Addressing increased customer demand requirements in the Macquarie Park area

DRAFT PROJECT ASSESSMENT REPORT

31 AUGUST 2018

Ausgrid

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Addressing increased customer demand requirements in the Macquarie Park area

Draft Project Assessment Report – August 2018

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Executive Summary

This report investigates the most economic option for meeting the increased customer demand requirements in the Macquarie Park area

This Draft Project Assessment Report (DPAR) has been prepared by Ausgrid and represents the first step in the application of the Regulatory Investment Test for Distribution (RIT-D) to options for ensuring the growing customer demand in Macquarie Park supply area is addressed in the most economic manner.

In particular, the future combined load increases from several major customers in the Macquarie Park supply area is anticipated to cause significant constraints on the existing Ausgrid 11kV network and a long term 33kV supply strategy presents an opportunity to support all customers efficiently.

Ausgrid has prepared this report consistent with the National Electricity Rules

A number of major customers[1] separately approached Ausgrid to initiate the connection applications process in 2017. Section 5.2.3 of the National Electricity Rules (NER) obliges Ausgrid to enable connection of these customers to the distribution network[2].

Two of these customers have progressed with formal connection applications and confirmed their load requirements and expected connection dates. In particular, these two customers are requesting connection by 2021/22 with a total eventual load of 91MVA in 2028. Further loads of this nature are expected given the close proximity to high capacity broadband communication links, high technology industry and Macquarie University.

The scale of expected load required by these customers is such that the existing network cannot accommodate these loads without augmentation. Ausgrid has therefore identified the need to augment the subtransmission network supplying the Macquarie Park area and is commencing this RIT-D.

The expected capital cost of the proposed investment to facilitate these loads is greater than $5 million (i.e. the threshold for having to apply a RIT-D). Ausgrid notes that this substation will be a shared network asset which will become part of Ausgrid’s Regulatory Asset Base. As these prospective customers are expected to utilise over 95% 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 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. Customers will directly fund the dedicated assets associated with their connections.

Whilst Ausgrid has an obligation to enable the connection of these customers, in accordance with section 5.2.3 of the NER, construction works will only commence on this augmentation once the material components of connection agreement contracts have been executed.

One credible network option has been identified and assessed

Ausgrid has identified one credible network option to address the immediate capacity constraint resulting from the growing customer demand in the Macquarie Park area. This option involves:

- construction of a new subtransmission substation (STS) within the existing Macquarie Park zone substation (ZS) site;
- installation of a new 132kV feeder; and
- rearrangement of the 132kV feeders supplying Macquarie Park ZS.

The estimated capital cost of this option is $35.5 million in $2018/19, with annual operating costs expected to be around $177,000 per year (i.e. around 0.5 per cent of the capital cost). Construction is anticipated to begin in 2018/19, with the new STS planned to be commissioned in 2021/22.

[1] At this stage, it would be inappropriate to name these customers due to commercial sensitivities. As discussed in this DPAR, once these customers have signed connection agreements with Ausgrid, their details will be able to be released.

[2] Specifically, clause 5.2.3(d) items 1 and 6, as well as 5.2.3(e1) outlines the connection and network management obligations for Ausgrid as a network service provider.

Other options have also been considered in this assessment including establishing a new STS on a greenfield site and initial 11kV supply to these customers from Top Ryde ZS with a future STS after two years. However, these options are unlikely to be technically feasible, are significantly more expensive or unable to meet the customer requested connection date. In particular, the initial 11kV supply would require the installation of a significant number of 11kV feeders that may not be achievable in the area due to the existing congestion of cables leading to significant rating and construction issues.

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

Ausgrid has also considered the ability of non-network solutions to assist in meeting the identified need. A demand management assessment into reducing the overload condition that results from the connection of the new customer load to Macquarie Park ZS showed that non-network alternatives cannot cost-effectively address the risk, compared to the network option outlined above. This result is driven primarily by the significant energy overload that occurs and the resultant low value of funds available in in relation to the required reduction in grid supplied electricity, and is detailed further in the separate notice released in accordance with clause 5.17.4(d) of the NER. If during the course of this RIT-D process, a cost-effective non-network solution emerges, it will be assessed alongside the other options.

Three different 'scenarios' have been modelled to deal with uncertainty

Ausgrid has elected to assess three alternative future scenarios – namely:

- Low benefit scenario – Ausgrid has adopted several assumptions that give rise to a lower bound NPV estimate for each credible option, in order to represent a conservative future state of the world with respect to potential market benefits that could be realised under the credible option;
- Baseline scenario – the baseline scenario consists of assumptions that reflect Ausgrid's central set of variable estimates, which, in Ausgrid's opinion, provides the most likely scenario; and
- High benefit scenario – this scenario reflects an optimistic set of assumptions, which have been selected to investigate an upper bound on reasonably expected potential market benefits.

A summary of each scenario and the sets of variable values adopted is presented in the table below.

Table E.1 – Summary of the three scenarios investigated

Variable	Scenario 1 – baseline	Scenario 2 – low benefits	Scenario 3 – high benefits
Load Growth	Expected load growth	Lower than expected load growth	Higher than expected load growth
VCR	$41/kWh (Derived from AEMO VCR estimate of $38.35/KWh at state level, indexed using CPI)	$29/kWh (30 per cent lower than AEMO VCR estimate)	$53/kWh (30 per cent higher than AEMO VCR estimate)
Commercial discount rate	6.13 per cent	8.07 per cent	4.19 per cent

Option 1 is expected to deliver significant benefits if the customers connect

Option 1 provides significant benefits across the scenarios investigated. These scenarios are driven solely by the value of avoided unserved energy for the major customers compared under the base case, as well as how many of these new major customers ultimately connect to the network.

Table E.2 – Present value of estimated benefits relative to base case, PV $m 2018/19

Option	Baseline scenario	Low benefit scenario	High benefit scenario	Weighted Benefits
Weighting	50 per cent	25 per cent	25 per cent	--
Option 1	66.4	3.3	3,155.0	822.8

The table below presents the estimated costs, in present value terms. The costs include both the discounted capital costs and the discounted operating costs.

Table E.3 – Present value of costs relative to the base case, PV $m 2018/19

Option	Baseline scenario	Low benefit scenario	High benefit scenario	Weighted Costs
Weighting	50 per cent	25 per cent	25 per cent	--
Option 1	-27.0	-28.0	-25.2	-26.8

On a weighted basis, costs are expected to be $26.8 million in present value terms, which is significantly lower than the value of avoided unserved energy under the high benefit and baseline scenarios. This investment allows for a very large amount of new load to be connected.

The table below provides a summary of the net market benefit for Option 1, on a scenario weighted basis. Overall, Option 1 exhibits positive NPV of $796 million on a weighted basis.

Table E.4 – Present value of expected net benefits relative to the base case, $m 2018/19

Option	Weighted PV Costs	Weighted PV Benefits	Weighted NPV
Option 1	-26.8	822.8	795.9

Option 1 is the preferred option at this draft stage

Option 1 has been found to be the preferred option, which satisfies the RIT-D. It involves the construction of a new STS on the existing Macquarie Park ZS. The scope of works consists of:

- construction of a new 132/33kV STS at the Macquarie Park ZS site with a nominal firm capacity of 140MVA;
- installation of a new 132kV cable and rearrangement of existing 132kV connections at Macquarie Park, such that each cable connection is adequate to supply both the STS and the ZS; and
- acquisition of 33kV and 132kV cable easements to ensure that full capacity of the STS and ZS can be utilised.

Construction of Option 1 will only commence once the material components of connection agreement contracts have been executed. The construction is anticipated to commence in 2018/19, with commissioning in 2021/22 to meet customers' requirements. The estimated capital cost of this option is $35.5 million.

Ausgrid commenced consultation with Ryde Council in June 2018 and is developing its community consultation plan which will include newsletters and updates to the broader community. Consultation has also commenced with the NSW Department of Planning. Ausgrid encourages community feedback and will keep the community informed as the project progresses through notification letters and the Ausgrid website.

Ausgrid considers that this DPAR, and the accompanying detailed analysis, identify Option 1 as the preferred option and that this satisfies the RIT-D. Ausgrid is the proponent for Option 1.

How to make a submission and next steps

Ausgrid welcomes written submissions on this DPAR. Submissions are due on or before 12 October 2018. Submissions and queries should be addressed to:

Matthew Webb
Head of Asset Investment
Ausgrid
GPO Box 4009
Sydney 2001

Or

email to: assetinvestment@ausgrid.com.au

Submissions will be published on the Ausgrid website. If you do not want your submission to be publicly available please clearly stipulate this at the time of lodgement.

The next step of this RIT-D involves publication of a Final Project Assessment Report (FPAR). The FPAR will update the assessment of the net benefit associated with different investment options, in light of any submissions received on this DPAR. Ausgrid intends to publish the FPAR as soon as practicable after submissions are received on this DPAR.

1 Introduction

This Draft Project Assessment Report (DPAR) has been prepared by Ausgrid and represents the first step in the application of the Regulatory Investment Test for Distribution (RIT-D) to options for addressing the expected capacity constraint in the Macquarie Park supply area in the near future.

In particular, Ausgrid has received several major customer connection applications in the Macquarie Park area. These loads are significant and the available spare 11kV capacity in the area is not sufficient to support the required load. Considering the magnitude of this load growth in the area, Ausgrid considers that a long term 33kV supply strategy is the most efficient way to supply these customers going forward. Ausgrid considers that the growing customer demand in the area is most efficiently met by constructing a new 132/33kV Subtransmission Substation (STS) and its associated feeder work.

Ausgrid commenced consultation with Ryde Council in June 2018 and is developing its community consultation plan which will include newsletters and updates to the broader community. Consultation has also commenced with the NSW Department of Planning. Ausgrid encourages community feedback and will keep the community informed as the project progresses through notification letters and the Ausgrid website.

Ausgrid has initiated this RIT-D since the proposed investment is above $5 million, consistent with the National Electricity Rules.

Ausgrid has determined that non-network 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 NER.

1.1 Role of this draft report

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

The purpose of the DPAR is to:

- describe the identified need Ausgrid is seeking to address, together with the assumptions used in identifying it;
- provide a description of the credible option assessed;
- quantify relevant costs and market benefits for the credible option;
- describe the methodologies used in quantifying each class of cost and market benefit;
- provide reasons why Ausgrid has determined that classes of market benefits or costs do not apply;
- present the results of a net present value analysis and accompanying explanation of the results; and
- identify the proposed preferred option.

The next stage of this RIT-D involves publication of a Final Project Assessment Report (FPAR). The FPAR will update the quantitative assessment of the net benefit associated with different investment options, in light of any submissions received on this DPAR.

The entire RIT-D process is detailed in Appendix B. The next steps for this RIT-D assessment are discussed below.

1.2 Submissions and queries

Ausgrid welcomes written submissions on this DPAR. Submissions are due on or before 12 October 2018. Submissions and queries should be addressed to:

Matthew Webb
Head of Asset Investment
Ausgrid
GPO Box 4009
Sydney 2001

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email to: assetinvestment@ausgrid.com.au

Submissions will be published on the Ausgrid website. If you do not want your submission to be publicly available please clearly stipulate this at the time of lodgement.

2 Description of the identified need

Ausgrid has received connection applications from multiple major customers in the Macquarie Park area. In accordance with section 5.3 of the NER, Ausgrid has an obligation to connect these customers into the network.

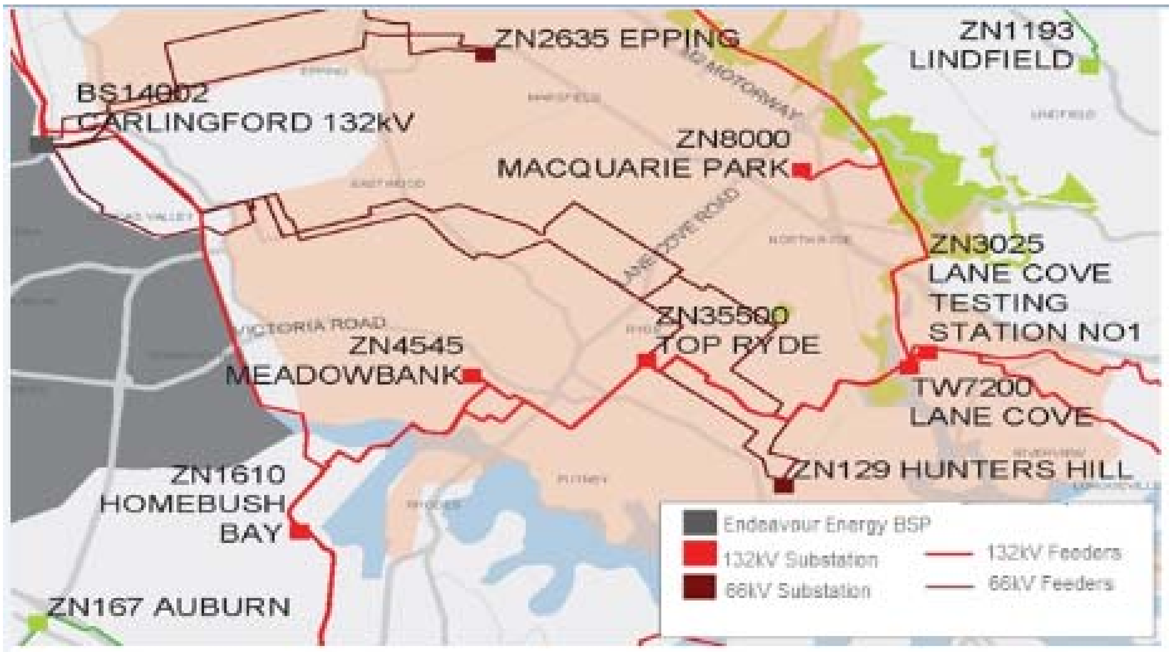
This section provides a description of the network area and the ‘identified need’ for this RIT-D.

2.1 Overview of the Carlingford distribution network

The Carlingford network area extends east from Carlingford to Epping and Macquarie Park, and as far south as Hunters Hill and Meadowbank. The area is bounded by the supply boundary with Endeavour Energy to the North-West, by the Lane Cove River Valley to the North, and the Parramatta River and Sydney Harbour to the South and East. The area is supplied at 132kV from TransGrid’s Sydney North Bulk Supply Point and at 66kV from Endeavour Energy’s Carlingford Subtransmission Substation.

The map below illustrates the Carlingford network and highlights where the three new loads are requesting to connect, i.e. around Macquarie Park.

Figure 2-1 – Carlingford geographical network area



The Macquarie Park area, along the northern boundary of the Carlingford area contains commercial load arising from:

- Macquarie shopping centre and Macquarie Park commercial area;
- Macquarie University;
- Carlingford Court shopping centre;
- Epping/Hunters Hill commercial centres, and
- Top Ryde shopping centre.

Commercial development is expected to continue in this area as a result of the active infrastructure construction such as Sydney Metro and NorthConnex. There are several prospective major proposals at various stages, including:

- Telecommunication and information technology facilities;
- Macquarie University educational and commercial developments; and
- High density residential development in the Epping, Macquarie, Meadowbank and Ryde areas.

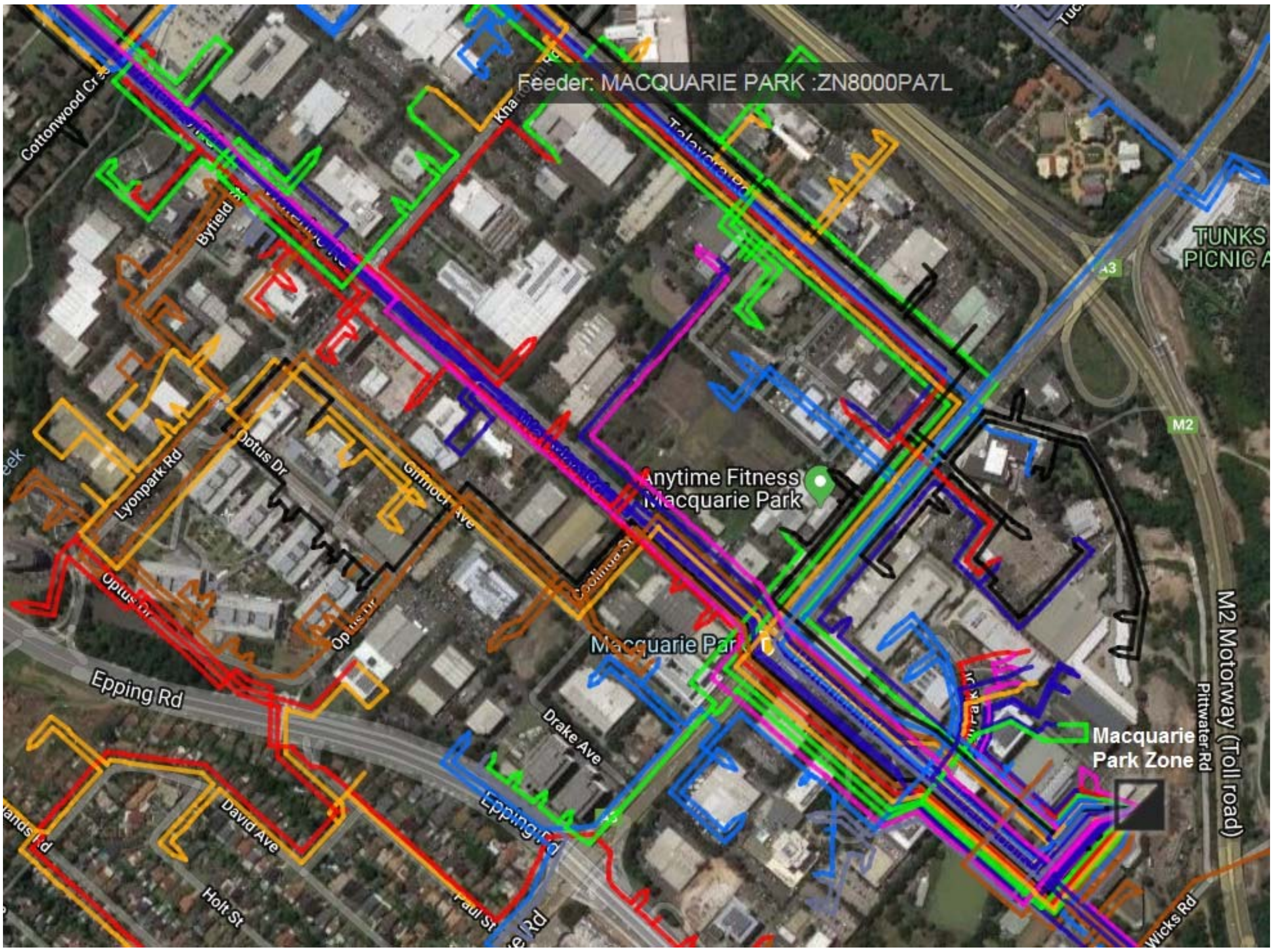
The timing for these proposals is yet to be established; however, some are rapidly maturing into new customers.

2.2 Overview of existing supply arrangements for Macquarie Park area

The Macquarie Park industrial, commercial and educational precinct is primarily served by Macquarie Park 132/11kV ZS, with supply at 11kV to local and nearby areas shared with Epping 66/11kV ZS and Top Ryde 132/11kV ZS. There is no 33kV subtransmission supply available in this district.

The figure below shows the congestion of 11kV feeder connections in the Macquarie Park area. Note that the different colours represent individual 11kV feeders.

Figure 2-2 – Macquarie Park Geographic Supply Area



2.3 Network Capacity Constraint in Macquarie Park area

Significant development activity is increasing the electricity demand in the Macquarie Park area. Ausgrid has received connection applications from two customers requesting connection by 2021/22 with a total eventual load of 91MVA by 2028, and there is a third prospective customer with additional load of 46MVA ramping steadily from 2021. This RIT-D has been initiated to investigate, and consult, on how to most efficiently allow the connection of these new loads.

The available spare 11kV capacity at zone substations in the area, based on summer 2016/17 actual loads, includes:

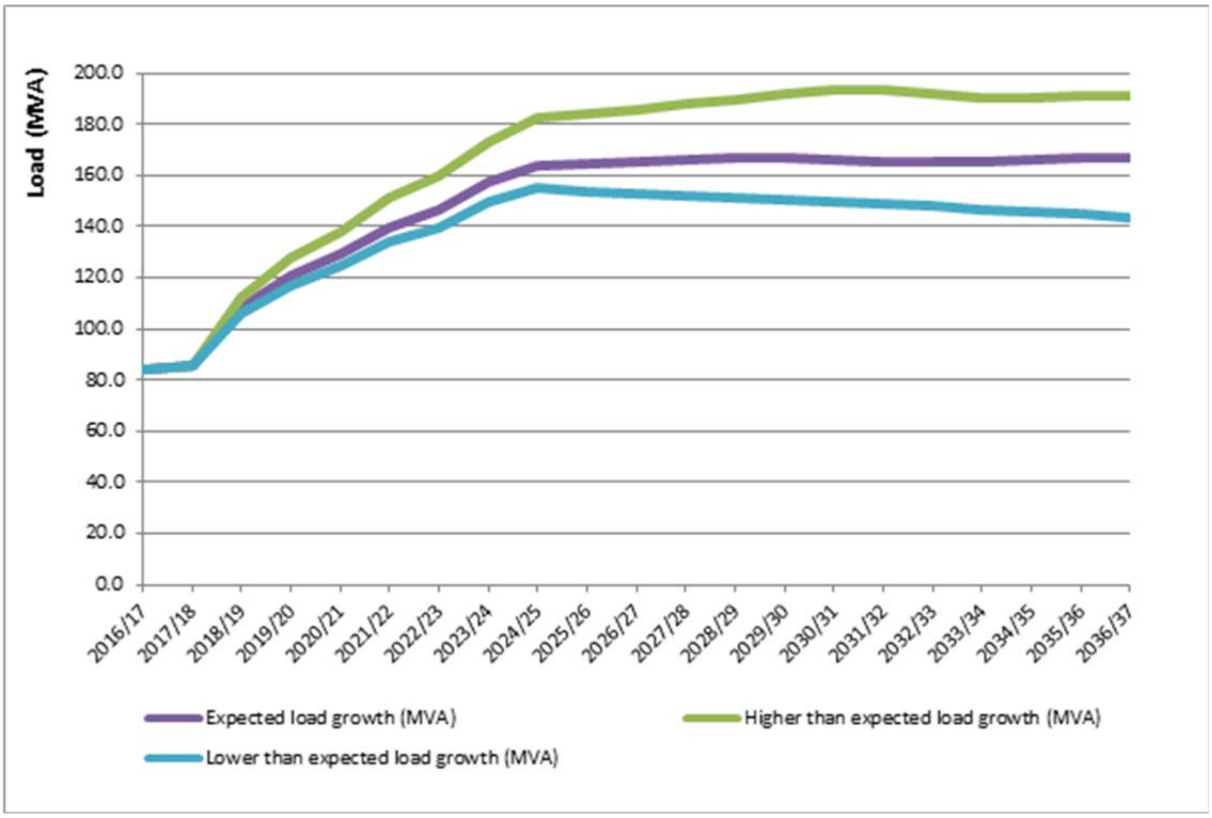
- 30MVA at Macquarie Park ZS;
- 10MVA at Epping ZS; and
- 1MVA at Top Ryde ZS.

Significant development in the area means that Ausgrid has insufficient 11kV spare capacity to connect the large customer loads to its 11kV network. Considering the scale of load desired by the customers, 11kV connection would not be cost effective or efficient, as extensive 11kV feeder rearrangement work is required to facilitate load transfers and the 11kV feeder routes will be congested, resulting in poor cable rating performance.

In addition, there are technical limitations associated with installing multiple 11kV feeders to a single large load customer, such as multiple switching stations, implementation of complex protection schemes to manage the operation and separate metering points at 11kV.

The figure below outlines the anticipated loads and the capacity at Macquarie Park ZS. High and low forecasts are derived from varying the impact of variables such as the new customer loads, economic activity, population growth, as well as customer response to electricity prices through energy conservation and investment in energy efficiency measures.

Figure 2-3 – Macquarie Park ZS load forecasts



2.4 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 allow the connection of the new major loads requesting connection 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 prospective customers are expected to utilise over 95% 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 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.

3 One credible option can address the identified need

This section describes the credible option Ausgrid has identified as part of its network planning activities to date. Other options could technically address the identified need, but are unable to meet the customer required connection date or cost significantly more without providing corresponding increases in benefits. Ausgrid has therefore identified only one credible option as other options are deemed non-credible on the basis they do not meet the customer's requirements or are not economically feasible. More details of other options are set out in section 3.2.

Ausgrid has considered whether there are non-network options that could address the identified need. However, non-network options are unlikely to address the significant load required by the customers. Ausgrid has therefore published a non-network screening notice setting out that a non-network option is unlikely to exist.

The identified credible option involves constructing a new 132/33kV STS at the existing Macquarie Park ZS site and associated feeder work. This option is the most cost effective and time efficient option that can meet the customer's required load and time. Table 3.1 provides a summary of this option. All costs in this section are in $2018/19, unless otherwise stated.

Table 3.1 – Summary of the credible option considered

Option details	Key components	Capital Cost	Completion date
Option 1 – Construction of a new STS on the existing Macquarie Park ZS site and associated 132kV feeder work	Construction of a two transformer 132/33kV STS utilising the vacant land on the existing Macquarie Park ZS site Installation of a new 132kV feeder Rearrangement of the 132kV feeders supplying Macquarie Park ZS Installation of ductlines to facilitate 33kV connections	$35.5 million	2021/22

3.1 Option 1 – Construction of a new STS on the existing Macquarie Park ZS site and associated 132kV feeder work

The option involves the construction of a new STS equipped with two 120MVA 132/33kV transformers utilising the vacant land on the existing Macquarie Park ZS site. A new 132kV feeder will be installed and the 132kV feeders supplying Macquarie Park ZS will be rearranged to facilitate supply to the new STS. 33kV ductlines will also be installed to facilitate 33kV connections.

The estimated capital cost of this option is approximately $35.5 million and its commissioning date is expected to be in 2021/22. Once the new STS is completed, it is assumed that operating costs are expected to average 0.5% of the capital expenditure per annum (i.e. $177,000 per year).

Considering this project is triggered by the major customers requesting network connection, specific tariff arrangements will be established to recover the cost of the shared network augmentation from 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. It is noted that customers will directly fund the dedicated assets associated with their connections.

Ausgrid intends to deliver the new STS via a mix of internal and external resources. Commissioning works will be delivered using internal resources.

3.2 Options considered but not progressed

Ausgrid has considered four other options that have not been progressed. In general, these options were found technically and/or commercially unfeasible, or they are unable to meet the customer's required connection date. Table 3.2 summarises Ausgrid's consideration and position on each of these potential options.

Table 3.2 – Options considered but not progressed

Options	Description	Reason why option was not progressed
Construction of a three transformer STS on the existing Macquarie Park ZS site	Construction of a three transformer 132/33kV STS utilising the vacant land on the existing Macquarie Park ZS site Associated 132kV feeder works and installation of 33kV ductlines to facilitate customer connection	Construction of a three transformer STS is not technically feasible on the existing Macquarie Park ZS site. The 132kV and 33kV feeders will be congested around the site and the capacity of the STS will not be fully utilised.
Construction of a two transformer STS (expandable to three transformers) on a newly acquired site	Acquisition of a new site Construction of a two transformer 132/3kV STS (with capability to accommodate a future third transformer) utilising the new site Associated 132kV feeder works Installation of 33kV ductlines to facilitate customer connection This option is estimated to cost $56.0 million	This option would cost similar to Option 1 but would also have an additional land cost associated with it. We therefore consider it inferior to Option 1 and commercially infeasible, i.e. it would cost more than Option 1 and would not provide any additional benefits. There is also uncertainty associated with the timing of the land acquisition process under this option. We are not confident that this process would be able to be completed sufficiently quickly to meet the customer requested connection date.
Construction of a new STSS, STS and ZS within Macquarie University land	Negotiation of land allocation in Macquarie University Construction of a new STSS, STS and ZS within the Macquarie University land Associated 132kV and 33kV feeder works This option is estimated to cost $60.0 million	A new 132kV network interface and likely split site would result in a higher cost than Option 1, without commensurate benefits, and this option is considered commercially unfeasible. There is also uncertainty associated with the timing of gaining access to university land under this option. There is no confidence that this process would be completed on time to meet the customer requested connection date.
Installation of a third transformer at Top Ryde ZS and 11kV load transfer to Top Ryde ZS to facilitate customer connection at 11kV initially, deferring the need for 33kV supply by 2 years	Installation of a 3rd 50MVA zone transformer at Top Ryde ZS Installation of additional 11kV switchgear at Top Ryde ZS Installation of 11kV feeders to facilitate load transfer from Macquarie Park ZS to Top Ryde ZS Installation of dedicated 11kV feeders to the customer's proposed site This option is estimated to cost $55.2 million	This would act as an interim measure only and would require a further major network augmentation within a short period of time. It is considered that this option would have a higher capital cost than Option 1, without providing commensurate benefits. This option would involve the installation of additional 20x11kV feeders to supply the requested load. This would result in significant additional network congestion in the area, as well as from other non-electrical assets, resulting in significant cable rating and construction issues. Consequently, it is very unlikely that this option would be technically feasible.

It should be noted that options to provide direct subtransmission supply at 132kV to these customers were dismissed because it would result in redundant network investments. Each customer would have to install switching equipment and substations to reduce the voltage to the required internal level at their expense, occupying areas in their properties which otherwise could be used for their core business activities. The overall expenditure to be incurred by the customers under this approach would range from $75-100 million.

Thus, it is more cost-effective to propose a shared network asset that can provide the required subtransmission supply and make better use of the available land.

In addition, even in the event only one customer goes ahead with a connection agreement signed, the installation of a third transformer at Top Ryde ZS and 11kV load transfers to this substation to enable supply from Macquarie Park ZS will not be adequate to provide customer requirements for N-1 supply. The cable congestion will result in significant complexity or even an inability to manage successive future load growth in this network area.

Furthermore, there are technical limitations associated with installing multiple 11kV feeders to a single large load customer, such as multiple switching stations, implementation of complex protection schemes to manage the operation and separate metering points at 11kV.

Ausgrid has also considered the ability of non-network solutions to assist in meeting the identified need. Due to the obligation to connect customers, a non-network solution would need to reduce the overload condition that results from the connection of the new customers. A demand management assessment of this overload condition shows that there would need to be a reduction in maximum demand and a reduction in grid supplied energy to serve the customer load. The scale of reduction is considered well in excess of the likely available demand and energy reductions from the customer base at Macquarie Park ZS. Furthermore, the available cashflow to fund the reduction in customer load is very low in relation to the required reduction in grid supplied electricity. Consequently, non-network options are not considered to offer a cost-effective alternative to addressing the need. This result is detailed further in the separate notice released in accordance with clause 5.17.4(d) of the NER.

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 employed to assess the option.

4.1 General overview of the assessment framework

All costs and benefits for the credible option have been measured against a ‘do nothing’ base case. Under this base case, Ausgrid will only supply part of the customer’s requested load with the existing 11kV spare capacity at Macquarie Park ZS in the absence of a network option. Note 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. The base case is therefore included in this RIT-D for illustration purposes only.

The RIT-D analysis has been undertaken over a 20-year period, from 2019 to 2039. Ausgrid considers that a 20-year period takes into account the size, complexity and expected life of the relevant credible options to provide a reasonable indication of the market benefits and costs. While 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 of long-lived credible options is appropriately captured in the 20-year assessment period.

Ausgrid has adopted a central real, pre-tax discount rate of 6.13 per cent as the central assumption for the NPV analysis presented in this report. Ausgrid considers that this is a reasonable contemporary approximation of a ‘commercial’ discount rate (a different concept to a regulatory WACC), consistent with the RIT-D.[3]

Ausgrid has also tested the sensitivity of the results to changes in this discount rate assumption, and specifically to the adoption of a lower bound real, pre-tax discount rate of 4.19 per cent (equal to the latest AER Final Decision for a DNSP’s regulatory proposal at the time of preparing this DPAR[4]), and an upper bound discount rate of 8.07 per cent (i.e., a symmetrical upwards adjustment).

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 for the credible option using supplier quotes or other pricing information.

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 involuntary load shedding.

The approaches and assumptions Ausgrid has made to estimate the financial impact in eliminated unserved energy are outlined in section 4.3.1 below.

Appendix C outlines the categories of market benefit that Ausgrid considers are not material for this particular RIT-D.

4.3.1 Avoided unserved energy (changes in involuntary load shedding)

Unserved energy (USE) 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.

The Expected Unserved Energy (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.

[3] Ausgrid notes that it has been sourced from the discount rate recently independently estimated as part of the Powering Sydney’s Future RIT-T. See: TransGrid and Ausgrid, *Project Assessment Conclusions Report*, Powering Sydney’s Future, November 2017, p. 62 – available at: https://www.transgrid.com.au/news-views/lets-connect/consultations/current-consultations/Documents/Powering%20Sydney%27s%20Future%20-%20PACR.pdf

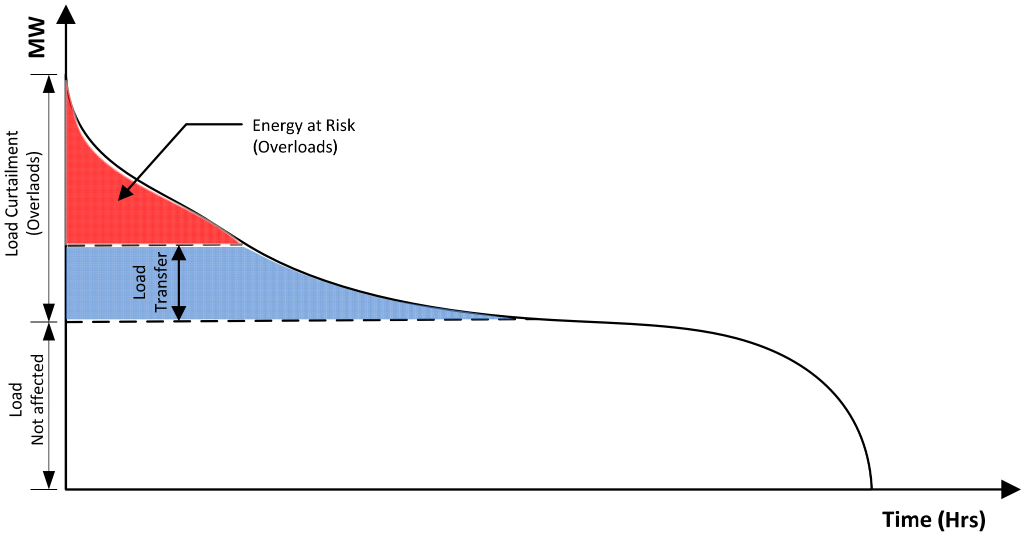
[4] See TasNetworks’ PTRM for the 2017-19 period, available at: https://www.aer.gov.au/networks-pipelines/determinations-access-arrangements/tasnetworks-determination-2017-2019/final-decision

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.

Energy at risk due to overloads of the network is illustrated in the diagram below.

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 zone substation load forecast which includes the quantity of new additional load requested in the customer connection application. The expected unserved energy 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 VCR estimate of $41/kWh, which has been derived from the 2014 AEMO VCR estimates.[5] In particular, Ausgrid has escalated the AEMO estimate to dollars of the day using the CPI.

We have also investigated the effect of assuming both a lower and higher underlying VCR estimate. The AEMO Value of Customer Reliability – Application Guide[6] recommends using values of ± 30% of the base case VCR for the purposes of testing how sensitive investment decisions are to the VCR input. Thus, a lower VCR of $29/kWh and a higher VCR of $53/kWh have been chosen as reasonable for the low and high benefit scenarios.

Ausgrid has 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 for the area in question - namely a central forecast which represents the load growth expected in the Macquarie Park area, as well as a lower than expected load growth forecast and a higher than expected forecast.

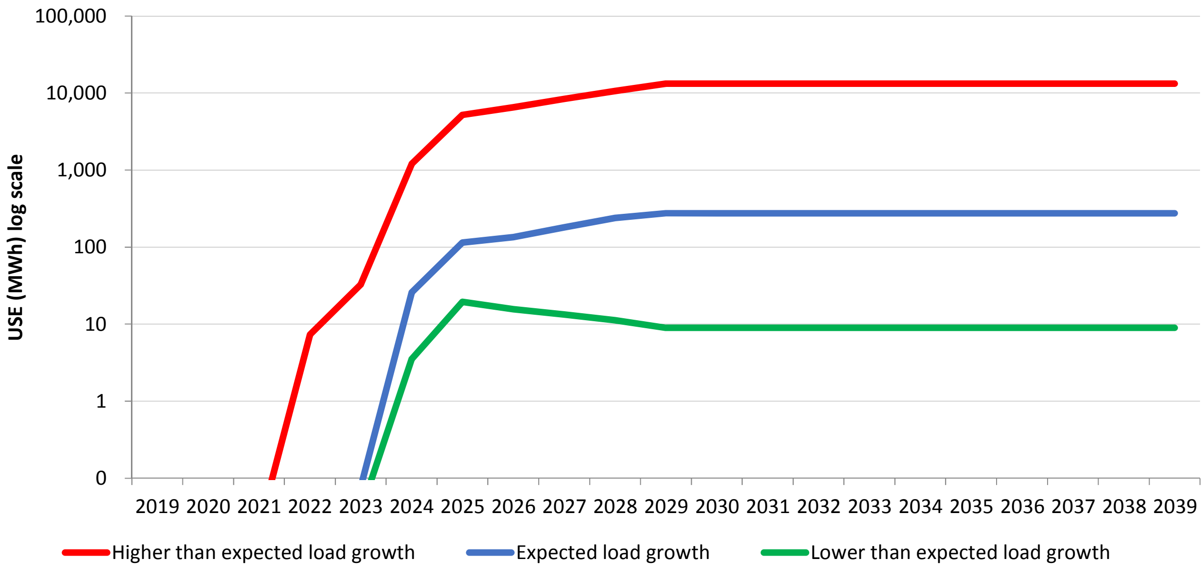
High and low forecasts are derived from varying the forecast impact from the new customer load, economic activity, population growth and customer response to electricity prices through energy conservation and investment in energy efficiency, solar power systems, battery storage and electric vehicles. For example, the low scenario forecast assumes a

[5] AEMO, *Value of Customer Reliability Review*, September 2014, Final Report.
[6] AEMO, *Value of Customer Reliability – Application Guide*, December 2014, Final Report, section 3.4, p. 15.

lower probability for new customer connections and that economic activity and population growth is lower. In addition, the low scenario assumes higher customer response to electricity prices through energy conservation and higher customer investment in energy efficiency, solar power systems, battery storage and electric vehicles.

Figure 4-2 shows the assumed levels of unserved energy, under each of the three underlying demand forecasts investigated over the next twenty years. For clarity, this figure illustrates the MWh of unserved energy assumed under each load forecast if no credible option is commissioned. Note that a logarithmic scale is used for USE values.

Figure 4-2 – Assumed level of USE under each of the three demand forecasts



Ausgrid has kept the level of USE under each of these assumed demand forecasts at the value in the tenth year for all remaining years in the assessment period. Since the base case reflects a 'do nothing' approach, Ausgrid considers that it is appropriate to maintain the level of USE at the level reached after ten years, because values are uncertain after this. It also recognises that in reality action would be taken before this occurred, and does not affect identification of the preferred option.

4.4 Three different '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 elected to assess three alternative future scenarios – namely:

- low benefit scenario – Ausgrid has adopted a number of assumptions that give rise to a lower bound NPV estimate for each credible option, in order to represent a conservative future state of the world with respect to potential market benefits that could be realised under each credible option;
- baseline scenario – the baseline scenario consists of assumptions that reflect Ausgrid's central set of variable estimates which, in Ausgrid's opinion, provides the most likely scenario; and
- high benefit scenario – this scenario reflects an optimistic set of assumptions, which have been selected to investigate an upper bound on reasonably expected market benefits.

A summary of the key variables in each scenario is provided in Table 4.1.

Table 4.1 – Summary of the three scenarios investigated

Variable	Scenario 1 – baseline	Scenario 2 – low benefits	Scenario 3 – high benefits
Load Growth	Expected load growth	Lower than expected load growth	Higher than expected load growth
VCR	$41/kWh (Derived from AEMO VCR estimate of $38.35/KWh at state level, CPI indexed)	$29/kWh (30 per cent lower than AEMO VCR estimate)	$53/kWh (30 per cent higher than AEMO VCR estimate)
Commercial discount rate	6.13 per cent	8.07 per cent	4.19 per cent

Ausgrid considers that the baseline scenario is the most likely, since it is based primarily on a set of expected/central assumptions. Ausgrid has therefore assigned this scenario a weighting of 50 per cent, with the other two scenarios being weighted equally with 25 per cent each. However, Ausgrid notes that the identification of the preferred option is the same across all three scenarios, i.e. the result is insensitive to the assumed scenario weights.

5 Assessment of credible options

This section provides a description of the credible network option Ausgrid has identified as part of its network planning activities to date. The option is compared against a base case 'do nothing' option.

5.1 Gross market benefits estimated for the credible option

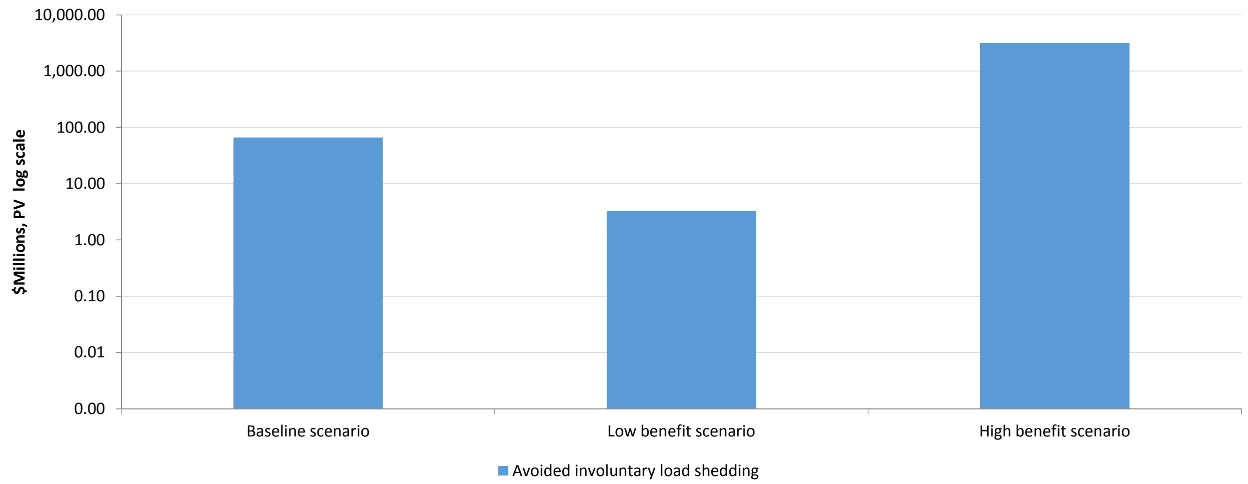
The table below summarises the gross benefit Option 1 relative to the 'do nothing' base case in present value terms. The gross market benefit for each option has been calculated for each of the three reasonable scenarios outlined in the section above.

Table 5.1 – Present value of gross benefits of Option 1 relative to the base case, $m 2018/19

Option	Baseline scenario	Low benefit scenario	High benefit scenario	Weighted benefits
Scenario weighting	50%	25%	25%	
Option 1	66.4	3.3	3,155.0	822.8

The figure below provides a breakdown of all benefits relating to each credible option. In this case, the only relevant market benefit is the avoidance of unserved energy. Note that a logarithmic scale is used for the present value of estimated benefits.

Figure 5-1 – Present value of estimated benefits relative to the base case, PV $m 2018/19



5.2 Estimated costs for each credible option

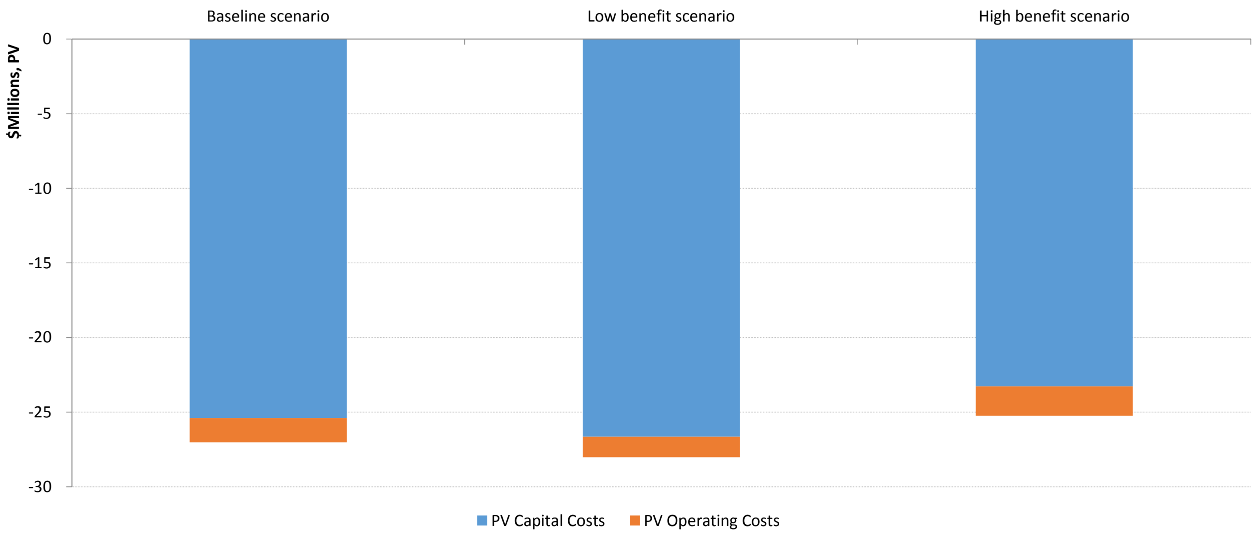
The table below summarises the costs of Option 1 relative to the base in present value terms. The cost is mostly capital expenditure and also includes operating costs. The cost has been calculated for each of the three reasonable scenarios, in accordance with the approaches set out in Section 4.

Table 5.2 – Present value of costs of Option 1 relative to the base case, NPV $m 2018/19

Option	Baseline scenario	Low benefit scenario	High benefit scenario	Weighted costs
Scenario weighting	50%	25%	25%	
Option 1	-27.0	-28.0	-25.2	-26.8

The figure below provides a breakdown of costs relating to each credible option. Capital cost is the predominant expenditure incurred under Option 1.

Figure 5-2 – Present Value of costs of each credible option relative to the base case, PV $m 2018/19



5.3 Net present value assessment outcomes

The table below summarises the net market benefit in NPV terms for Option 1 under each scenario. The net market benefit is the gross market benefit (as set out in Table 5.1) minus the cost of each option (as set out in Table 5.2), all in present value terms.

Overall, Option 1 demonstrates net economic benefits, which is primarily driven by it avoiding unserved energy.

Table 5.3 – Present value of weighted net benefits relative to the base case, $m 2018/19

Option	Weighted PV costs	Weighted PV benefits	Weighted NPV of Market Benefit
Option 1	-26.8	822.8	795.9

5.4 Sensitivity analysis results

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

In particular, we have undertaken one tranche of sensitivity testing – namely:

- Testing the sensitivity of the NPV of gross market benefit associated with the investment proceeding in the customer's required connection year, in the event that actual circumstances turn out to be different.

The project trigger year is solely dependent on customers' requirement outlined in their connection applications, as Ausgrid has obligation to facilitate the customers' connection application.

We outline how the sensitivity analysis has been applied to test the gross market benefit of Option 1 under different scenarios.

5.4.1 Sensitivity of the overall net market benefit

Ausgrid has conducted sensitivity analysis on the overall NPV of the net market benefit.

Specifically, Ausgrid has investigated the following sensitivity factors:

- a lower than expected and higher than expected load growth;
- a lower VCR ($29/kWh) and a higher VCR ($53/kWh); and
- a lower discount rate of 4.19 per cent as well as a higher rate of 8.07 per cent.

All these sensitivities investigate the consequences of 'getting it wrong' having committed to a certain investment decision.

The following table presents the results of these sensitivity tests for option 1. Option 1 is found to have positive net market benefit across all sensitivities investigated, except for the case in which a lower than expected load growth forecast scenario is considered.

Table 5.4 – Sensitivity testing results, $m PV 2018/19

Sensitivity	Option 1
Baseline	**39.4**
Low load growth	**-23.8**
High load growth	**3,128.0**
VCR $29/kWh	**19.5**
VCR $53/kWh	**59.3**
4.19 per cent discount rate	**58.2**
8.07 per cent discount rate	**25.3**

6 Proposed preferred option

Option 1 has been found to be the preferred option, which satisfies the RIT-D. Ausgrid is the proponent for Option 1 and is currently in consultations with key stakeholders such as the City of Ryde local council and the NSW Department of Planning. A community consultation plan is currently being developed and will include newsletters and updates to the broader community.

The scope of works Option 1 involves:

- Construction of a new 132/33kV STS with two 132/33kV transformers at the Macquarie Park ZS site with a nominal firm capacity of 140MVA, as adequate to meet the immediate anticipated load requirements in the area;
- Installation of a new 132kV cable with a rating of 280MVA, and rearrangement of the existing 132kV connections at Macquarie Park, such that each cable connection (92A and 92B) is adequate to supply both the STS and the ZS;
- Acquisition of 33kV and 132kV cable easements to public roads to ensure that the full capacity of the STS and ZS can ultimately be utilised. Ducts should be installed sufficient to connect 12 x 33kV feeders and load the STS to a minimum of 140MVA;
- Installation of sufficient 33kV duct to provide adequate egress for current and future connections to the substation; and
- Associated control and protection communication work at the new Macquarie STS.

The estimated capital cost of this option is $35.5 million. Ausgrid notes that this substation will be a shared network asset which will become part of Ausgrid's Regulatory Asset Base. As these prospective customers are expected to utilise over 95% 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 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. It is noted that customers will directly fund the dedicated assets associated with their connections.

Construction of Option 1 will only commence once material components of connection agreement contracts have been executed. The construction is anticipated to commence in 2018/19, with commissioning in 2021/22 to meet customers' requirements.

Figure 6-1 - Proposed new STS site and route plan for the new 132kV feeder

Ausgrid considers that this DPAR, and the accompanying detailed analysis, identify Option 1 as the preferred option and that this satisfies the RIT-D.

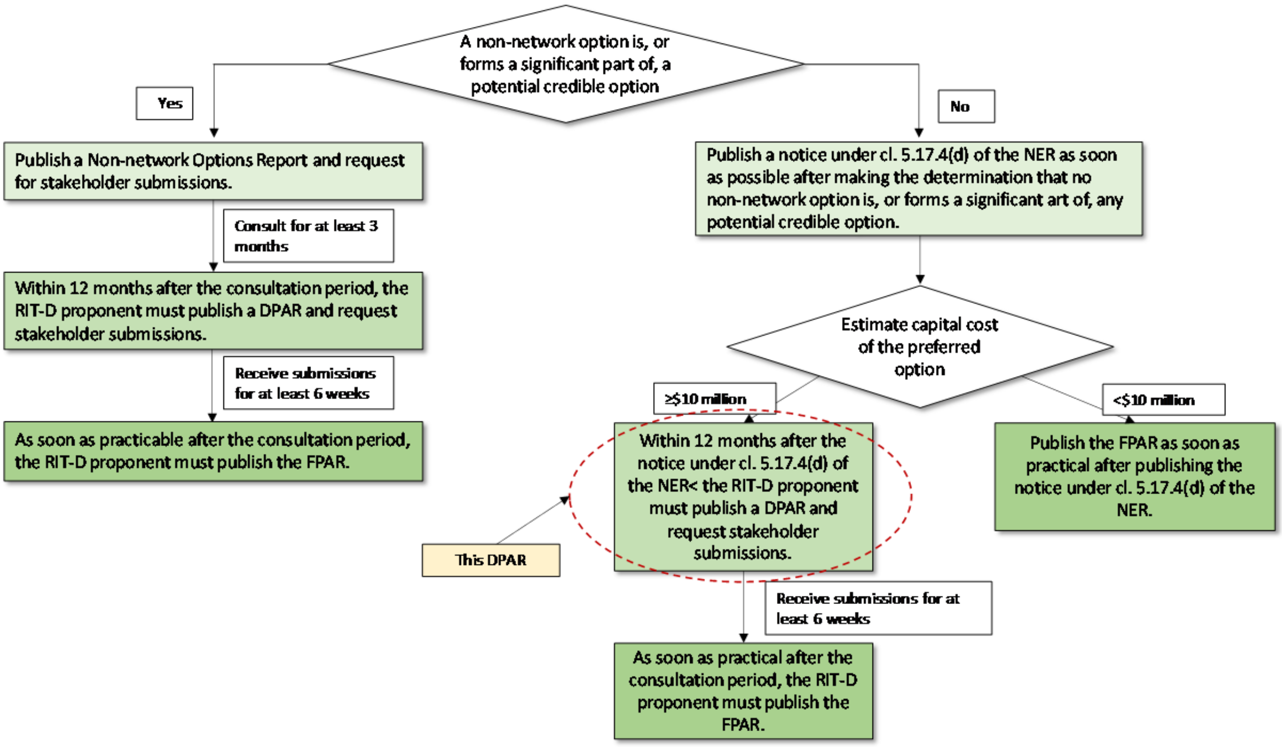
Appendix A – Checklist of compliance clauses

This section sets out a compliance checklist that demonstrates the compliance of this DPAR with the requirements of clause 5.17.4(j) of the National Electricity Rules version 107.

Rules clause	Summary of requirements	Relevant sections in the DPAR
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 voluntary load curtailment;
- costs to other parties;
- load transfer capability and embedded generators;
- option value; and
- 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 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 none of the options are 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 options. Ausgrid notes that none of the options will 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. Credible options under consideration do not affect high voltage feeders and therefore are unlikely to materially change load transfer capacity. Further, credible options are 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 none of the credible options assessed 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 any of the credible options considered would 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

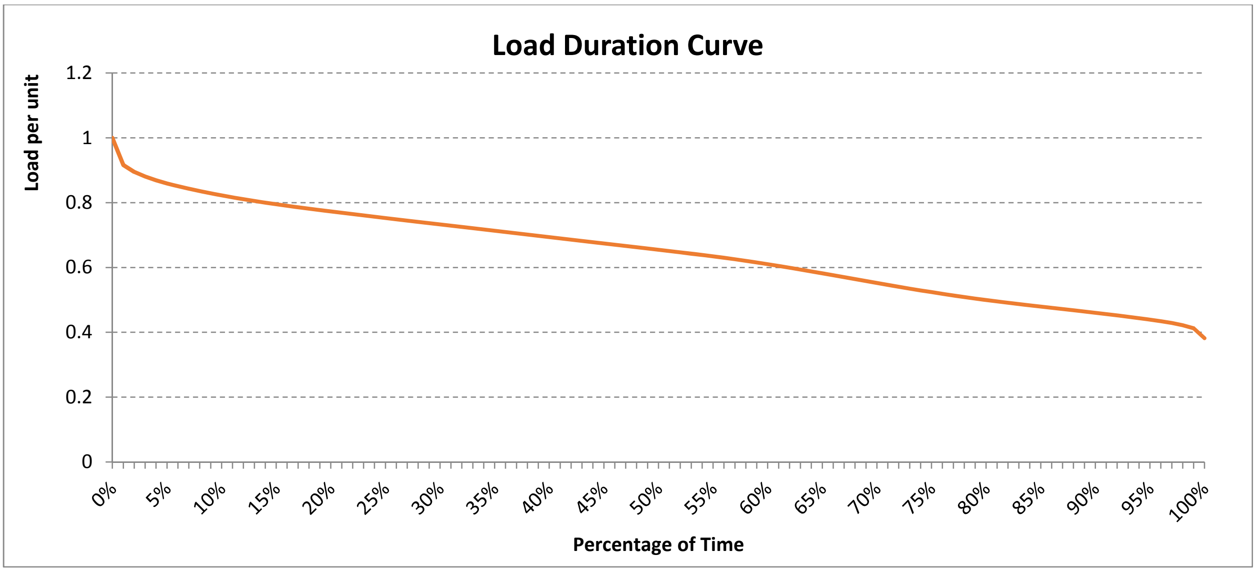
This appendix presents additional detail on the supply restoration assumptions and probability of failure assumptions.

D.1 Characteric load duration curves

The load duration curve for Macquarie Park ZS is presented in Figure D.1 below.

It is assumed that the load types supplied by this substation will not change substantially into the future and therefore the load duration curves will maintain their characteristic shape regardless of the zone substation supplying the existing load at Macquarie Park.

Figure D. 1 – Load duration curve for Macquarie Park



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
Zone 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 – Zone transformer parameters

Transformer	Type	Year of commissioning	μ factor	β factor	MTTR (Weeks)
Transformer No.1	132kV Bushing Type (132/11kV)	2001	66.9	3.47	5
Transformer No.2	132kV Bushing Type (132/11kV)	2001	66.9	3.47	5
Transformer No.3	132kV Bushing Type (132/11kV)	2008	66.9	3.47	5

* Mean Time To Repair

The following equation is used to calculate the yearly major failure rates based on the Weibull parameters related to the zone 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 a 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

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

Equation 4

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

where:

f is the failure rate

r_s is the switching time (in hours)

r_r is the repair time (in hours)