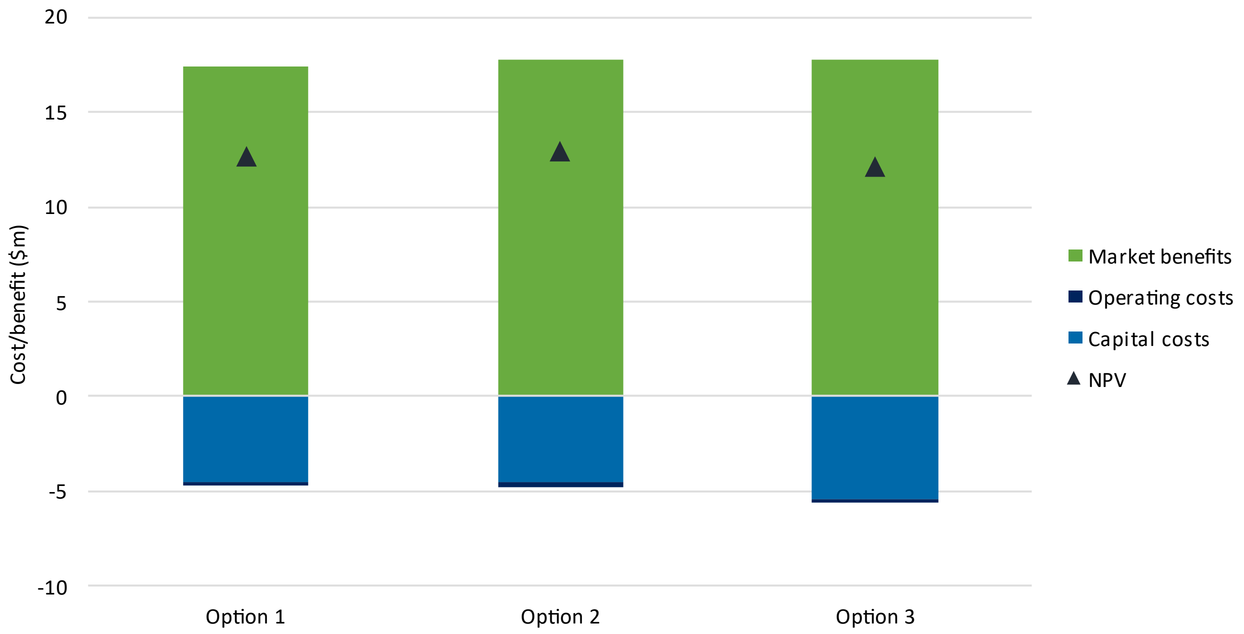
Specifically, the scope of Option 2 includes:

- construction of a new transformer bay, including civil works to install an additional 132kV circuit breaker;
- installation of a new 120MVA 132/33kV transformer unit;
- modifications and upgrades in the 132kV busbar bolted assemblies and flexible connections to achieve the required throughput busbar rating; and
- installation of 132kV cable connections to the new transformer and 33kV cable connections from the new transformer to the existing 33kV switchroom.

Commissioning of the new transformer is expected in 2025/26.

Figure E1 below shows the present value of cost and benefit components weighted across the three scenarios for the three options considered as part of this RIT-D.

Figure E1: Present value of costs and benefits weighted across demand scenarios ($ million).



Next steps

This FPAR represents the final step in the application of the RIT-D to options for addressing increased customer demand in the Macquarie Park area.

Under the NER, parties have 30 days from the publication of this report to dispute the application of the RIT-D. Disputes are only able to be made on the grounds that Ausgrid has not applied the RIT-D in accordance with the NER, or that Ausgrid made a manifest calculation error in applying the RIT-D. Disputing parties cannot dispute issues in this FPAR that the RIT-D treats as externalities, or relate to an individual's personal detriment of property rights. Clause 5.17.5 of the NER sets out the full process and requirements regarding a dispute on how the RIT-D has been applied.

Ausgrid intends to commence work on delivering Option 2 in July 2023.

Any queries in relation to this RIT-D should be addressed to:

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Sydney 2001

Or

email to: assetinvestment@ausgrid.com.au

1. Introduction

This Final Project Assessment Report (FPAR) has been prepared by Ausgrid and represents the final step in the application of the Regulatory Investment Test for Distribution (RIT-D) to options for addressing expected capacity constraints at the Macquarie 132/33kV Sub-transmission Substation (STS) in the near future. It follows publication of the Options Screening Notice for this RIT-D.

In particular, Ausgrid has received two connection applications in the Macquarie Park network area to supply major loads located in close proximity to the recently commissioned Macquarie 132/33kV STS. The two connection applications have both requested secured “N-1” supply. Ausgrid considers that these additional customer loads are most efficiently met by installing a third 120MVA 132/33kV transformer at the Macquarie 132/33kV STS. These major customers have committed to make a direct contribution to the investment, to facilitate the timing of the expansion of the STS being brought forward.

As these major customers are expected to utilise nearly 90% of the asset, specific tariff arrangements will be established to recover the majority of the cost of the augmentation from the beneficiaries (i.e., the new major customers), taking into account their share in the capacity added to the network.

Ausgrid has also received further enquiries from other major customers relating to connection at Macquarie Park. The accommodation of any further additional major customer load at Macquarie Park is likely to require the construction of a new STS, which would be considered as part of a future RIT-D.

Ausgrid will commence consultation with the Ryde City Council and the local community shortly after perspective drawings and a program of work is finalised. This will help to develop a construction plan that minimises impacts during construction. Ausgrid will keep the community informed as the project progresses through notification letters and the Ausgrid website.

Ausgrid has determined that non-network or stand-alone power system (SAPS) solutions are unlikely to form a standalone credible option, or form a significant part of a credible option, as set out in the separate notice released in accordance with clause 5.17.4(d) of the National Electricity Rules (NER).

1.1. Role of this final report

Ausgrid has prepared this FPAR in accordance with the requirements of the NER under clause 5.17.4. It is the final stage of the RIT-D process set out in the NER in relation to the application of the RIT-D.

The purpose of the FPAR is to:

- describe the identified need Ausgrid is seeking to address, including the assumptions used in identifying this need;
- provide a description of each credible option assessed;
- quantify relevant costs and market benefits for each credible option;
- describe the methodologies used in quantifying each class of cost and market benefit;
- explain why Ausgrid has determined that classes of market benefits or costs do not apply to the options considered;
- present the results of a net present value (NPV) analysis of each credible option and explain these results; and
- identify the proposed preferred option.

This FPAR follows the Notice of Non-Network Options released earlier in March 2023. As the cost of the preferred investment option is below $12 million, Ausgrid is not required to publish a Draft Project Assessment Report (DPAR). This FPAR therefore represents the final stage of the formal consultation process set out in the NER in relation to the application of the RIT-D. The entire RIT-D process is detailed in Appendix B.

1.2. Contact details for queries in relation to this RIT-D

Any queries in relation to this RIT-D should be addressed to:

Matthew Webb
Head of Asset Investment
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GPO Box 4009
Sydney 2001

Or

email to: assetinvestment@ausgrid.com.au

2. Description of the identified need

This section provides a description of the network area and the 'identified need' for this RIT-D, before presenting a number of key assumptions underlying the identified need.

2.1. Overview of the existing distribution network

The Macquarie 132/33 kV STS was commissioned in July 2021 following a RIT-D undertaken over 2018.[1]

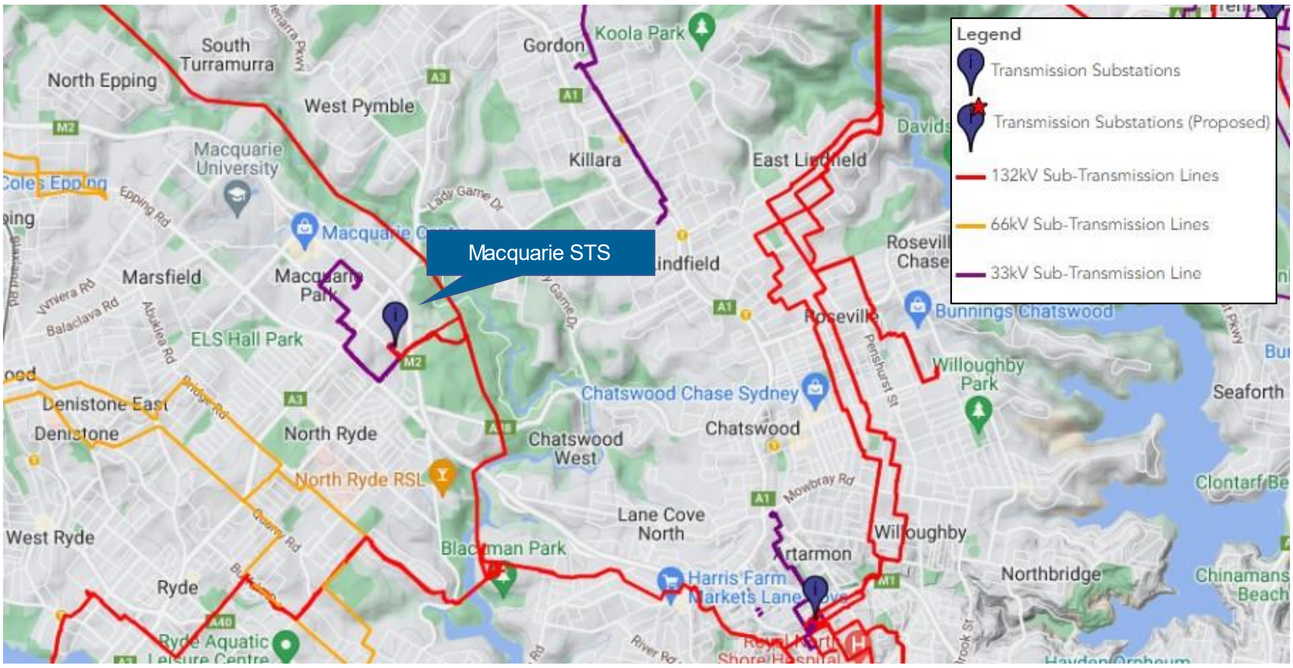
The Macquarie 132/33 kV STS has an arrangement of:

- two 120 MVA 132/33 kV transformers; and
- three sections of 33 kV busbar, comprising sixteen 33kV gas insulated switchgear (GIS) circuit breakers.

It is supplied via 132 kV feeders teed off from 132 kV feeders 92A and 92B between the Sydney North Bulk Supply Point (BSP) and the Lane Cove Subtransmission Switching Station (STSS). It is co-located within the same site as the existing Macquarie 132/11kV Zone Substation (ZS), in Waterloo Rd, Macquarie Park.

Figure 2.1 illustrates where the Macquarie 132/33 kV STS sits in the wider Carlingford network area.

Figure 2.1 – Carlingford network area.



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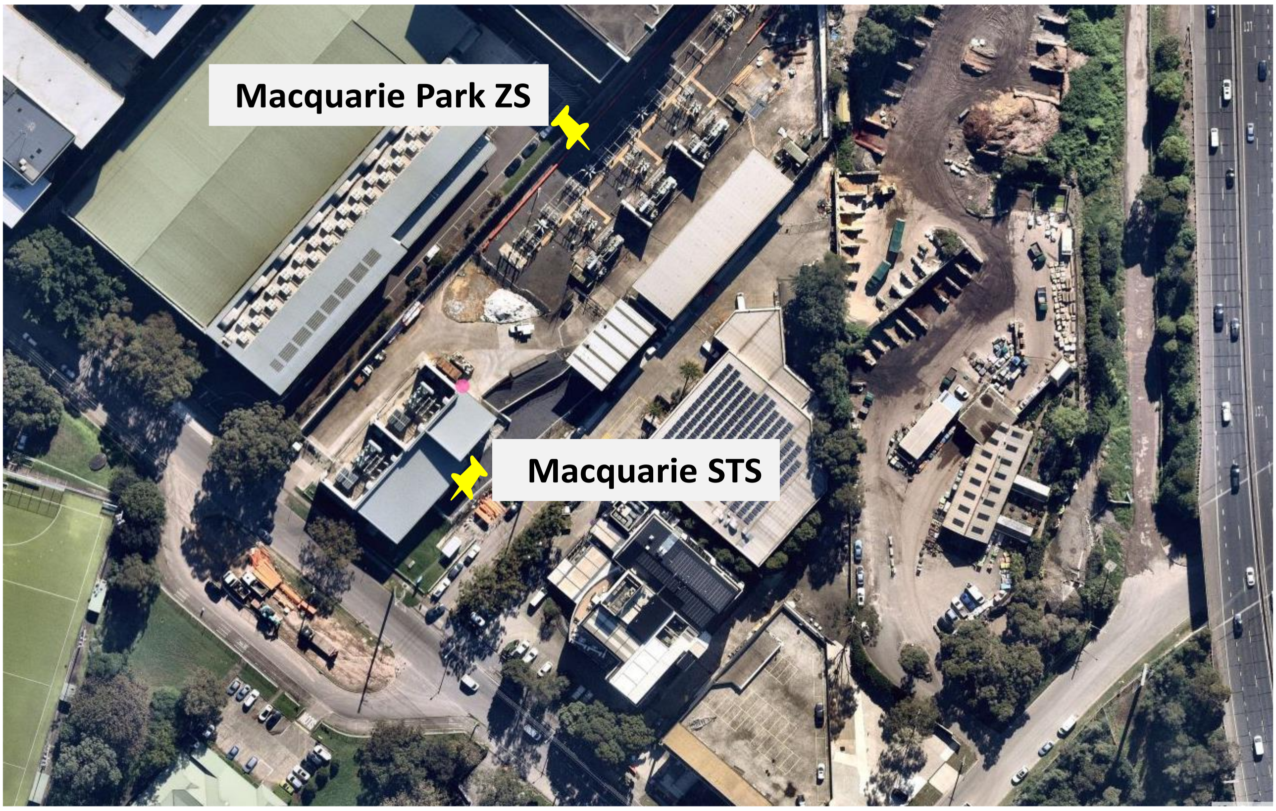
[1] See: Ausgrid, *Addressing increased customer demand requirements in the Macquarie Park area*, Final Project Assessment Report, 19 October 2018.

Figure 2.2 provides an overview of the Macquarie STS site and adjacent Macquarie Park ZS.

Figure 2.2 – Location of the Macquarie STS and adjacent Macquarie Park ZS.



The Macquarie 132/33kV STS was commissioned to assist with providing supply to three major customers that were ready to connect at the time. The names and individual loads of these customers have been redacted due to confidentiality; however, they have a total expected eventual load of 133 MVA.

The Macquarie 132/33kV STS has a secured capacity rating of 142.9MVA, which means that it currently has spare secured capacity during peak periods of approximately 9MVA with the existing two transformers (i.e., 142.9MVA less the combined MVA of the three major customers already connected).

We have subsequently received two additional applications for connection at the Macquarie 132/33 kV STS, totalling an additional 105MVA. Specifically:

- in April 2021, a connection application was received requesting an additional 45MVA of secured "N-1" supply, commencing in 2026 and expected to reach the requested capacity by 2033; and
- in September 2021, a connection application was submitted by a second major customer for 60MVA of secured "N-1" supply, commencing in 2026 and expected to ramp up from 10MVA to 60MVA by 2028/29.

The existing spare capacity at the Macquarie 132/33kV STS (i.e., approximately 9 MVA) is not sufficient to support the connection of these two new loads. Further, as these loads are significant, and the available spare 11kV capacity in the area is not sufficient to support these loads, it is considered that a 33kV supply is the most efficient way to supply these customers going forward.

Over the course of 2022, Ausgrid also received two other connection enquires from other major customers. These loads are not yet considered committed.

Ausgrid considers that an expansion of the existing 132/33kV STS through the addition of a third transformer will be able to accommodate the two committed additional major loads. Further network investment would be required to accommodate any additional major loads, as there are site limitations on adding any further transformers at the Macquarie STS. Any further investment to accommodate future additional loads (including those that have been the subject of connection enquiries to date) would be considered as part of a separate RIT-D process.

2.2. Statement on the ‘identified need’ and Ausgrid’s obligation to connect customers

This RIT-D has been initiated to investigate, and consult, on how to most efficiently accommodate the connection requests of two new major loads in the Macquarie Park area. Importantly, no construction will commence until material components of connection agreements contracts have been executed.

Ausgrid has a requirement to connect customers under section 5.2.3(d) of the NER, which states that “A Network Service Provider must:

> (1) Review and process applications to connect or modify a connection which are submitted to it and must enter into a connection agreement…
>
> (6) Permit and participate in commissioning of facilities and equipment which are to be connected to its network in accordance with rule 5.8;”

As these two prospective customers are expected to utilise nearly 90% of the asset, specific tariff arrangements will be established to recover the majority of the cost of the augmentation from the beneficiaries (i.e., the new major customers), taking into account their share in the capacity added to the network.

These customers will be charged a cost reflective network price, determined specifically from this network augmentation investment, plus allocated costs from the use of the upstream system - i.e., through ‘Distribution Use of System (DUOS) tariffs.

In addition, and as discussed in section 3 below, the two new customers have committed to providing a direct capital contribution to assist with expediting the preferred option.

2.3. Key assumptions underpinning the identified need

The key driver for this RIT-D is the requested connection of load at the Macquarie 132/33kV STS. If action is not taken, there is a significant and increasing forecast supply risk when the combined total major customer demand is near or close to 100% of requested demand, leading to a shortfall of secured substation capacity under both credible contingencies (i.e., transformer outage) and full availability.

We have investigated how assuming different load forecasts going forward changes the expected net market benefits under the proposed options. In particular, we have investigated three future load forecasts– namely a central forecast that represents the load growth expected from the three existing and two committed major customer loads, as well as a lower-than-expected load forecast and a higher-than-expected forecast for these customers (reflecting different timelines to get to full utilisation).

In particular, the three future load forecasts that have been investigated are:

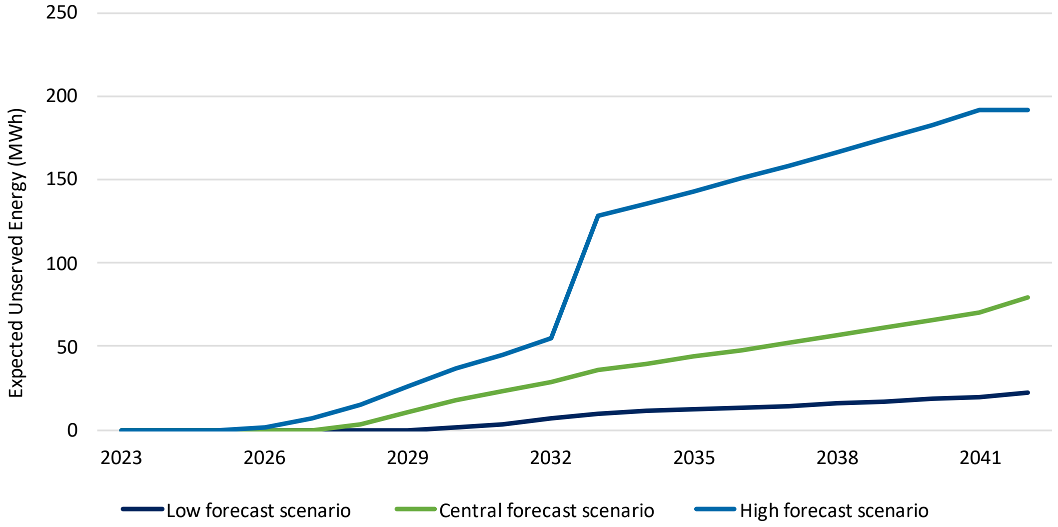
- a central forecast assuming 84 per cent scaled load from the three existing major loads and the two additional committed loads;
- a low demand forecast assuming 70 per cent scaled load from the three existing major loads and the two additional committed loads; and
- a high forecast assuming 100 per cent scaled load from the three existing major loads and the two additional committed loads.

The existing major loads and committed new loads have been scaled across the forecasts to account for uncertainty over the ramp up rate of customer demand in the future (i.e., the timing for these major loads to reach the total load requirements) and therefore the amount of secured capacity at the Macquarie 132/33kV STS with the two existing transformers. These percentages are reflective of ramp up rates experienced in recent years by similar major customers in the area.

In addition, the expected unserved energy (EUE) has been estimated for potential outages under N-1 and N-2 conditions for all three forecasts, as well as for N in the high forecasts.

The figure below shows the modelled levels of EUE, under each of the three underlying demand forecasts investigated, over the next twenty years. For clarity, this figure illustrates the MWh of EUE assumed under each load forecast if no credible option is commissioned (i.e., under the ‘do nothing’ base case for that load forecast).

Figure 2.2 – Forecast EUE under each of the three demand forecasts.



The analysis shows varying levels of EUE based on different expected load ramp up rates across the demand forecasts. Under the high demand forecast of 100 per cent of scaled load, there is a step change in EUE from 2032 onwards which reflects that the existing capacity of the Macquarie STS is less than the level of demand under the 'do-nothing' base case.

EUE is primarily driven by the predicted failure rates of the existing transformer units and the capacity provided by the existing two transformers. EUE in the high demand scenario is driven by the increase in load that cannot be met even with the two transformers in service. Appendix D provides additional detail on the assumptions underpinning the identified need (i.e., the assumed load duration curve and how the probability of transformer failure has been modelled).

We have capped the level of EUE under the high demand forecast in the NPV assessment at 50 per cent of the forecast amounts shown above for the base case from 2033 onwards (we note that this cap is not reflected in the figure above which shows the full EUE forecasts). Since the base case reflects a 'do nothing' approach with rapidly escalating EUE, which is unrealistic, we consider it appropriate to cap the level of EUE to avoid a situation where an exponential increase in EUE skews the results (and note that this approach does not affect identification of the preferred option).[2]

[2] Ausgrid notes that this approach was commented on and supported by Dr Darryl Biggar in his review of the modelling undertaken for the Powering Sydney's Future RIT-T. See: Biggar, D., *An Assessment of the Modelling Conducted by TransGrid and Ausgrid for the "Powering Sydney's Future" Program*, May 2017, available at: https://www.aer.gov.au/system/files/Biggar%2C%20Darryl%20-%20An%20assessment%20of%20the%20modelling%20conducted%20by%20TransGrid%20and%20Ausgrid%20for%20the%20%20Powering%20Sydney%20s%20Future%20%20program%20-%20May%202017.pdf

3. Three credible options have been assessed

While Ausgrid has identified only one credible option as part of its network planning activities, it has also been approached by the two major customers offering a direct capital contribution to support development/design work to expedite the investment. We have therefore assessed three credible options as part of this FPAR that vary in terms of timing and whether the capital contribution is included or not.

Considering this project is triggered by these two major customers requesting network connection, specific tariff arrangements will be established to recover the cost of the shared network augmentation from the beneficiaries, taking into account their share in the capacity added to the network. The cost recovery mechanism will be part of the customer connection agreements and acts as a means of mitigating against the risk of having stranded network assets. This includes charges being levied on a capacity basis, rather than on usage. The major customers will also directly fund the dedicated assets associated with their connections.

All costs and benefits presented in this FPAR are in $2022/23, unless otherwise stated.

3.1. Option 1 – Install a new transformer in 2029

Option 1 involves installing a third 120MVA 132/33kV transformer at the Macquarie 132/33kV STS. This is the only type of solution that Ausgrid considers able to meet the expected increase in demand, whilst also being technically and commercially feasible (and is required even if only one of the two proposed loads connects).

Specifically, the scope of Option 1 includes:

- construction of a new transformer bay, including civil works to install an additional 132 kV circuit breaker;
- installation of a new 120 MVA 132/33 kV transformer unit;
- modifications and upgrades in the 132 kV busbar bolted assemblies and flexible connections to achieve the required throughput busbar rating; and
- installation of 132 kV cable connections to the new transformer and 33kV cable connections from the new transformer to the existing 33 kV switchroom.

Commissioning of the new transformer (and all associated works) is expected in 2028/29 under Option 1. The timing has been determined by the year in which the expected benefit from avoided unserved energy exceeds the cost of investment (in the central scenario). However we note that in reality the major customers require supply ahead of 2028/29, and so would not connect under this option.

The estimated capital cost of this option is $9.1 million. Annual routine operating costs are assumed to be 0.2 per cent of the estimated capital cost (i.e., $18,000/year).

3.2. Option 2 – Install a new transformer in 2026 (with capital contribution)

Option 2 is the same as Option 1 in terms of scope.

The cost of installing the transformer would be marginally lower than under Option 1, due to lower expected real cost escalation. This option also factors in a direct capital contribution from the two major customers of approximately $1.3 million to bring the investment forward three years to 2025/26. This capital contribution covers the design works for the investment.

The effective capital cost of Option 2 is therefore $7.4 million (i.e., $8.7 million less $1.3 million). Annual routine operating costs are assumed to be 0.2 per cent of the estimated capital cost (i.e., $17,500/year).

Option 2 tests whether the bring forward costs (i.e., incurring capital and operating costs three years earlier than under Option 1) are outweighed by the capital contribution. It also takes into account a small proportion of avoided EUE that arises from 2026 and 2028 under the high and central demand forecast scenarios, respectively.

3.3. Option 3 – Install a new transformer in 2026 (without capital contribution)

Option 3 is the same option as Option 2 with exception that the direct capital contribution from the two major customers has not been included. Option 3 has been included to serve as a comparison to Option 2 and to increase transparency regarding what is driving the results of the cost–benefit analysis, consistent with the AER RIT-D Guidelines.[3]

Under this option the capital cost of the investment is $8.7 million. Annual routine operating costs are assumed to be 0.2 per cent of the estimated capital cost (i.e., $17,500/year).

3.4. Options considered but not progressed

Ausgrid also considered several other options that have not been progressed. In general, these options were not progressed because they were found to be technically infeasible or economically infeasible.

The table below summarises Ausgrid's consideration and position on each of these potential options.

Table 3.1 – Options considered but not progressed.

Option	Reason why option was not progressed
11 kV options	Given the magnitude of the load requirements, 11 kV supply options are not considered able to assist with meeting the identified need given the underlying 11 kV network is near capacity. In addition, there are technical limitations associated with installing multiple 11 kV feeders to a single large load customer, such as multiple switching stations, complex protection schemes to manage the operation and separate metering points at 11kV. These solutions are therefore not considered technically feasible.
Direct supply at 132 kV to the customers	This option was not pursued because it would result in unnecessary duplication of network investments, which would be materially more expensive and less space efficient. Each customer would have to install switching equipment and substations to reduce the voltage to the required internal level, occupying areas in their properties which otherwise could be used for their core business activities. This option is therefore not considered commercially feasible.
Establishing a second Macquarie STS	The option to establish another STS site to be able to provide additional 33kV supply was disregarded because the construction of a new STS would not take advantage of existing capacity at Macquarie STS and would not be delivered in time to meet customer requirements, as a suitable site must be acquired. The costs involved for this option are also considerably higher than the credible options assessed. This option is therefore not considered a credible option to meet the identified need in this RIT-D.
Using non-network solutions either in combination with, or in-place of, a network option.	Ausgrid has considered the ability of non-network solutions to assist in meeting the identified need. Specifically, an analysis of non-network options considered how the timing of the preferred network solution could be deferred and whether the estimated unserved energy at risk could be cost effectively reduced. The assessment shows that non-network alternatives would not be cost effective due to the magnitude of the load reduction required. This is detailed further in the separate Options Screening Notice released in accordance with clause 5.17.4(d) of the NER.
Transferring and/or connecting customers to SAPS	Ausgrid has considered the feasibility of SAPS, informed by its trial of SAPS with selected customers living in fringe-of-grid areas of Ausgrid's network. Based on Ausgrid's trial, the cost of SAPS would limit the number of customers available to reduce demand given the deferral funds available and consequently, the reduction in demand would not be sufficient to defer or postpone the network solution. This is detailed further in the separate Options Screening Notice released in accordance with clause 5.17.4(d) of the NER.

[3] AER, *Application guidelines Regulatory Investment Test for Distribution*, August 2022, pp. 55.

4. How the options have been assessed

This section outlines the methodology that Ausgrid has applied in assessing market benefits and costs associated with the credible options considered in this RIT-D. Appendix D presents additional detail on the assumptions and methodologies used to assess the option.

4.1. General overview of the assessment framework

All costs and benefits for each credible option have been measured against a 'business as usual' base case. Under this base case, Ausgrid will only be able to supply part of the customer requested load with the existing 33kV spare capacity at the Macquarie STS in the absence of a network option. Under the base case, there is expected to be a significant shortfall of substation capacity under both normal operation and credible contingencies during peak periods, which leads to substantial levels of unserved energy.

Note that the base case is not a realistic scenario as it is Ausgrid's obligation to process and facilitate customer connection requirements under Section 5.2.3 in the NER, and the major customers would not in practice connect unless they were able to receive sufficient supply. The base case is included in this RIT-D for illustration purposes only, consistent with the RIT-D framework.

The RIT-D analysis has been undertaken over a 20-year period, from 2022-23 to 2041-42. Ausgrid considers that a 20-year period takes into account the size, complexity and expected life of the relevant credible option to provide a reasonable indication of the market benefits and costs of the option.

Where the capital components of the credible option have asset lives greater than 20 years, Ausgrid has taken a terminal value approach to incorporate capital costs in the assessment, which ensures that the capital cost is appropriately captured in the 20-year assessment period. This ensures that costs and benefits are assessed over a consistent period. The terminal value has been calculated as the undepreciated value of capital costs at the end of the analysis period.

Ausgrid has adopted a real, pre-tax discount rate of 3.44% for the NPV analysis. This represents Ausgrid's opportunity cost for its capital investments, based on the guidelines provided in the AER rate of return instrument. As no non-network options have been found to be viable, Ausgrid considers that the appropriate discount rate is the regulated cost of capital.

To test the results against variations in the discount rate, a value of 2.34% has been adopted for the lower bound discount rate sensitivity, to reflect the average of the latest AER Final Decision for a DNSP's regulated weighted average cost of capital (WACC) at the time of preparing this DPAR.[4] This is approximately 32% lower than the central discount rate assumption. For the upper bound discount rate sensitivity, the value of 5.50% is adopted, in line with the estimate prepared by AEMO for the 2022 Integrated System Plan (ISP).

4.2. Ausgrid's approach to estimating project costs

Ausgrid has estimated capital costs by considering the scope of works necessary under the credible option together with costing experience from previous projects of a similar nature. Where possible, Ausgrid has also estimated capital costs using supplier quotes or other pricing information. Where costs for design work have been incurred prior to 2022/23, we have adjusted these costs to reflect the opportunity cost of this expenditure using Ausgrid's regulated cost of capital.

Operating and maintenance costs have been determined by comparing the operating and maintenance costs with the option in place to the operating and maintenance costs without the option in place. These costs are included for each year in the planning period.

4.3. Market benefits are expected from reduced involuntary load shedding

Ausgrid considers that the only relevant category of market benefits prescribed under the NER for this RIT-D relate to changes in EUE.

The approach Ausgrid has adopted to estimating reductions in EUE are outlined in section 4.3.1 below. Further details on the assumptions and methodology considered are presented in Appendix D.

In addition, Appendix C summarises the market benefit categories that Ausgrid considers are not material for this RIT-D.

[4] Specifically, we take a straight average of the real, pre-tax WACCs for the Victorian DNSPs (since they represent the latest Final Decision(s) by the AER).

Reduced involuntary load shedding

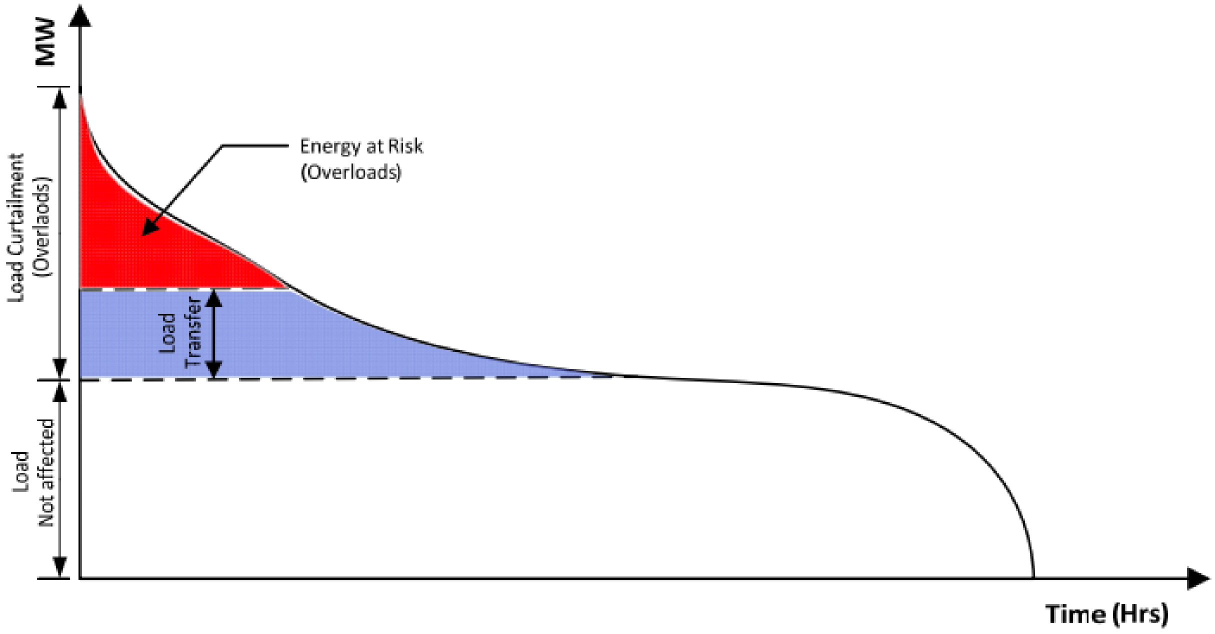
EUE is the amount of energy that customers request to utilise but cannot be supplied due to a network capacity limitation. A reduction of the unserved energy expected from the credible option, relative to the base case, results in a positive contribution to market benefits.

EUE is the probability weighted average amount of load that would need to be involuntarily curtailed due to system limitations (i.e., the network being overloaded). These limitations arise from the unavailability of network elements and the resulting reduction in network capacity to supply the load. It also relates to the availability of network connectivity and design configuration at the substation.

The load duration curve at a substation is used to determine the energy at risk and/or the amount of load curtailment required at certain loading levels. The amount of load curtailment can be determined by using a discrete number of load points and the capacity adequacy at the substation following various credible contingencies and/or outages (i.e. single or multiple transformers out of service).

The following diagram illustrates the load curtailment due to overloads and the treatment of load transfer capability. During an overload condition, initially the necessary amount of load is shed, and then partial load is restored via available load transfer opportunities to surrounding zone substations.

Figure 4.1 – Illustration of load curtailment



$$Energy\ At\ Risk\ (Overloads) = Area\ of\ the\ curve\ (as\ shown\ above)$$

The calculation of the energy at risk considers the STS load forecast which includes the quantity of new additional load requested in the customer connection application. The EUE is the energy at risk weighted by the probability of each state and/or state probabilities of all credible contingencies or outages.

The market benefit as a result of the preferred option by eliminating unserved energy with a network solution is estimated by multiplying the unserved energy by the Value of Customer Reliability (VCR). The VCR is measured in dollars per kWh and is used as a proxy to evaluate the economic impact of unserved energy on customers under the RIT-D.

Ausgrid has applied a central VCR estimate of $46.9/kWh reflecting the NSW state-wide VCR estimated by the AER in its December 2019 VCR Final Report, adjusted by the Consumer Price Index (CPI) to be in 2022/23 dollars.[5] We have tested

[5] AER, *Values of Customer Reliability – Final report on VCR values*, December 2019, p 71. The NSW state-wide VCR has been inflated to $2022/23 using the Australian Bureau of Statistics CPI weighted average of eight capital cities (series ID: A2325846C).

the VCR as a sensitivity with values that are 30 per cent lower and 30 per cent higher than the central rate, consistent with the AER's specified +/- 30 per cent confidence interval.[6]

Ausgrid has investigated how assuming different load forecasts going forward changes the EUE under the proposed options, as discussed further below.

4.4. Three different demand scenarios have been modelled to address uncertainty

RIT-D assessments are required to be based on cost-benefit analysis that includes an assessment of 'reasonable scenarios', which are designed to test alternate sets of key assumptions and whether they affect identification of the preferred option.

Ausgrid has assessed three alternative future load demand scenarios– namely:

- a central forecast assuming 84 per cent scaled load from the three existing major loads and the two additional loads;
- a low demand forecast assuming 70 per cent scaled load from the three existing major loads and the two additional loads; and
- a high forecast assuming 100 per cent scaled load from the three existing major loads and the two additional loads.

The scenarios only differ by the demand forecasts given this is the key parameter that may affect the ranking of the credible options. How the results are affected by changes to other variables (e.g., the discount rate and capital costs) have been investigated in the sensitivity analysis.[7]

A summary of the key variables in each scenario is provided in the table below.

Table 4.1 – Summary of the three demand scenarios investigated.

Variable	Scenario 1 – central demand scenario	Scenario 2 – low demand scenario	Scenario 3 – high demand scenario
Demand	Central forecast	Low forecast	High forecast
VCR		$46.9/kWh across all scenarios	
Discount Rate		3.44% across all scenarios	

Note: The demand forecasts reflect different assumptions regarding the evolution of data centre load.

Ausgrid has weighted each of the demand scenarios equally in the NPV assessment. However, we note that the NPV outcome is positive across all scenarios, therefore the weightings do not influence the RIT-D outcome.

[6] AER, *Values of Customer Reliability – Final Report on VCR values*, December 2019, p. 84.

[7] This represents a change in approach to earlier Ausgrid RIT-Ds and reflects additional guidance provided by the AER in November 2022 in the context of the RIT-T, which Ausgrid considers is also relevant for the RIT-D. Specifically, this refers to the guidance provided in the AER's determination on the North West Slopes and Bathurst, Orange and Parkes RIT-T disputes.

5. Assessment of the credible options

This section provides the assessment of the credible network options Ausgrid has identified as part of its network planning activities.

5.1. Estimated gross market benefits

The table below summarises the gross market benefits of the credible options relative to the base case in present value terms. The gross market benefit for the options compared to the credible base case has been calculated for each of the three demand scenarios outlined in the section above and is also provided on a weighted basis.

Table 5.1 – Present value of benefits of credible options relative to the base case ($2022/23, million).

Option	Central demand scenario	Low demand scenario	High demand scenario	Weighted benefits
Scenario weighting	33.3%	33.3%	33.3%	
Option 1	18.4	4.8	29.0	17.4
Option 2	18.6	4.8	29.9	17.8
Option 3	18.6	4.8	29.9	17.8

The market benefit from undertaking the proposed investments is avoided EUE, due to increasing forecast supply risk under the current capacity of the Macquarie STS. Small differences in market benefit arise due to the different commissioning dates between the option, with Options 2 and 3 (which are commissioned earlier) allowed for the avoidance of EUE in earlier years.

5.2. Estimated costs

The table below summarises the cost of the options in present value terms. Option costs comprise capital costs and ongoing operating and maintenance costs.

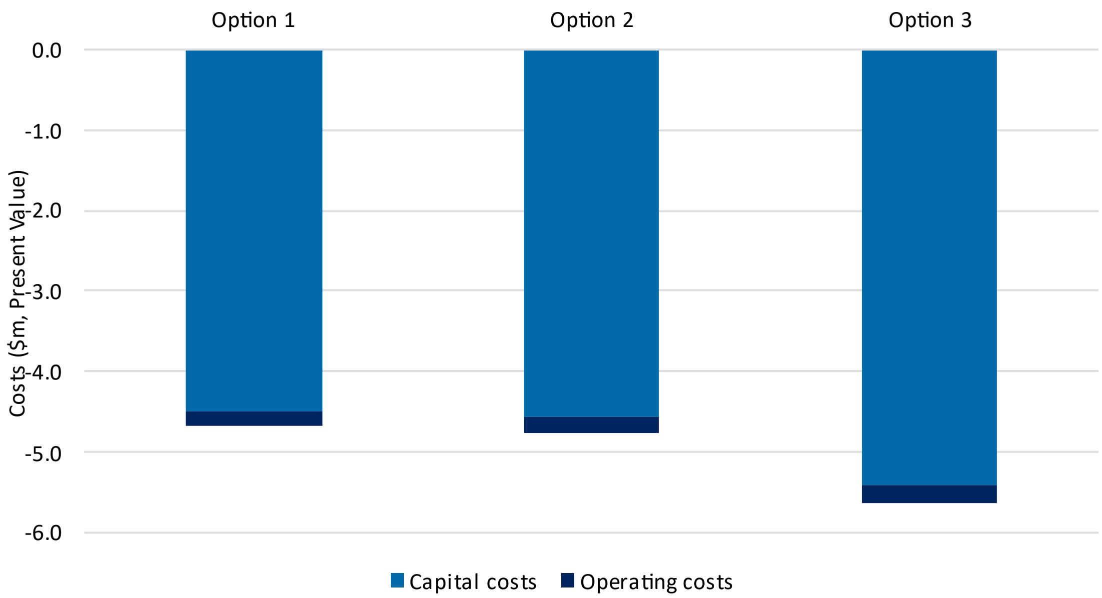
The capital cost of each option does not vary across the three demand scenarios. Variations in the capital costs have been tested as part of the sensitivity analysis.

Table 5.2 – Present value of costs of credible options relative to the base case ($2022/23, million).

Option	Central demand scenario	Low demand scenario	High demand scenario	Weighted costs
Scenario weighting	33.3%	33.3%	33.3%	
Option 1	-4.7	-4.7	-4.7	-4.7
Option 2	-4.8	-4.8	-4.8	-4.8
Option 3	-5.6	-5.6	-5.6	-5.6

Figure 5.1 presents a breakdown of the costs for the proposed options on a weighted basis. It demonstrates that on average, routine operating costs are approximately 4.0 per cent of total costs across the options over the assessment period.

Figure 5.1 - Breakdown of gross costs of credible options relative to the base case weighted across scenarios ($2022/23, million).



5.3. Net present value assessment outcomes

The table below summarises the net market benefit in Net Present Value (NPV) terms for the credible options under each scenario. The net market benefit is the gross market benefit (as set out in Table 5-1) minus the cost of the option (as set out in Table 5-2), all in present value terms.

The net market benefit is positive for all options across the three demand scenarios, and on a weighted basis. Overall, Option 2 exhibits the highest (or equal highest) net benefit across all the scenarios, and also results in the highest net benefit on a weighted basis. This demonstrates that the additional cost (in present value terms) of bringing forward investment under this option is more than offset by the capital contribution made by the two major customers.

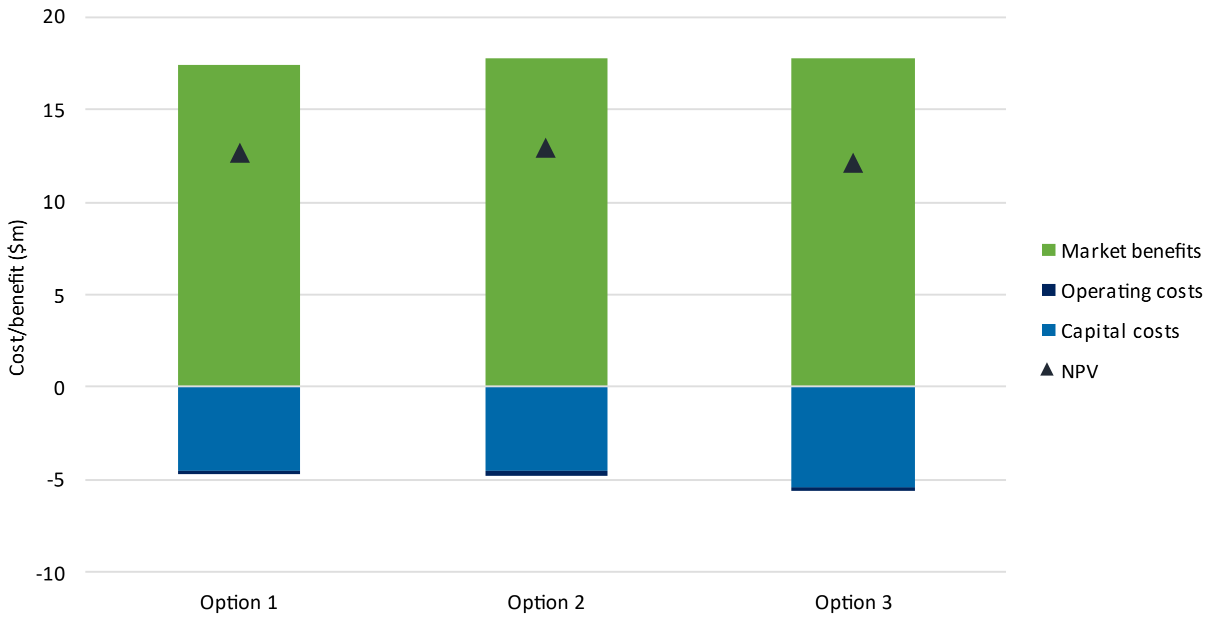
Table 5.3 – Present value of net benefits of credible options relative to the base case by scenario and weighted across demand scenarios ($2022/23, million).

Option	Central demand scenario	Low demand scenario	High demand scenario	Weighted net benefits
Scenario weighting	33.3%	33.3%	33.3%	
Option 1	13.8	0.1	24.3	12.7
Option 2	13.8	0.0	25.2	13.0
Option 3	12.9	-0.9	24.3	12.1

Under the low scenario, Option 3 results in negative net market benefit. Option 3 reflects the earlier commissioning of the transformer absent the capital contributions made by the two major customers. It is provided to demonstrate transparency of the RIT-D results but does accurately reflect the actual level of capital expenditure associated with this configuration, given the agreements for the major load to provide the capital contributions.

Figure 5.2 presents a breakdown of net present costs and benefits across the three scenarios, and on a weighted basis.

Figure 5.2 - Present value of benefits and costs, weighted across demand scenarios ($ 2022/23, million)



5.4. Sensitivity analysis results

Ausgrid has undertaken a number of sensitivity tests to understand the robustness of the RIT-D assessment to underlying assumptions about key variables.

Specifically, we have investigated the following sensitivities:

- a 25 per cent increase/decrease in the assumed network capital costs;
- a 25 per cent increase/decrease in the assumed planned maintenance costs;
- a 30 per cent lower VCR ($32.8/kWh) and a higher VCR ($60.9/kWh); and
- higher or lower discount rate assumptions.

The results of the sensitivity tests are presented in the table below and show that Option 2 remains the top-ranked option and has positive net market benefits across all the sensitivities modelled. The results indicate that the ranking of the preferred option is robust to variations in key parameters.

Table 5.4 – NPV results from sensitivity tests, weighted across demand scenarios ($2022/23, million).

Sensitivity	Option 1	Option 2	Option 3
Baseline weighted outcome across scenarios	12.7	13.0	12.1
High capital costs (+25%)	11.6	11.8	10.8
Low capital costs (-25%)	13.8	14.1	13.5
High planned maintenance costs (+25%)	12.7	12.9	12.1
Low planned maintenance costs (-25%)	12.8	13.0	12.2
High VCR ($60.9/kWh)	17.9	18.3	17.5
Low VCR ($32.8/kWh)	7.5	7.7	6.8
High discount rate (5.50%)	8.2	8.3	7.3
Low discount rate (2.34%)	15.9	16.2	15.4

6. Proposed preferred option

Ausgrid considers that Option 2 is the preferred option that satisfies the RIT-D. It involves installing a third 120 MVA 132/33 kV transformer at the Macquarie 132/33 kV STS. Ausgrid is the proponent for Option 2.

Specifically, the scope of Option 2 includes:

- construction of a new transformer bay, including civil works to install an additional 132kV circuit breaker;
- installation of a new 120MVA 132/33kV transformer unit;
- modifications and upgrades in the 132kV busbar bolted assemblies and flexible connections to achieve the required throughput busbar rating; and
- installation of 132kV cable connections to the new transformer and 33kV cable connections from the new transformer to the existing 33kV switchroom.

Commissioning of the new transformer is expected in 2025-26.

While the estimated capital cost of this option is $8.7 million ($2022/23), it also involves a direct capital contribution from the two major customers of $1.3 million meaning that the effective capital cost is $7.4 million. Annual routine operating costs are assumed to be 0.2 per cent of the estimated capital cost (i.e., approximately $17,500/year).

The timing of commissioning for Option 2 is 2025/26. The RIT-D demonstrates that the increase in costs (in present value terms) resulting from the earlier commissioning date is more than offset by (or is no more than) the capital contribution that will be made by the two major customers.

As the major customers are expected to utilise nearly 90% of the asset capacity, specific tariff arrangements will also be established to recover the majority of the cost of the augmentation from the beneficiaries, taking into account their share in the capacity added to the network. These customers will also be charged a cost reflective network price, determined specifically from this network augmentation investment, plus allocated costs from the use of the upstream system – i.e., through 'Distribution Use of System (DUOS) tariffs.

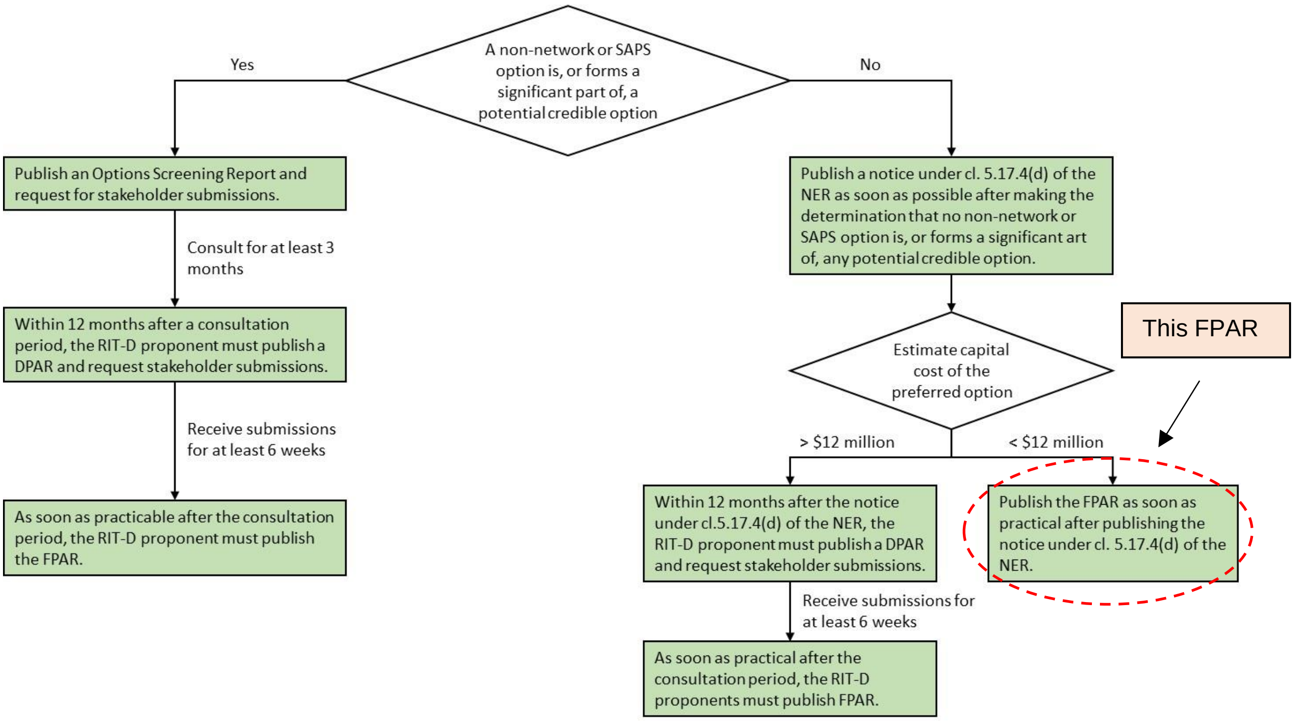
Appendix A – Checklist of compliance clauses

This section sets out a compliance checklist that demonstrates the compliance of this DPAR with the requirements of clause 5.17.4(r) of the National Electricity Rules version 195.

Clause	Summary of requirements	Section in the DPAR
5.17.4(r)	A summary of any submissions received on the draft project assessment report and the RIT-D proponent's response to each such submission	NA
5.17.4(j)	(1) a description of the identified need for the investment	2
	(2) the assumptions used in identifying the identified need	2.3
	(3) if applicable, a summary of, and commentary on, the submissions on the non-network options report	NA
	(4) a description of each credible option assessed	3
	(5) where a DNSP has quantified market benefits, a quantification of each applicable market benefit for each credible option	5.1
	(6) a quantification of each applicable cost for each credible option, including a breakdown of operating and capital expenditure	5.2
	(7) a detailed description of the methodologies used in quantifying each class of cost and market benefit	4
	(8) where relevant, the reasons why the RIT-D proponent has determined that a class or classes of market benefits or costs do not apply to a credible option	Appendix C
	(9) The results of a net present value analysis of each of credible option and accompanying explanatory statements regarding the results	5
	(10) the identification of the proposed preferred option	6
	(11) for the proposed preferred option, the RIT-D proponent must provide: (i) details of technical characteristics; (ii) the estimated construction timetable and commissioning date (where relevant); (iii) the indicative capital and operating cost (where relevant); (iv) a statement and accompanying detailed analysis that the proposed preferred option satisfies the regulatory investment test for distribution; and (v) if the proposed preferred option is for reliability corrective action and that option has a proponent, the name of the proponent	6
	(12) Contact details for a suitably qualified staff member of the RIT-D proponent to whom queries on the draft report may be directed.	1.2

Appendix B – Process for implementing the RIT-D

For the purposes of applying the RIT-D, the NER establishes a three-stage process: (1) the Non-Network Options Report (or notice circumventing this step); (2) the DPAR; and (3) the FPAR. This process is summarised in the figure below.



Appendix C – Market benefit classes considered not relevent

The market benefits that Ausgrid considers will not materially affect the outcome of this RIT-D assessment include:

- changes in the timing of unrelated expenditure;
- changes in voluntary load curtailment;
- changes in costs to other parties;
- changes in load transfer capability and capacity of embedded generators to take up load;
- option value; and
- changes in electrical energy losses.

The reasons why Ausgrid considers that each of these categories of market benefit is not expected to be material for this RIT-D are outlined in the table below.

Table C.1 – Market benefit categories under the RIT-D not expected to be material.

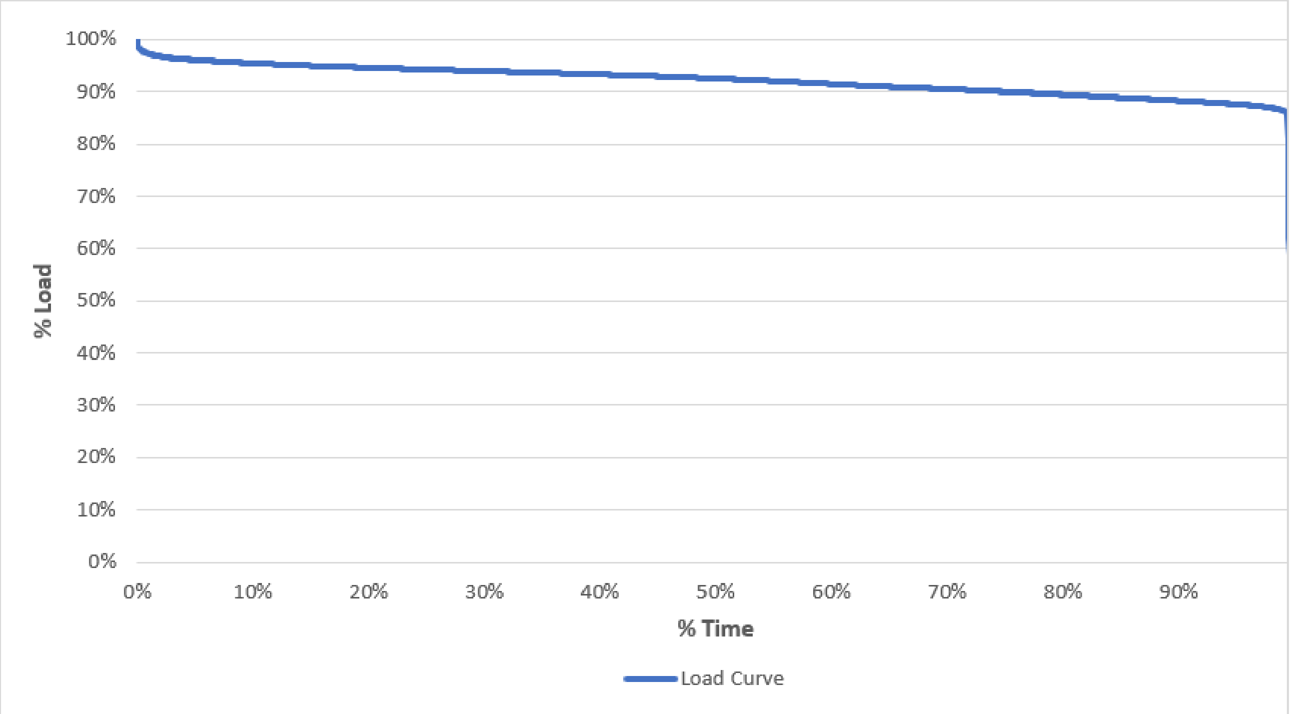
Market benefits	Reason for excluding from this RIT-D
Timing of unrelated expenditure	Ausgrid does not expect the project will have any effect on unrelated expenditures in other parts of the network. Accordingly, Ausgrid considers the market benefit from changes in timing of unrelated expenditure is not material.
Changes in voluntary load curtailment	Ausgrid notes that the level of voluntary load curtailment currently present in the National Electricity Market (NEM) is limited. Where the implementation of a credible option affects pool price outcomes, and in particular results in pool prices reaching higher levels on some occasions than in the base case, this may have an impact on the extent of voluntary load curtailment. Ausgrid notes that the option is not expected to affect the pool price and so there is not expected to be any changes in voluntary load curtailment.
Costs to other parties	This category of market benefit typically relates to impacts on generation investment from the option. Ausgrid notes that the option will not affect the wholesale market and so we have not estimated this category of market benefit.
Changes in load transfer capacity and embedded generators	Load transfer capacity between substations is predominantly limited by the high voltage feeders that connect substations. The option under consideration does not affect high voltage feeders and therefore are unlikely to materially change load transfer capacity. Further, the option is unlikely to enable embedded generators in Ausgrid's network to be able to take up load given the size and profile of the load serviced by network assets currently considered for replacement. Consequently, Ausgrid has not attempted to estimate any benefits from changes in load transfer capacity and embedded generators.
Option value	Option values arise where there is uncertainty regarding future outcomes, the information that is available in the future is likely to change, and the credible options considered have sufficiently flexible to respond to that change. Ausgrid notes that the credible option assessed does not involve stages or any other flexibility and so we do not consider that option value is relevant.
Changes in electrical energy losses	Ausgrid does not expect that the credible option considered will lead to significant changes in network losses and so have not estimated this category of market benefits.

Appendix D – Additional detail on the assessment methodology and assumptions

D.1 Characteristic load duration curve

The load duration curve used in the analysis is presented in the figure below. It is assumed that the load types supplied will not change substantially into the future and therefore the load duration curve will maintain its characteristic shape.

Figure D.1 – Load duration curve



D.2 Probability of failure

Ausgrid has adopted probability models to estimate expected failure of different network assets. A summary of the models adopted, and the key parameters used are summarised in the table below.

Table D.1 – Summary of failure probability models used to estimate failure probability.

Network asset type	Failure probability model	Key parameters
Subtransmission substation transformer	Weibull distribution function	Transformer failure rate Age of transformer at failure in years Repair time

Transformers

The failure rate of transformers is expressed in terms of the Weibull distribution with sets of parameters for different transformer types.

Table D.2 – Subtransmission Substation transformer parameters

Transformer	Type	Year of commissioning	*μ* factor	*Q* factor	MTTR (Weeks)*
Transformer No.1	132kV Bushing Type	2021	160.8	2.33	6
Transformer No.2	132kV Bushing Type	2021	160.8	2.33	6

* Mean Time To Repair

The following equation is used to calculate the yearly major failure rates based on the Weibull parameters related to the subtransmission substation transformer.

Equation 1

$$f = \left(\frac{\beta}{\mu}\right) \times \left(\frac{t}{\mu}\right)^{(\beta-1)}$$

Where:

f is the failure rate

t is the age (in years)

β is the shape parameter

μ is the scale parameter

Equation 2 shows how the failure rate is used to calculate unavailability for failures.

Equation 2

$$U = \frac{f \times MTTR_{weeks}}{52 + f \times MTTR_{weeks}}$$

Unavailability of each network element is calculated for pre switching and post switching scenarios, by using Equations 3 and 4.

Equation 3

$$Pre - switching\ unavailability = \frac{8760 \times \lambda \times r_s}{f \times r_r + 8760}$$

Equation 4

$$Post - switching\ unavailability = \frac{8760 \times \lambda \times (r_r - r_s)}{f \times r_r + 8760}$$

Where:

f is the failure rate

r_s is the switching time (in hours)

r_r is the repair time (in hours)

Ausgrid