TransGrid

Meeting demand growth in the Greater Macarthur area

RIT-T – Project Specification Consultation Report

Region: Greater Sydney

Date of issue: 5 June 2020

Disclaimer

This suite of documents comprises TransGrid's application of the Regulatory Investment Test for Transmission (RIT-T) which has been prepared and made available solely for information purposes. It is made available on the understanding that TransGrid and/or its employees, agents and consultants are not engaged in rendering professional advice. Nothing in these documents is a recommendation in respect of any possible investment.

The information in these documents reflect the forecasts, proposals and opinions adopted by TransGrid at the time of publication, other than where otherwise specifically stated. Those forecasts, proposals and opinions may change at any time without warning. Anyone considering information provided in these documents, at any date, should independently seek the latest forecasts, proposals and opinions.

These documents include information obtained from the Australian Energy Market Operator (AEMO) and other sources. That information has been adopted in good faith, without further enquiry or verification. The information in these documents should be read in the context of the Electricity Statement of Opportunities, the National Transmission Network Development Plan published by AEMO and other relevant regulatory consultation documents. It does not purport to contain all of the information that AEMO, a prospective investor, Registered Participant or potential participant in the National Electricity Market (NEM), or any other person may require for making decisions. In preparing these documents it is not possible, nor is it intended, for TransGrid to have regard to the investment objectives, financial situation and particular needs of each person or organisation which reads or uses this document. In all cases, anyone proposing to rely on or use the information in this document should:

1. Independently verify and check the currency, accuracy, completeness, reliability and suitability of that information
2. Independently verify and check the currency, accuracy, completeness, reliability and suitability of reports relied on by TransGrid in preparing this document
3. Obtain independent and specific advice from appropriate experts or other sources.

Accordingly, TransGrid makes no representations or warranty as to the currency, accuracy, reliability, completeness or suitability for particular purposes of the information in this suite of documents.

Persons reading or utilising this suite of RIT-T related documents acknowledge and accept that TransGrid and/or its employees, agents and consultants have no liability for any direct, indirect, special, incidental or consequential damage (including liability to any person by reason of negligence or negligent misstatement) for any damage resulting from, arising out of or in connection with, reliance upon statements, opinions, information or matter (expressed or implied) arising out of, contained in or derived from, or for any omissions from the information in this document, except insofar as liability under any New South Wales and Commonwealth statute cannot be excluded.

Privacy notice

TransGrid is bound by the *Privacy Act 1988 (Cth)*. In making submissions in response to this consultation process, TransGrid will collect and hold your personal information such as your name, email address, employer and phone number for the purpose of receiving and following up on your submissions.

Under the National Electricity Law, there are circumstances where TransGrid may be compelled to provide information to the Australian Energy Regulator (AER). TransGrid will advise you should this occur.

TransGrid's Privacy Policy sets out the approach to managing your personal information. In particular, it explains how you may seek to access or correct the personal information held about you, how to make a complaint about a breach of our obligations under the Privacy Act, and how TransGrid will deal with complaints. You can access the Privacy Policy here (https://www.transgrid.com.au/Pages/Privacy.aspx).

Executive summary

TransGrid is applying the Regulatory Investment Test for Transmission (RIT-T) to options for meeting forecast demand growth in the Greater Macarthur area in Sydney's south-west going forward. Publication of this Project Specification Consultation Report (PSCR) represents the first step in the RIT-T process.

The Endeavour Energy 66 kV network in the Greater Macarthur area is currently supplied by:

> one 250 MVA 330/66 kV transformer at TransGrid's Macarthur substation

> two 120 MVA 132/66 kV transformers at Endeavour Energy's Nepean substation.

A single 375 MVA 330/132 kV transformer at TransGrid's Macarthur substation also provides 132 kV supply to Endeavour Energy's Nepean substation via the tail-ended high capacity 9L1 Macarthur to Nepean 132 kV circuit.

In addition, the normally open 9L4/93X and 9L5/93Y 132 kV circuits provide a limited level of backup to Nepean at 132 kV from Sydney West and Liverpool. The level of backup available from these feeders is progressively being reduced as load growth in the South West Priority Growth Area materialises.

Identified need: meeting demand growth in the Greater Macarthur area

Endeavour Energy has experienced unprecedented growth in new customer connections in the last five years driven by the growth in the greenfield housing market. Continued growth in demand within the Greater Macarthur area is forecast to result in network constraints that, if unaddressed, will result in significant involuntary load shedding to end consumers.

A summary of these constraints, and their network implications, are as follows:

> A forced outage of the Macarthur 330/66 kV transformer at times of peak demand would cause:
  - Endeavour Energy's Nepean 132/66 kV transformers to exceed their contingency rating of 127 MVA
  - Endeavour Energy's 132 kV 9L1 line to Nepean to exceed its thermal contingency rating of 358 MVA
  - TransGrid's Macarthur 330/132 kV transformer to exceed its contingency rating of 412.5 MVA

> A forced outage of the Macarthur 330/132 kV transformer at times of peak demand would cause TransGrid's Macarthur 330/66 kV transformer to exceed its short-time step rating.

For the constraints relating to a forced outage of the Macarthur 330/132 kV transformer, transfer of Campbelltown load to Ingleburn would provide some relief to this constraint in the next few years.

These constraints are forecast to result in significant Expected Unserved Energy (EUE) if nothing is done. Avoiding this EUE is the key driver for this RIT-T.

While there are several embedded generators in the area, these sources are not considered to be an effective means of reducing the EUE in light of both response capability and forecast load growth. Generation predominantly occurs using gas that is created from coal mining activity, with very limited gas storage capability that would enable the generators to adequately respond to periods of high demand and/or loss of infrastructure.

Assessment of credible options

TransGrid considers that there are two feasible network options from a technological and project delivery perspective.

Option 1 - installation of a second 330/66 kV transformer at Macarthur substation - will require the following works to be carried out by TransGrid:

- provision of a 250 MVA 330/66 kV transformer, including compound, switchgear, oil containment and all other necessary HV gear
- establishment of a 330 kV busbar to allow cut in of the second 330/66 kV transformer into the existing 330 kV mesh
- appropriate secondary systems for transformer control and protection are to be installed for the new transformer and switchbay
- integration of Automatic Voltage Regulation (AVR) for the new transformer with the existing 330/66 kV transformer control system
- upgrade of 110 V DC battery banks and chargers to meet new capacity

Option 2 - permanent transfer Campbelltown load to the Ingleburn BSP- will require the following works to be carried out by Endeavour Energy and TransGrid:

- installation of a new feeder switchbay at Ingleburn 66 kV busbar – TransGrid
- installation of a new bus section and a new feeder bay at Campbelltown – Endeavour Energy
- a new 66 kV feeder between Ingleburn and Campbelltown – Endeavour Energy
- appropriate secondary system works for new 66 kV feeder and feeder bays – Endeavour Energy

The risk of future unserved energy under Option 1 is assessed to be effectively zero. With Option 2, residual risks of unserved energy will re-emerge from 2023, based on current forecasts by Endeavour Energy. This has not been quantified in this RIT-T, as Option 2 is not the preferred option and additional risk of unserved energy will make it less favourable.

The estimated capital cost of the Option 1 and 2 are $8.88 million and $35 million[1] respectively. The estimated operating costs for both options are assumed to be two per cent of the capital cost. Both options are expected to be commissioned by June 2022, which aligns with the optimal commissioning date.

Non-network options may be able to help mitigate the effects of network constraints

The objective of any non-network solution for this RIT-T should be to obtain a sufficient net peak demand reduction in the target area supplied by the Macarthur BSP and Nepean substation to manage the load at risk in order to defer or avoid the network option of installing a second 250 MVA 330/66 kV transformer at Macarthur BSP (preferred option). This PSCR provides detail on the technical characteristics that any non-network solutions would need to provide to help meet the identified need.

Proponents of non-network options are encouraged to make submissions on any non-network option they believe can address, or contribute to, the identified need. Proponents are encouraged to reach out and contact TransGrid as soon as practicable about potential solutions, and ahead of preparing a formal submission.

Net economic benefits of the options have been assessed under three different scenarios

The assessment was conducted under three net economic benefits scenarios. These are plausible scenarios which reflect different assumptions about the future market development and other factors that are expected to affect the relative economic benefits of the options being considered. All scenarios (low, central and high)

[1] High-level cost estimate provided by Endeavour Energy

involve a number of assumptions that result in the lower bound, the expected, and the upper bound estimates for present value of net economic benefits respectively.

A key expected driver of the net economic benefits is the Value of Customer Reliability (VCR) and the underlying demand forecast since avoided EUE is the primary market benefit. TransGrid has applied a VCR estimate of $43.03/kWh in the central scenario and +/-30 per cent for the other two scenarios, which is consistent with the AER's VCR review released in December 2019.[2]

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

Table E-1 Summary of scenarios

Variable	Central	Low net economic benefits	High net economic benefits
Capital and operating costs	Base estimate	Base estimate + 25%	Base estimate - 25%
Demand forecasts	Based on POE50 demand forecast	Based on POE90 demand forecast	Based on POE10 demand forecast
Value of Customer Reliability (VCR)	The AER's VCR	The AER's VCR – 30%	The AER's VCR + 30%
Discount rate	5.90%	8.95%	2.85%

TransGrid consider that the central scenario is most likely since it is based primarily on a set of expected assumptions. TransGrid have therefore assigned this scenario a weighting of 50 per cent, with the other two scenarios being weighted equally with 25 per cent each.

Implementing Option 1 is the most efficient way of meeting forecast demand growth

The table below summarises the net economic benefit in NPV terms for the options considered across the three scenarios, as well as on a weighted basis. The net economic benefit is the gross less the costs, all expressed in present value terms.

The table below demonstrates that the options considered provides an expected net economic benefit under the central and high benefits scenario, as well as on a weighted basis.

While the net economic benefits are marginally negative under the low scenario, TransGrid notes that this scenario comprises an extreme combination of assumptions, including low avoided unserved energy, high capital costs and a high commercial discount rate.

On a weighted basis, Option 1 is estimated to deliver approximately $93.5 million in net benefits and is considered the preferred option.

[2] The central estimate of $43.03/kWh reflects an inflation adjustment to the load weighted VCR estimate for NSW and ACT ($42.12/kWh). The confidence interval selected is also drawn from the AER's VCR review. AER, *Value of Customer Reliability Review – Final report*, December 2019, pp 71 (Table 5.22) & 84. https://www.aer.gov.au/system/files/AER%20-%20Values%20of%20Customer%20Reliability%20Review%20-%20Final%20Report%20-%20December%202019.pdf.

Table E-2 Estimated net economic benefit for each option, present value ($m 2019/20)

Option	Low benefits scenario	Central scenario	High benefits scenario	Weighted	Ranking
Option 1 – Installation of a second 330/66 kV transformer at Macarthur substation	-2.2	62.7	250.7	93.5	1
Option 2 - Permanent transfer Campbelltown load to the Ingleburn BSP	-33.9	37.5	232.7	68.4	2

Sensitivity testing finds that, while the results are most sensitive to the assumed discount rate and adjustments to expected unserved energy estimates, Option 1 is still found to deliver strongly positive net benefits over a range of alternate assumptions regarding key parameters. Option 1 delivers the most benefit under all scenarios and sensitivities.

Draft conclusion

Option 1 has been identified as the preferred option for addressing the identified need in this PSCR. Option 1 involves the installation of a second 330/66 kV transformer at the Macarthur substation. This option is described in section 3 and is estimated to have a capital cost of $8.88 million. In addition, Option 1 is expected to be commissioned by June 2022.

Option 1 is the preferred option in accordance with NER clause 5.16.1(b) because it is the credible option that maximises the net present value of the net economic benefit to all those who produce, consume and transport electricity in the market.

Exemption from preparing a Project Assessment Draft Report (PADR)

NER clause 5.16.4(z1) provides for a TNSP to be exempt from producing a Project Assessment Draft Report (PADR) for a particular RIT-T application, in the following circumstances:

- if the estimated capital cost of the preferred option is less than $43 million;
- if the TNSP identifies in its PSCR its proposed preferred option, together with its reasons for the preferred option and notes that the proposed investment has the benefit of the clause 5.16.4(z1) exemption; and
- if the TNSP considers that the proposed preferred option and any other credible options in respect of the identified need will not have a material market benefit for the classes of market benefit specified in clause 5.16.1(c)(4), with the exception of market benefits arising from changes in voluntary and involuntary load shedding.

TransGrid considers that its investment in relation to Option 1 is exempt from producing a PADR under NER clause 5.16.4(z1).

In accordance with NER clause 5.16.4(z1)(4), the exemption from producing a PADR will no longer apply if TransGrid considers that an additional credible option that could deliver a material market benefit is identified during the consultation period. Accordingly, if TransGrid considers that any additional credible options are identified, TransGrid will produce a PADR which includes a net present value (NPV) assessment of the net economic benefits of each additional credible option.

Should TransGrid consider that no additional credible options were identified during the consultation period, TransGrid intends to produce a Project Assessment Conclusions Report (PACR) that addresses all

submissions received including any issues in relation to the proposed preferred option raised during the consultation period.[3]

Submissions and next steps

The purpose of this PSCR is to set out the reasons TransGrid proposes that action be undertaken, present the options that address the identified need, outline the technical characteristics that non-network options would need to provide, and allow interested parties to make submissions and provide input to the RIT-T assessment.

TransGrid welcomes written submissions on materials contained in this PSCR. Submissions are due on or before 31 August 2020. Submissions should be emailed to TransGrid's Regulation team via RIT-TConsultations@transgrid.com.au. In the subject field, please reference 'Greater Macarthur Area PSCR'.

At the conclusion of the consultation process, all submissions received will be published on the TransGrid's website. If you do not wish for your submission to be made public, please clearly specify this at the time of lodgement.

Subject to submissions received on this PSCR, a Project Assessment Conclusions Report (PACR), including full option analysis, is expected to be published in September 2020.

[3] In accordance with NER clause 5.16.4(z2).

Contents

List of Tables

List of Figures

1. Introduction

TransGrid is applying the Regulatory Investment Test for Transmission (RIT-T) to options for meeting forecast demand growth in the Macarthur-Nepean distribution network in Sydney's south-west going forward. In particular, demand growth in Endeavour Energy's distribution network is forecast to result in network constraints that, if unaddressed, will result in significant involuntary load shedding to end consumers.

Publication of this Project Specification Consultation Report (PSCR) represents the first step in the RIT-T process to investigate options for alleviating the supply reliability concerns if action is not taken for the Nepean and Greater Macarthur supply areas posed by increasing demand.

This PSCR has been prepared in conjunction with Endeavour Energy (as the relevant distribution network service provider).[4]

1.1 Purpose of this report

The purpose of this PSCR[5] is to:

> set out the reasons why TransGrid proposes that action be undertaken (that is, the 'identified need')
> present the option that TransGrid currently considers addresses the identified need
> outline the technical characteristics that non-network options would need to provide
> allow interested parties to make submissions and provide input to the RIT-T assessment.

1.2 Exemption from preparing a Project Assessment Draft Report (PADR)

NER clause 5.16.4(z1) provides for a TNSP to be exempt from producing a PADR for a RIT-T application, in the following circumstances:

> if the estimated capital cost of the preferred option is less than $43 million;
> if the TNSP identifies in its PSCR its proposed preferred option, together with its reasons for the preferred option and notes that the proposed investment has the benefit of the clause 5.16.4(z1) exemption; and
> if the TNSP considers that the proposed preferred option and any other credible options in respect of the identified need will not have a material market benefit for the classes of market benefit specified in clause 5.16.1(c)(4), with the exception of market benefits arising from changes in voluntary and involuntary load shedding.

TransGrid considers that its investment in relation to Option 1 is exempt from producing a PADR under NER clause 5.16.4(z1).

In accordance with NER clause 5.16.4(z1)(4), the exemption from producing a PADR will no longer apply if TransGrid considers that an additional credible option that could deliver a material market benefit is identified during the consultation period.

Accordingly, if TransGrid considers that any additional credible options are identified, TransGrid will produce a PADR which includes an NPV assessment of the net economic benefit of each additional credible option.

[4] Consistent with the joint-planning requirements in the National Electricity Rules.

[5] See Appendix A for the National Electricity Rules requirements.

Should TransGrid consider that no additional credible options were identified during the 12-week consultation period[6], TransGrid intends to produce a PACR that addresses all submissions received including any issues in relation to the proposed preferred option raised during the consultation period.[7]

1.3 Submissions and next steps

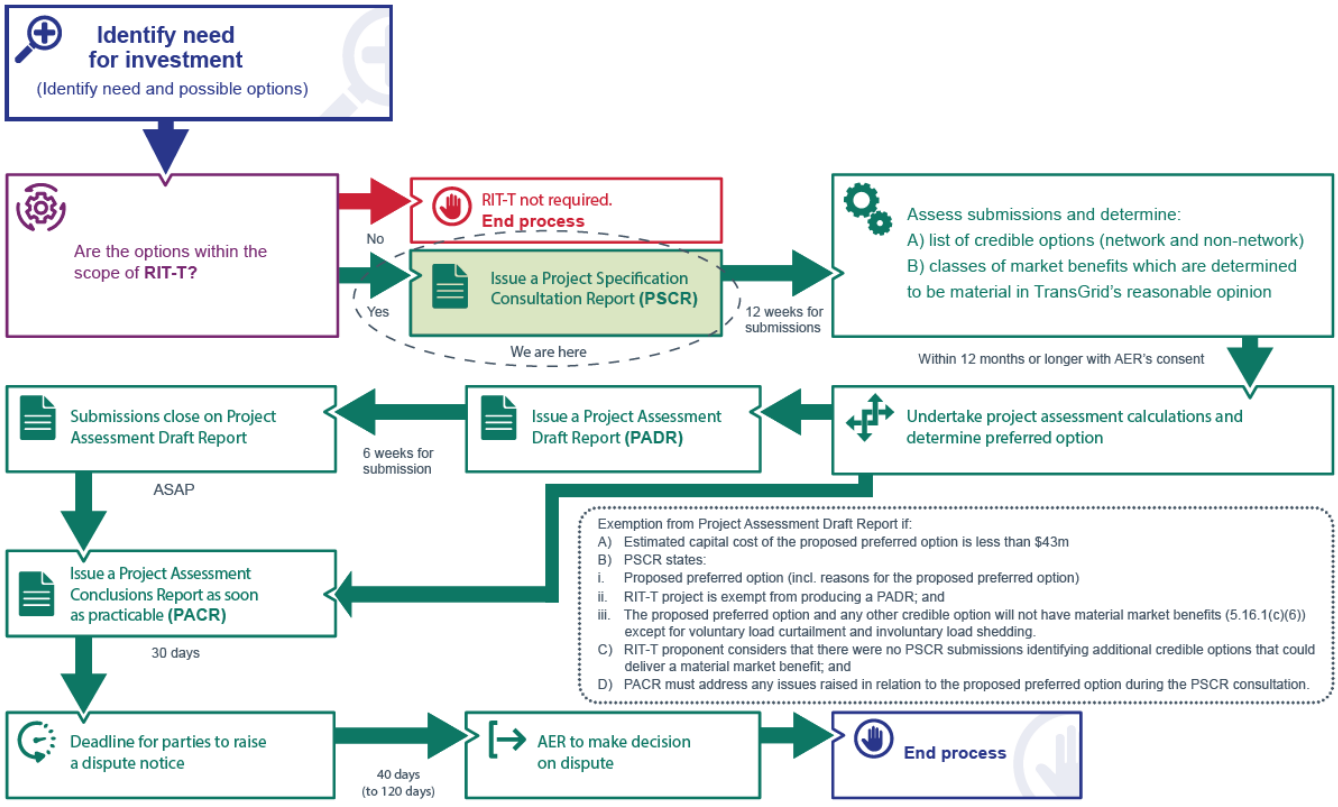
TransGrid welcomes written submissions on materials contained in this PSCR. Submissions are due on or before 31 August 2020.

Submissions should be emailed to TransGrid's Regulation team via RIT-TConsultations@transgrid.com.au.[8] In the subject field, please reference 'Greater Macarthur Area PSCR'.

At the conclusion of the consultation process, all submissions received will be published on the TransGrid's website. If you do not wish for your submission to be made publicly available, please clearly specify this at the time of lodging your submission.

Subject to submissions received on this PSCR, a Project Assessment Conclusions Report (PACR), including full option analysis, is expected to be published in September 2020.

Figure 1-1 This PSCR is the first stage of the RIT-T process[9]



[6] Additional days have been added to cover public holidays

[7] In accordance with NER clause 5.16.4(z2).

[8] TransGrid is bound by the Privacy Act 1988 (Cth). In making submissions in response to this consultation process, TransGrid will collect and hold your personal information such as your name, email address, employer and phone number for the purpose of receiving and following up on your submissions. If you do not wish for your submission to be made public, please clearly specify this at the time of lodgement. See Privacy Notice within the Disclaimer for more details.

[9] Australian Energy Market Commission. "*Replacement expenditure planning arrangements, Rule determination*". Sydney: AEMC, 18 July 2017.65. Accessed 8 May 2020. https://www.aemc.gov.au/sites/default/files/content/89fbf559-2275-4672-b6ef-c2574eb7ce05/Final-rule-determination.pdf

2. The identified need

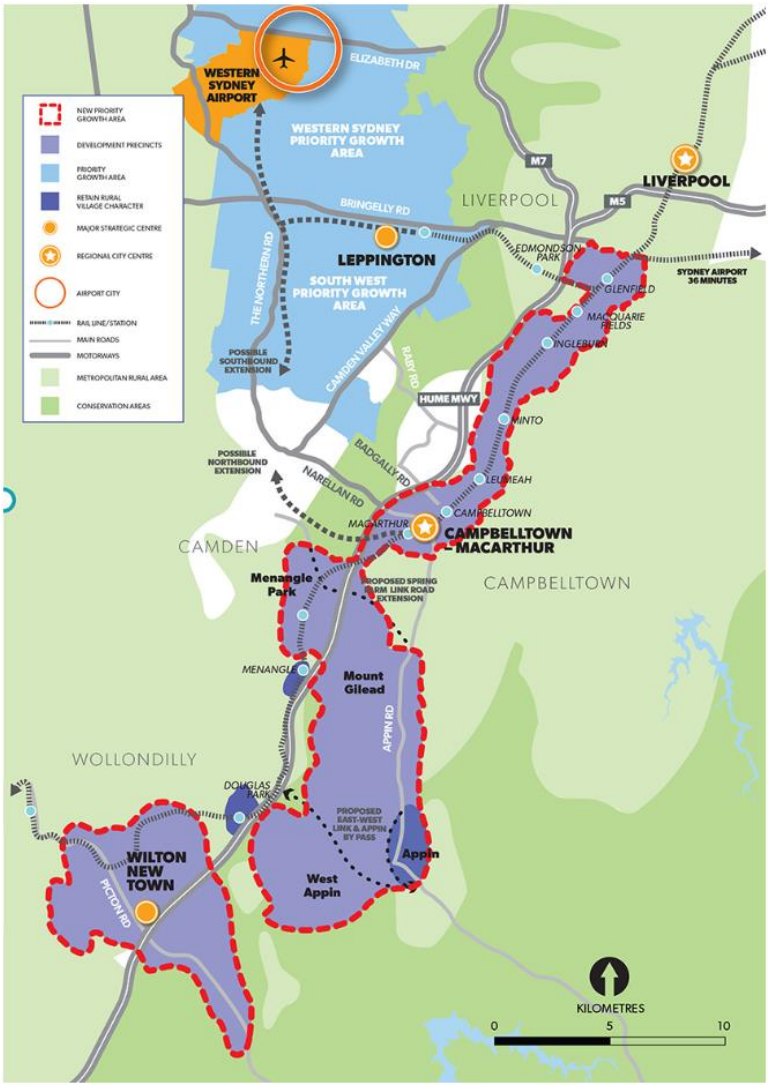
This section outlines the identified need for this RIT-T, as well as the assumptions and data underpinning it. It first sets out background information related to the Greater Macarthur area network and existing electricity supply arrangements.

2.1 Background to the identified need

Macarthur substation provides grid exit points to Endeavour Energy at 132 kV and 66 kV. The ultimate configuration for Macarthur substation is for two 330/132 kV transformers tail-ended onto Endeavour Energy's 132 kV busbar at Nepean 132/66/33 kV substation, and two 330/66 kV transformers feeding a 66 kV busbar at TransGrid's Macarthur substation. The substation was initially commissioned with a single 330/132 kV 375 MVA transformer and a single 330/66 kV 250 MVA transformer.

Endeavour Energy has constructed two 132 kV feeders from TransGrid's Macarthur substation to Endeavour Energy's Nepean substation. However, only one feeder is operated at 132 kV (the second feeder is currently operated at 66 kV and serves as a link between the Macarthur and Nepean 66 kV busbars). The second feeder will be converted to 132 kV when the second 330/132 kV transformer at Macarthur is required.

Figure 2-1 Overview of the Greater Macarthur area



The Endeavour Energy 66 kV network in the Greater Macarthur area is currently supplied by:

> one 250 MVA 330/66 kV transformer at TransGrid's Macarthur substation

> two 120 MVA 132/66 kV transformers at Endeavour Energy's Nepean substation

A single 375 MVA 330/132 kV transformer at TransGrid's Macarthur substation also provides 132 kV supply to Endeavour Energy's Nepean substation via the tail-ended high capacity 9L1 Macarthur to Nepean 132 kV circuit.

In addition, the normally open 9L4/93X and 9L5/93Y 132 kV circuits provide a limited level of backup to Nepean at 132 kV from Sydney West and Liverpool. The level of backup available from these feeders is progressively being reduced as load growth in the South West Priority Growth Area materialises.[10]

The present configuration of this network and historical loadings allowed the Macarthur 330/132 kV and 330/66 kV transformers to provide backup capability to each other without interruptions to customers. However, due to load growth in the area and without further investment in the network, this level of backup can no longer be provided without interruptions to customers.

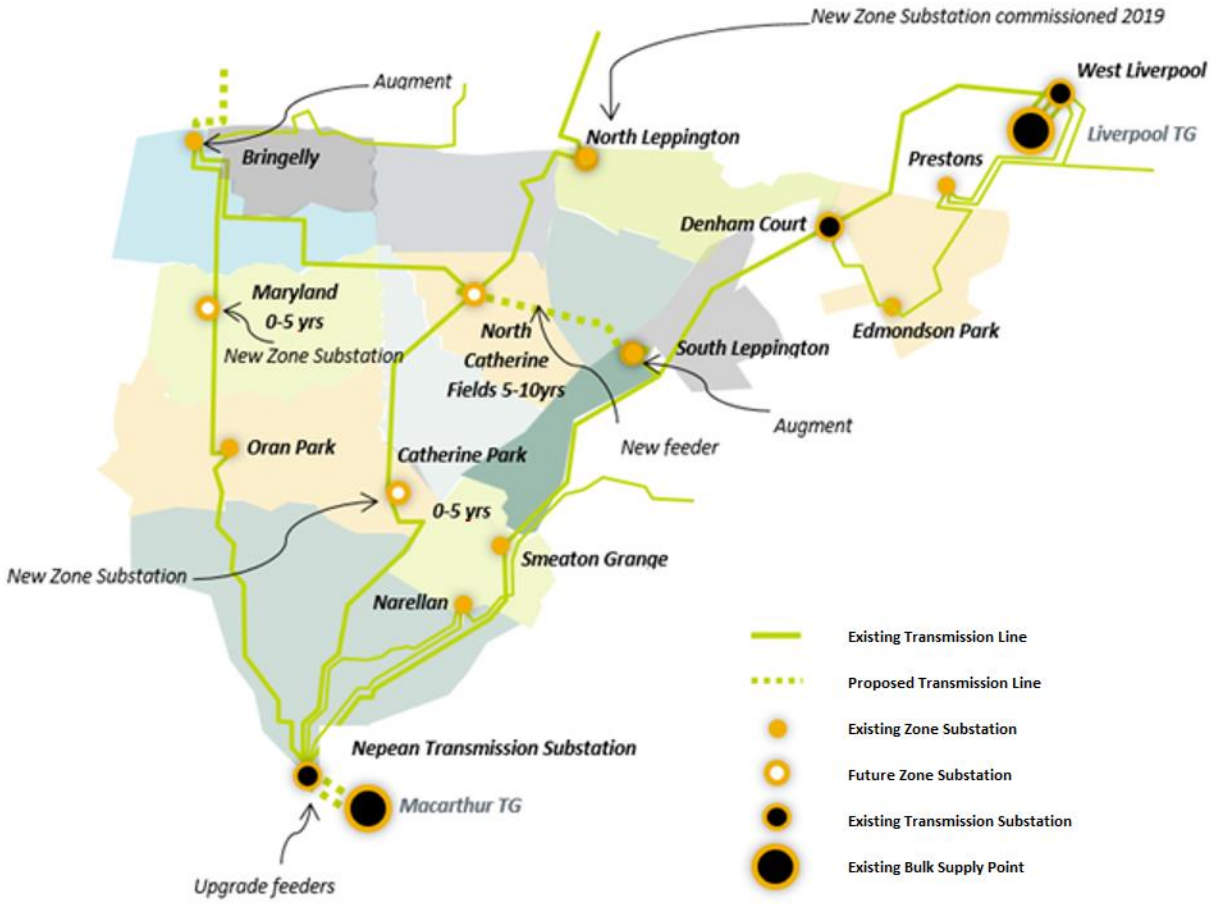
Besides other loads supplied at 132 kV, the Macarthur substation also supplies the Nepean-Macarthur 66 kV area load either directly from Macarthur substation itself or via Nepean 132/66 kV substation.

Endeavour Energy has experienced unprecedented growth in new customer connections in the last five years driven by the growth in the greenfield housing market. This uplift in demand has seen Endeavour Energy commission four new zone substations in the south-west Sydney area in the last five years and it plans to commission a further three or four in the next five years.

Figure 2-2 below depicts the number, and approximate location, of these new zone substations in Endeavour Energy's distribution network. Plans for further substations to the north of Bringelly Road including the Aerotropolis area have not been outlined in this document, although it is envisaged that initial supply into this area will be sourced from Macarthur and Sydney West substations.

[10] https://www.planning.nsw.gov.au/Plans-for-your-area/Priority-Growth-Areas-and-Precincts/South-West-Growth-Area

Figure 2-2 Actual and forecast new zone substation commissioning in the south-west Sydney area



TransGrid and Endeavour Energy have carried out a comprehensive planning study that has identified the nature and likely timing of emerging constraints if action is not taken. These are as follows:

> A forced outage of the Macarthur 330/66 kV transformer at times of peak demand would cause:
  – Endeavour Energy's Nepean 132/66 kV transformers to exceed their contingency rating of 127 MVA
  – Endeavour Energy's 132 kV 9L1 line to Nepean to exceed its thermal contingency rating of 358 MVA
  – TransGrid's Macarthur 330/132 kV transformer to exceed its contingency rating of 412.5 MVA
> A forced outage of the Macarthur 330/132 kV transformer at times of peak demand would cause TransGrid's Macarthur 330/66 kV transformer to exceed its short-time step rating.

For the constraints relating to a forced outage of the Macarthur 330/132 kV transformer, transfer of Campbelltown load to Ingleburn would provide some relief to this constraint in the next few years.

These constraints are forecast to result in significant expected unserved energy (EUE) if nothing is done. Avoiding this EUE is the key driver for this RIT-T.

While there are several embedded generators in the area, sources are not considered to be an effective means of reducing the EUE in light of both response capability and forecast load growth. Generation predominantly occurs using gas that is created from coal mining activity, with very limited gas storage capability that would enable the generators to adequately respond to periods of high demand and/or loss of infrastructure.

2.2 Description of the identified need

TransGrid considers the proposed investment a 'market benefits' driven RIT-T as the proposed investment is for the purpose of maintaining network security, which is estimated to deliver significant benefits in terms of avoided involuntary load shedding.

Investments made under a 'market benefits' identified need differ from those undertaken under a 'reliability corrective action' identified need in that market benefits driven investments are not made to meet externally imposed obligations on the network business and, consequently the preferred option must have positive net economic benefits.[11]

2.3 Assumptions underpinning the identified need

This section sets out several key assumptions TransGrid and Endeavour Energy consider underpin the identified need. These relate to the quantum of forecast EUE and how it is expected if no action is taken.

2.3.1 Additional detail on the network elements causing constraints

Figure 2-3 below provides a high-level summary of the existing electricity supply arrangements. Additional detail is provided in Appendix B.

Under system normal conditions, the single Macarthur 330/132 kV transformer presently supplies Nepean transmission substation, Oran Park 132/11 kV zone substation, North Leppington 132/11 kV zone substation, South Leppington 132/11 kV zone Substation and a large customer installation at Smeaton Grange supplied at 132 kV. In the future it will supply additional proposed zone substations including initial supplies to the proposed Aerotropolis core 132/22 kV zone substation.

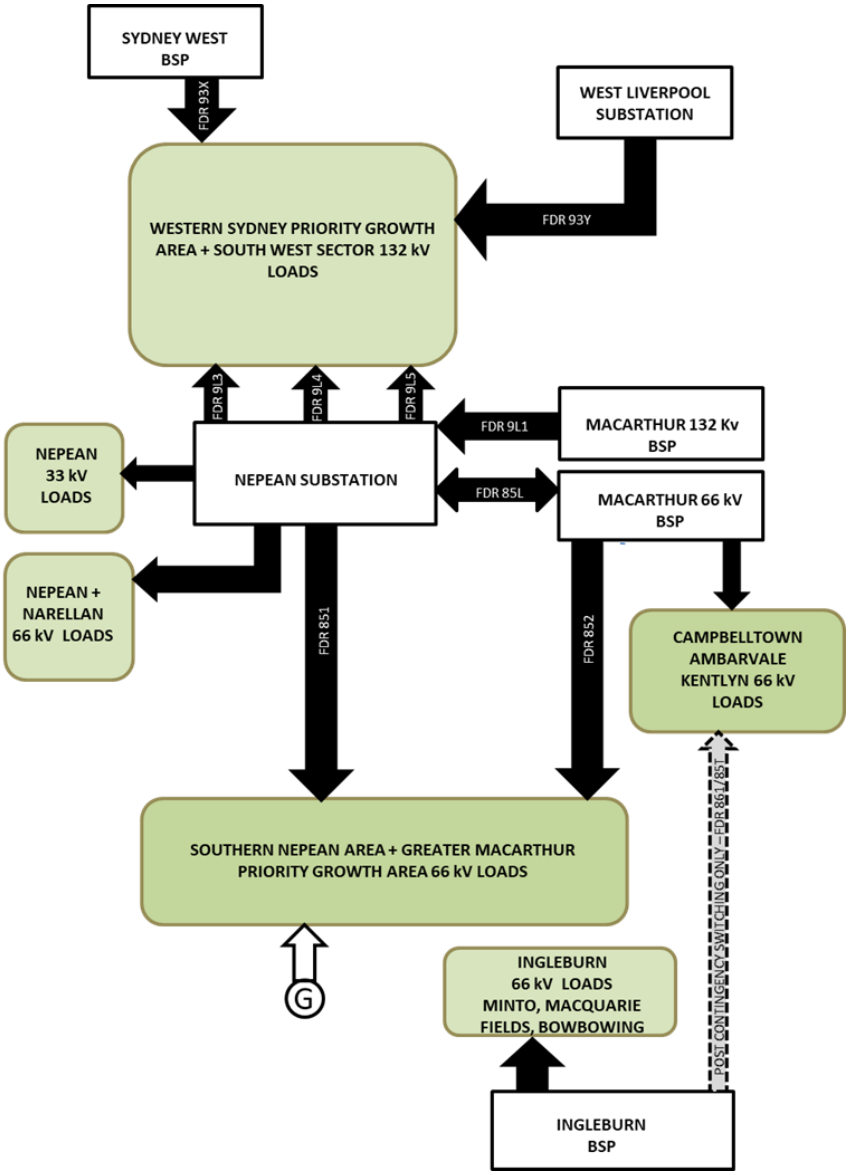
As noted above, the Macarthur 330/132 kV transformer supplies Nepean transmission substation and, in particular, the two 132/66 kV transformers that also feed the Nepean-Macarthur 66 kV network and the Nepean 33 kV network. The 66 kV loads that are fed from Nepean substation (and ultimately via the 330/132 kV Macarthur transformer) are Maldon 66/11 kV, Narellan 66/11 kV, Nepean 66/11 kV, Tahmoor 66/11 kV and Wilton 66/11 kV zone substations as well as large industrial customers.

The single Macarthur 330/66 kV transformer, under system normal conditions, presently supplies Ambarvale, Appin, Campbelltown and Kentlyn zone substations, as well as a number of significant large customer installations. In the future it will also supply Menangle Park zone substation (currently under construction) and proposed additional zone substations in the Greater Macarthur growth area (notably at Gilead, South Gilead and Wilton New Town).

From the two figures below, for an outage of the Macarthur 330/66 kV transformer, all of the Nepean-Macarthur 66 kV load will have to be supplied via the Macarthur 330/132 kV transformer and the two Nepean 132/66 kV transformers. Nameplate ratings on the 330/132 kV transformer start to be exceeded from 2020/21 onwards. The combined nameplate ratings of the two 132/66 kV Nepean transformers are already being exceeded for this contingency case.

[11] Reliability corrective action identified need RIT-Ts can have negative net economic benefits on account of having to meet an externally imposed obligation on the network business.

Figure 2-3 Existing supply arrangements to the Macarthur-Nepean area



Conversely, for an outage of the Macarthur 330/132 kV transformer, all of the load for this catchment area would need to be initially supplied from the Macarthur 330/66 kV transformer until load can be transferred away. This means that for the duration of the switching time (assuming load can be switched away), the Macarthur 330/66 kV transformer will see an additional load equivalent to the load previously on the 330/132 kV transformer. This presents a significant load jump on this smaller transformer and it is unlikely that this load will be sustained for the duration of the switching operations. In fact, it is likely to severely overload the transformer and cause significant loss of availability.

Figure 2-4 and Figure 2-5 below present load forecasts for the Macarthur and Nepean substations at the 10 per cent probability of exceedance (POE) and 50 per cent POE, respectively.

Figure 2-4 Summer POE10 Demand Forecast Load for Macarthur and Nepean Substations

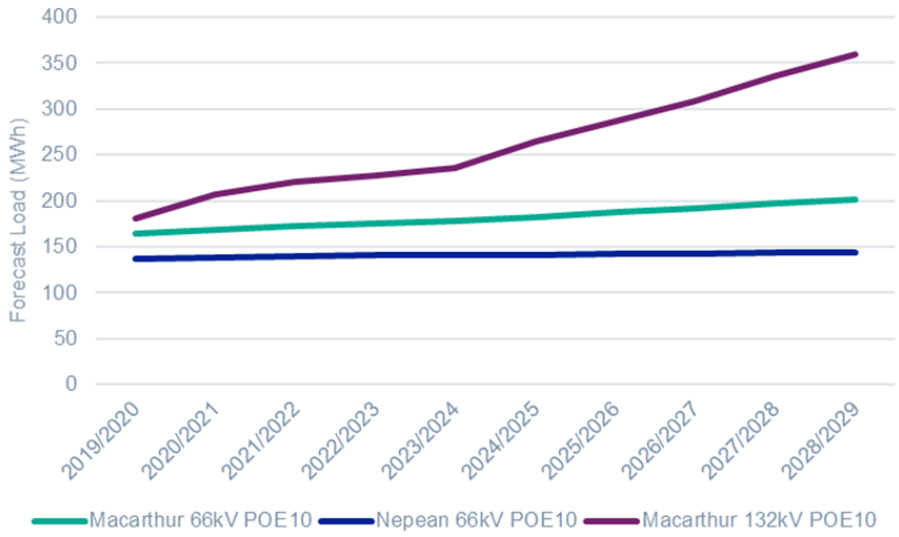
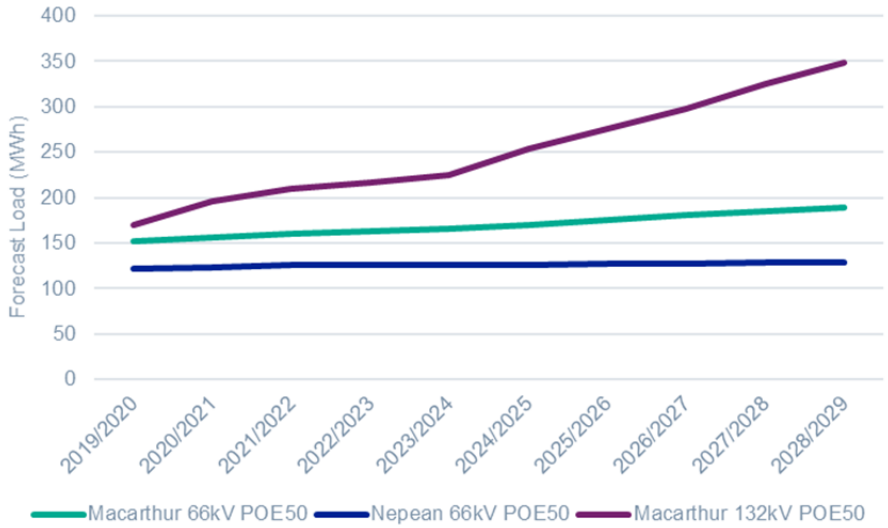


Figure 2-5 Summer POE50 Demand Forecast Load for Macarthur and Nepean Substations



While the TransGrid sources of supply have their own load catchment areas (which include fast growing regions of the Aerotropolis and the South West growth area), these areas are experiencing their own supply constraints and the availability of backup supply will reduce as these areas are developed. It is not feasible to have pre-contingency switching in place due to fault level issues and for the case of Ingleburn substation, will leave substantial areas of this load catchment exposed to the risk of customer outages in the event of a single contingency event, ie, this catchment area will be left without any backup supply if pre-switching takes place to cover the risk of outages from any contingency event at Macarthur substation. If nothing were to be done, customers would therefore face outages in the event of an outage of either Macarthur transformer.

2.3.2 Forecast unserved energy if action is not taken

TransGrid and Endeavour Energy have assessed the peak load at risk based on Endeavour Energy's distribution load forecasts. It shows the expected unserved energy projections using three different load forecasts, namely:

- a central forecast of 50 per cent probability of exceedance (POE50)
- a low forecast using POE90
- a high forecast using the POE10 forecasts

Figure 2-6 below illustrates these three unserved forecasts over the assessment period.

Figure 2-6 Forecast Macarthur 132 kV and 66 kV expected unserved energy

As outlined above, this load at risk is due to developments in south west Sydney and the Greater Macarthur area. These developments increase the level of unsupportable load in Endeavour Energy's network upon outage of a Macarthur transformer.

Each of the three load forecasts above has been included in the economic assessment undertaken in this PSCR, as outlined in section 6.4. In addition, TransGrid has also undertaken a range of sensitivities on the load forecasts (along with other assumptions), which are presented in section 7.4.

3. Potential credible options

TransGrid considers that there are two feasible network options from a technological and project delivery perspective. This section provides more information on the scope and cost of those options, as well as a range of options considered but not progressed.

The options below are considered to be both technically and commercially feasible and able to be implemented in sufficient time to meet the identified need.[12] All works under these option are assumed to be completed in accordance with the relevant standards and components shall be replaced or refurbished with the objective of minimal modification to the wider transmission and distribution assets. Neither option is expected to have a material inter-network impact.

Section 4 provides additional details on non-network options and the technical information that the non-network option needs to provide to be considered in this RIT-T.

TransGrid expects coronavirus (COVID-19) to impact its suppliers and disrupt their supply chains. TransGrid has preliminary advice that this is already occurring, although at this time the extent of the current or future impact is unknown. Consequently, some of the costs associated with the works outlined in this document may be affected.

All costs presented in this PACR are in 2019/20 dollars.

3.1 Base Case

The costs and benefits of each option in this document are compared against those of a base case. Under this base case, no investment is undertaken and so this presents a risk of significant amounts of involuntary load shedding.

TransGrid notes that this outcome is not expected in practice. However, this approach has been adopted since it is consistent with AER guidance on the base case for RIT-T applications.[13]

The costs and benefits of each option in this PACR were compared against those of a base case[14]. Under this base case, no investment is undertaken and so this presents a risk of significant amounts of involuntary load shedding.

The Expected Unserved Energy (EUE) under the base case is assessed to be approximately 10 MWh[15] in 2021.

3.2 Option 1 – Installation of a second 330/66 kV transformer at Macarthur substation

This option will require the following works to be carried out by TransGrid:

> provision of a 250 MVA 330/66 kV transformer, including compound, switchgear, oil containment and all other necessary HV gear

[12] In accordance with the requirements of NER clause 5.15.2(a).

[13] TransGrid notes that the final updated December 2018 AER RIT-T Guidelines state that the base case is where the RIT–T proponent does not implement a credible option to meet the identified need, but rather continues its 'BAU activities'. The AER define 'BAU activities' as ongoing, economically prudent activities that occur in the absence of a credible option being implemented. See: AER, *Regulatory Investment Test for Transmission Application Guidelines,* December 2018. 21.

[14] As per the RIT-T Application Guidelines, the base case provides a clear reference point for comparing the performance of different credible options. Australian Energy Regulator. *"Application guidelines Regulatory Investment Test for Transmission - December 2018."* Melbourne: Australian Energy Regulator, 2018. Accessed 6 May 2020. 22. https://www.aer.gov.au/system/files/AER%20-%20Final%20RIT-T%20application%20guidelines%20-%2014%20December%202018_0.pdf

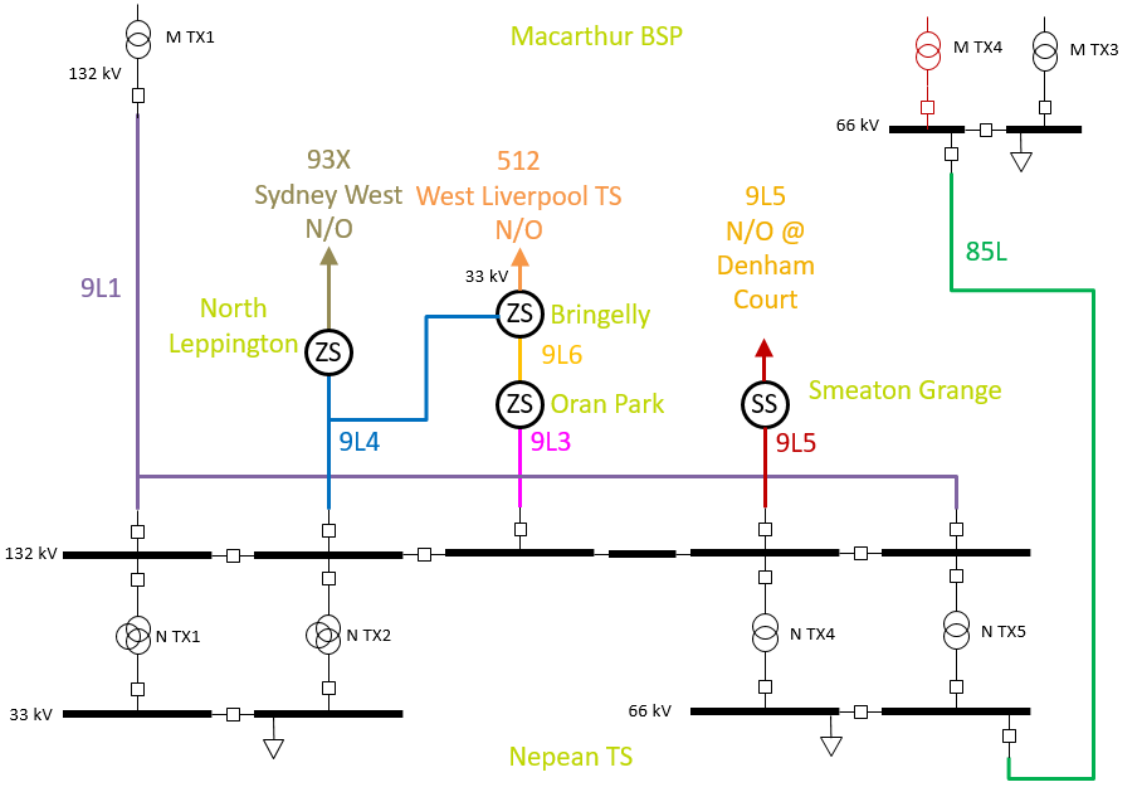
[15] Central Scenario

- establishment of a 330 kV busbar to allow cut in of the second 330/66 kV transformer into the existing 330 kV mesh
- appropriate secondary systems for transformer control and protection are to be installed for the new transformer and switchbay
- integration of Automatic Voltage Regulation (AVR) for the new transformer with the existing 330/66 kV transformer control system
- upgrade of 110 V DC battery banks and chargers to meet new capacity

The risk of unserved energy under Option 1 is assessed to be effectively zero.

Figure 3-1 below provides a network diagram for Option 1.

Figure 3-1 Network diagram for Option 1



The estimated capital cost of the option is $8.88 million. The estimated operating cost for Option 1 is assumed to be two per cent of the capital cost. Option 1 is expected to be commissioned by June 2022, which aligns with the optimal commissioning date.

3.3 Option 2 – Permanent transfer Campbelltown load to the Ingleburn BSP

This option will require the following works to be carried out by Endeavour Energy and TransGrid:

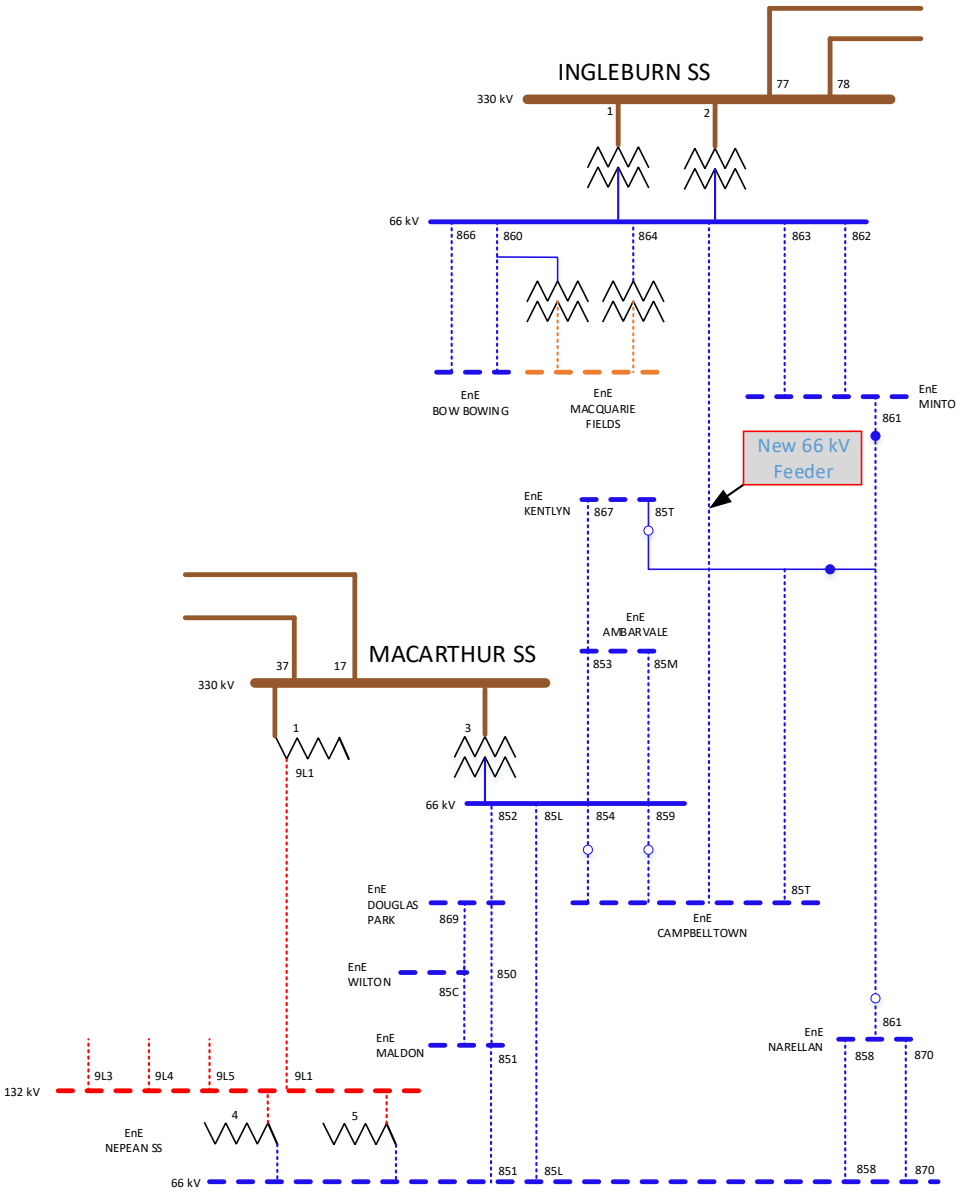
- installation of a new feeder switchbay at Ingleburn 66 kV busbar – TransGrid
- installation of a new bus section and a new feeder bay at Campbelltown – Endeavour Energy
- a new 66 kV feeder between Ingleburn and Campbelltown – Endeavour Energy
- appropriate secondary system works for new feeder and feeder bays – Endeavour Energy

With Option 2, residual risks of unserved energy will re-emerge from 2023, based on current forecasts by Endeavour Energy. This has not been quantified in this RIT-T, as Option 2 is not the preferred option and additional risk of unserved energy will make it less favourable.

The estimated capital cost of the option is $35 million[16]. The estimated operating cost for Option 2 is assumed to be two per cent of the capital cost. Option 2 is expected to be commissioned by June 2022.

Figure 3-12 below provides a network diagram for Option 2.

Figure 3-2 Network diagram for Option 2



3.4 Options considered but not progressed

TransGrid has also considered whether a number of other credible options would meet the identified need. The reasons these options were not progressed further are summarised in Table 3-1 below.

[16] Cost Estimate provided by Endeavour Energy,

Table 3-1 Options considered but not progressed

Option	Reason(s) for not progressing
Install a third 132/66 kV transformer at Nepean transmission substation	Analysis by Endeavour Energy finds that, whilst replacing the spare 33 kV bus section and 132/33 kV transformer at Nepean TS with a new 66 kV bus section and 132/66 kV transformer aligns with ultimate network configuration, the 66 kV fault level at Nepean TS will exceed the breaking capacity of some 66 kV circuit breakers at Nepean TS if all four of the 66 kV transformers are paralleled. Feeder 9L1 and Macarthur 330/132 kV transformer will still be overloaded in the pre-contingency switching stage, which is not acceptable. This option is therefore not considered technically feasible.
Seasonal transfer of Campbelltown ZS to Ingleburn BSP	Analysis by Endeavour Energy finds that this option introduces additional unserved energy risk for Campbelltown ZS. The additional EUE of this option is estimated to grow from 6.38 MWh in 2021 to 97.08 MWh by 2035[17], and so this option is not considered technically feasible. Specifically, these substations will be left on N supply security for the season if seasonal pre-contingency switching is implemented to cater for N-1 supply security on the Macarthur – Nepean system. This has the effect of shifting the outage risks onto the established Campbelltown area. These risks increase in proportion with load forecast increases and so increase with time.
Feeder 9L5 Manual changeover	Analysis by Endeavour Energy finds that this option introduces additional load at risk due to the fact that manual switching operations following a contingency are not able to be completed in time for the Nepean transformers to be safely offloaded and will result in customer outages. These risks increase as load forecast increases and so increase with time. The level of load at risk on the Nepean transformers also risks permanent damage to the transformers. This option is therefore not considered technically feasible.
Feeder 93X auto-changeover scheme	Analysis by Endeavour Energy finds that this option has the same issues as the Feeder 9L5 manual changeover option (outlined above) and so is not considered technically feasible.
Paralleling Liverpool and Macarthur BSPs	Analysis by Endeavour Energy finds that, under this option, the calculated fault level exceeds the existing fault rating in Endeavour Energy distribution network. This option is therefore not considered feasible.

[17] In accordance with Endeavour Energy EUE calculation results.

4. Non-network options

This section sets out the required technical characteristics for non-network options, consistent with the requirements of the RIT-T. Specifically, this section details the outage conditions and load at risk to be addressed by any non-network options. It also provides details of the target area for demand reduction and load type with the area.

The objective of any non-network option for this RIT-T should be to obtain a sufficient net peak demand reduction in the target area supplied by the Macarthur BSP and Nepean substation to manage the load at risk in order to defer or avoid the network option of installing a second 250 MVA 330/66 kV transformer at Macarthur BSP (ie, Option 1). A non-network option may be successful if sufficient peak demand can be reduced to remove the network limitations under all outage conditions.

Proponents of non-network options are encouraged to make submissions on any non-network option they believe can address, or contribute to, the identified need. TransGrid encourages proponents to reach out and contact us as soon as practicable about potential solutions, ahead of preparing a formal submission.

4.1 Summary of relevant network contingencies and constraints

There are several network elements within the TransGrid Macarthur BSP and Endeavour Energy Nepean TS networks that become constrained when either of the transformers at Macarthur BSP experience an unplanned outage. Table 4-1 details the outage conditions and resultant load at risk (LAR). The LAR has been calculated using the average FY19 annual embedded generation levels of 37 MVA. Actual peak time generation during the summer is lower than the annual average and occasionally is zero. The actual LAR will lie between the two levels quoted in Table 4-1.

Table 4-1 Summary of network contingencies and constrained element

Element Fault	Network Element	Load with generation (MVA)	Load without generation (MVA)	LAR with generation (MVA)	LAR without generation (MVA)
Macarthur 330/66 kV transformer	Nepean 132/66 kV transformers 254 MVA cyclic rating	276	313	22	59
	9L1 132 kV Feeder 380 MVA contingency rating[1]	314	351	0	0
	Macarthur 330/132 kV transformer 431 MVA step rating[2]	314	351	0	0
Macarthur 330/132 kV transformer	Macarthur 330/66 kV transformer 250 MVA continuous 275 MVA step rating[2]	314	351	39	76

Note: Contingency rating based on maximum operating temperature of 100°C. Step ratings based on 100 per cent initial loading, 40°C ambient temperature and 24-hour operation to allow continuous operation until faulty assets are replaced. Actual peak time generation during the summer is lower than the annual average and occasionally is zero. The actual LAR will lie between the two levels quoted in this table.

The LAR levels have been determined on the instantaneous overload condition that would be experienced by the network for the half hour period it would take to transfer load away from Macarthur. This is to avoid severe overloads of Endeavour Energy's 132/66 kV transformers beyond safe limits and avoid asset degradation and damage.

4.2 Forecast load at risk

Table 4-2 summarises the expected levels of load at risk at each of the relevant points in the network.

Table 4-2 Forecast load at risk

Summer 50 PoE Forecast Load at Risk Macarthur and Nepean Substations										
Summer	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29
Macarthur 330/132 kV Generation	0	0	0	0	0	7	27	46	69	88
Macarthur 330/132 kV No Generation	0	0	0	8	22	44	64	83	106	125
Macarthur 330/66 kV Generation	62	95	116	127	141	163	183	202	225	244
Macarthur 330/66 kV No Generation	99	132	153	164	178	200	190	239	262	281
Nepean 132/66 kV Generation	29	35	45	49	56	60	66	72	78	83
Nepean 132/66 kV No Generation	66	72	82	86	93	97	103	109	115	120
9L1 132 kV Feeder Generation	0	0	11	22	36	58	78	97	120	139
9L1 132 kV Feeder No Generation	0	27	48	59	73	95	115	134	157	176

4.3 Technical characteristics of a non-network option

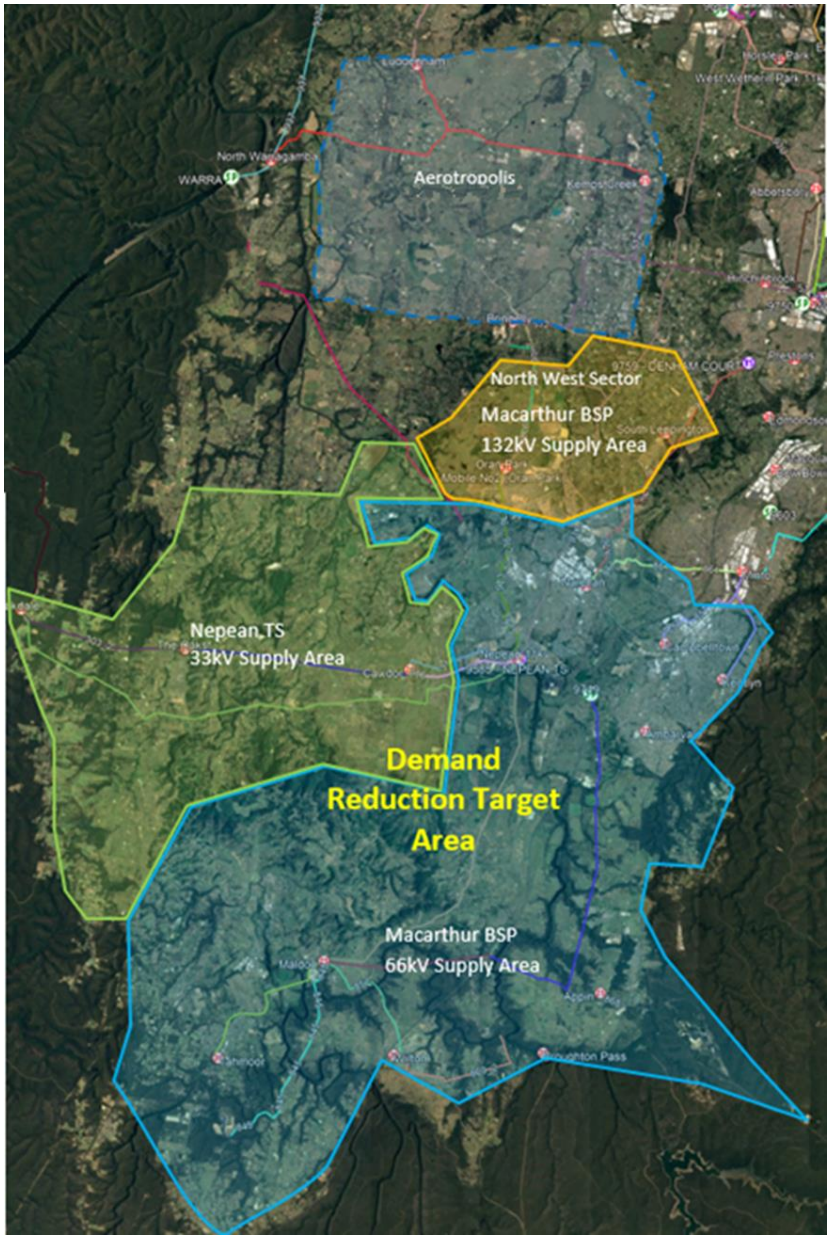
As illustrated in Table 4-1, there are currently forecast to be large quantities of load at risk on the Macarthur BSP 330/66 kV transformer and the Nepean TS 132/66 kV transformers if no action is taken. There is also a high rate of load growth on Macarthur BSP primarily due to the South West Sector and Aerotropolis development areas.

The objective of any non-network option should be to obtain sufficient net peak demand reduction in the target area supplied by the Macarthur BSP, to manage the load at risk and so defer the network option of installing a second 250 MVA 330/66 kV transformer at Macarthur BSP. At a minimum, a one-year deferral is sought.

To achieve the non-network option objective, the demand reduction must target the Macarthur BSP 66 kV supply areas (refer to Figure 4-1 below). The Macarthur BSP 66 kV supply areas are the Southern Macarthur area and the Northern Macarthur BSP supply area (Ambarvale, Campbelltown and Kentlyn zone substations).

By 2022/23, the bulk of the demand reduction will be required in the Macarthur BSP 66 kV supply areas, but a portion of the demand reduction can be from the Macarthur BSP 132 kV and/or Nepean TS 33 kV supply areas. Under an outage of either the Macarthur BSP 330/132 kV 330/66 kV transformers, the remaining transformer will supply the entire Macarthur BSP.

Figure 4-1 Non-network option target area



The trigger for network investment (ie, Option 1) is not necessarily the load and energy at risk alone. However, when evaluating options, the load and energy at risk needs to be successfully eliminated to compare options equally.

The technical characteristics of any non-network solution(s) include the following:

- providing demand reduction levels as specified in Table 4-2 Forecast load at risk
- (up to 82 MVA in 2022)
- meeting the demand reduction characteristics (detailed in Table 4-3 Indicative non-network option availability
- below)
- demand reduction to primarily target the Macarthur BSP 66 kV supply area (refer to Figure 4-1)

Table 4-3 summarises the indicative non-network availability required.

Table 4-3 Indicative non-network option availability

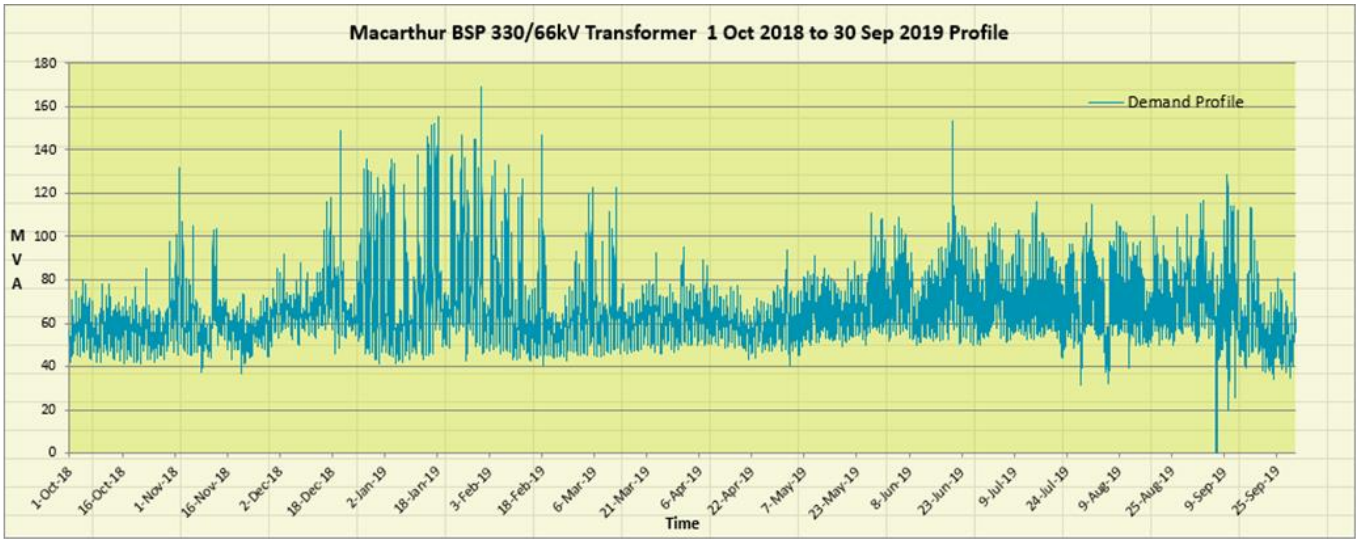
Objective	Target
Time of year	1 November to 31 March
Time of day	3 pm to 8 pm
Season condition	Summer
Day type	All Days of Week (Greater than 30 degrees)

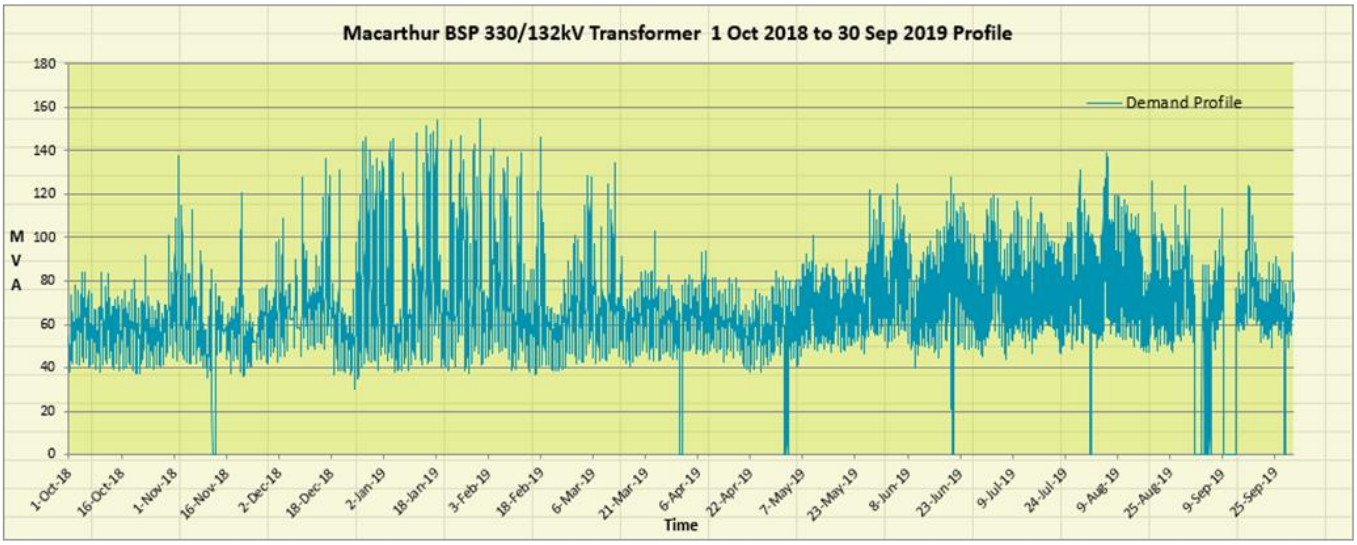
The load profiles for the Macarthur BSP transformers for the period of 1 October 2018 to 30 September 2019 are shown in Figure 4-2. This provides an indication of the frequency of which demand exceeds network capacity under contingency conditions. The profile showing the total Macarthur BSP load also indicates the temperature.

The typical hot day demand profiles for the Macarthur BSP 330/132 kV and the 330/66 kV transformers, for the period of 1 October 2018 to 30 September 2019, is shown in Figure 4-3 below. This profile is heavily influenced by the peaky residential load coinciding with the flat major customer load peaking between 1pm and 9pm. Peak demand is higher on hot days, ie, above 30 degrees for both weekdays and weekends. This is illustrated in Figure 4-4. Noting that weekends are greyed out.

Customer demand response (DR) initiatives may need to be initiated up to 40 times over the 2020/21 summer period for an outage of the Macarthur BSP 330/132 kV transformer and 60 times for an outage of the Macarthur BSP 330/66 kV transformers, on a pre-emptive basis, growing to over 50 and 80 times respectively by 2022/23. This figure will continue to grow as the demand increases. This indicates that voluntary load curtailment may not be feasible due to the quantity of load curtailment events required.

Figure 4-2 Twelve month load profile for Macarthur BSP 330/132 kV and 330/66 kV transformers





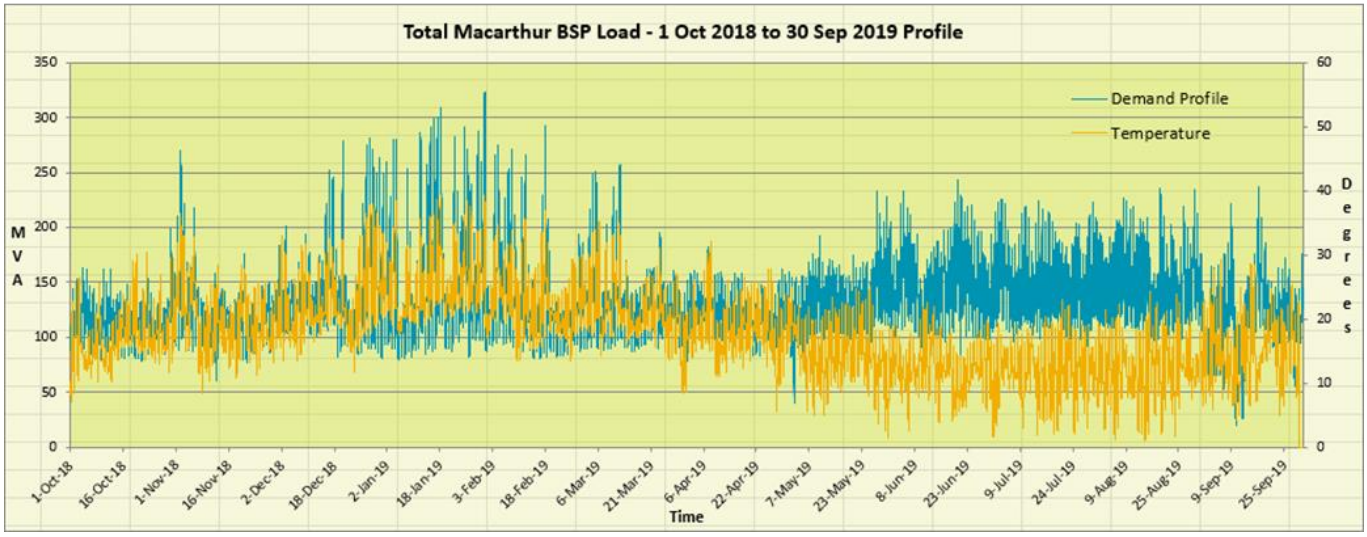


Figure 4-3 Typical hot-day load profile for Macarthur BSP 330/132 kV transformer

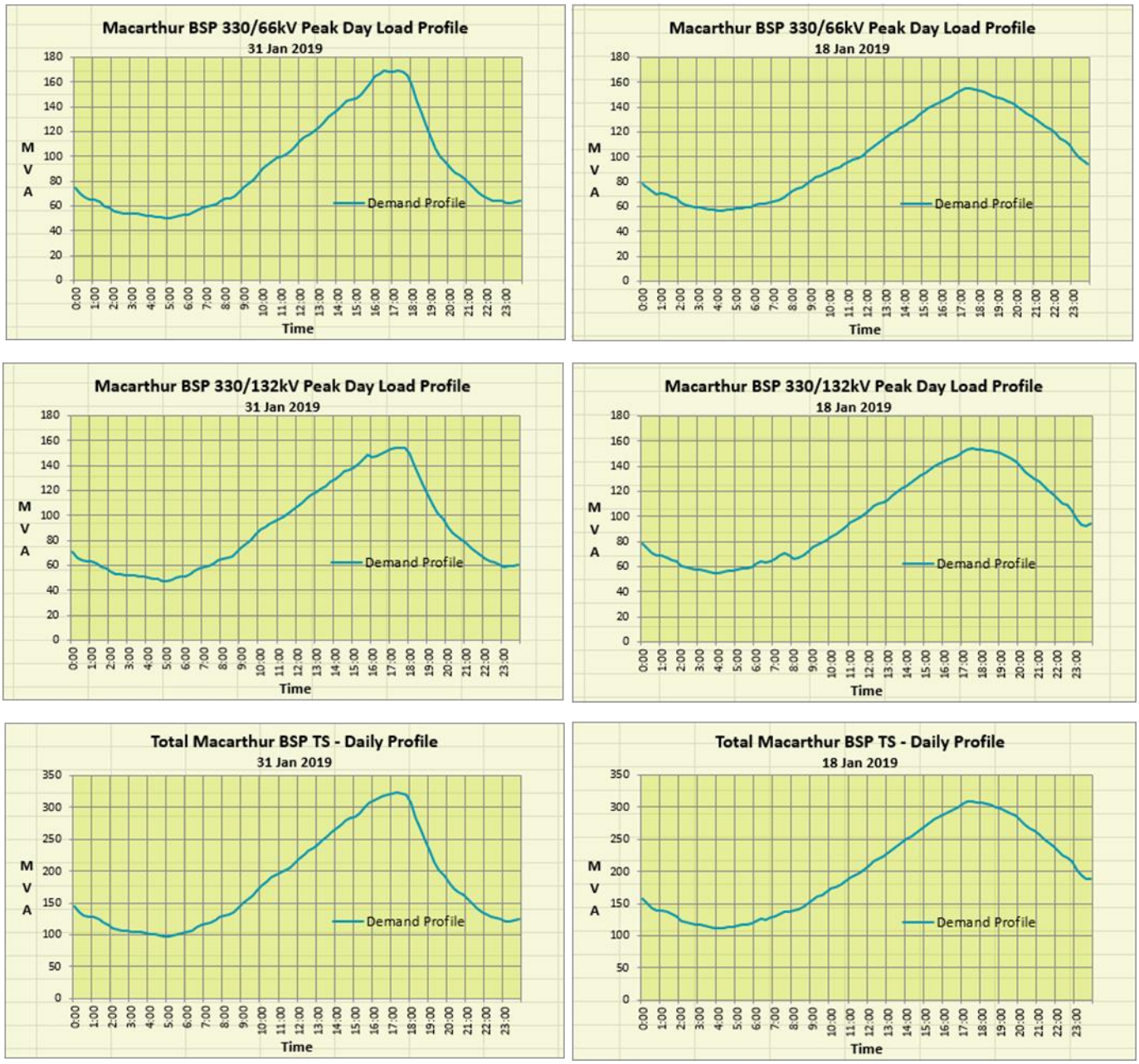
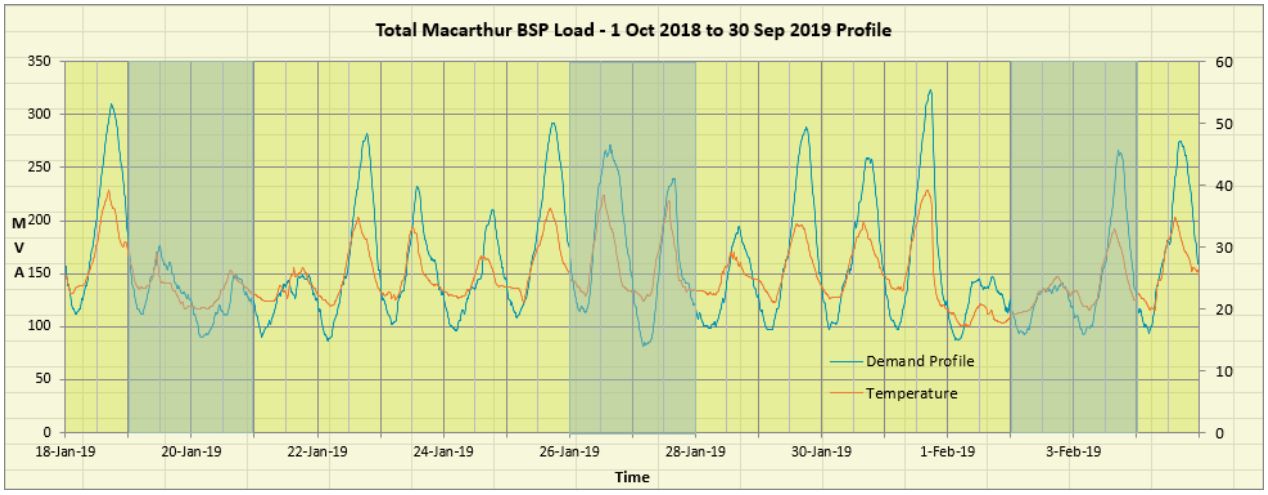


Figure 4-4 Load Profile for Macarthur BSP – 18 January 2019 to 4 February 2019



5. Materiality of market benefits

This section outlines how only one category of market benefit under the RIT-T is expected to be material (ie, 'changes in involuntary load shedding'), as well as why all other categories are not expected to be material.[18]

5.1 Changes in involuntary load shedding are expected to be material

TransGrid considers that the only category of market benefit that is likely to be material is changes in involuntary load shedding. This is driven by Option 1 avoiding the network constraints outlined in section 2 above and the consequent risk to supply to end consumers.

5.2 Wholesale electricity market benefits are not material

The AER has recognised that if the credible options considered will not have an impact on the wholesale electricity market, then a number of classes of market benefits will not be material in the RIT-T assessment, and so do not need to be estimated.[19]

TransGrid determines that the credible options considered in this RIT-T do not address network constraints between competing generators and will not have an impact on generation dispatch outcomes and the wholesale electricity market. Therefore, TransGrid considers that the following classes of market benefits are not material for this RIT-T assessment:

- changes in fuel consumption arising through different patterns of generation dispatch
- changes in price-responsive voluntary load curtailment (since there is no significant impact on pool price)
- changes in costs for parties, other than for TransGrid (since there will be no deferral of generation investment)
- changes in ancillary services costs
- changes in network losses
- competition benefits
- Renewable Energy Target (RET) penalties.

5.3 No other classes of market benefits are material

In addition to the classes of market benefits listed above, NER clause 5.16.1(c)(4) requires TransGrid to consider the following classes of market benefits, listed in Table 4-1, arising from each credible option.

The same table sets out the reason TransGrid considers these classes of market benefits to be immaterial.

[18] The NER requires that all classes of market benefits identified in relation to the RIT-T are included in the RIT-T assessment, unless the TNSP can demonstrate that a specific class (or classes) is unlikely to be material in relation to the RIT-T assessment for a specific option – NER clause 5.16.1(c)(6). Under NER clause 5.16.4(b)(6)(iii), the PSCR should set out the classes of market benefits that the NSP considers are not likely to be material for a particular RIT-T assessment. See Appendix A for requirements applicable to this document.

[19] Australian Energy Regulator. "Application guidelines Regulatory Investment Test for Transmission - December 2018." Melbourne: Australian Energy Regulator, 2018.39.Accessed 15 March 2019. https://www.aer.gov.au/system/files/AER%20-%20Final%20RIT-T%20application%20guidelines%20-%2014%20December%202018_0.pdf

Table 4-1 Reasons non-wholesale electricity market benefits categories are considered immaterial

Market benefits	Reason
Differences in the timing of unrelated expenditure	No unrelated planned transmission or distribution expenditure is affected by Option 1.
Option value	TransGrid notes the AER's view that option value is likely to arise where there is uncertainty regarding future outcomes, the information that is available is likely to change in the future, and the credible options considered by the TNSP are sufficiently flexible to respond to that change.[20] TransGrid notes that no credible option is sufficiently flexible to respond to change or uncertainty. Additionally, a significant modelling assessment would be required to estimate the option value benefit but it would be disproportionate to potential additional benefits for this RIT-T. Therefore, TransGrid has not estimated any additional option value benefit.

[20] Australian Energy Regulator. *"Application guidelines Regulatory Investment Test for Transmission - December 2018."* Melbourne: Australian Energy Regulator, 2018.58-59. Accessed 8 May 2020. https://www.aer.gov.au/system/files/AER%20-%20Final%20RIT-T%20application%20guidelines%20-%2014%20December%202018_0.pdf

6. Overview of the assessment approach

This section outlines the approach that TransGrid has applied in assessing the net benefits associated with each of the credible options.

6.1 Description of the base case

The costs and benefits of each option in this document are compared against those of a base case. Under this base case, no investment is undertaken and so this presents a risk of significant amounts of involuntary load shedding.

TransGrid notes that this outcome is not expected in practice. However, this approach has been adopted since it is consistent with AER guidance on the base case for RIT-T applications.[21]

6.2 Assessment period and discount rate

The analysis presented in this RIT-T considers a 20-year period, from 2019/20 to 2038/39. TransGrid consider that a 20-year period takes into account the size, complexity and expected lives of the options and provide a reasonable indication of the costs and benefits over a long outlook period. Since the capital components have asset lives greater than 20 years, a terminal value approach has been applied to ensure that the capital costs of long-lived assets are appropriately captured in the 20-year assessment period.

TransGrid adopt a central real, pre-tax 'commercial' discount rate[22] of 5.90 per cent as the central assumption for the NPV analysis presented in this report. TransGrid consider that this is a reasonable contemporary approximation of a commercial discount rate, consistent with the commercial discount rate calculated in the RIT-T Economic Assessment Handbook published by Energy Networks Australia (ENA) in March 2019[23].

TransGrid also test the sensitivity of the results to discount rate assumptions. A lower bound real, pre-tax discount rate of 2.85 per cent equal to the latest AER Final Decision for a TNSP's regulatory proposal at the time of preparing this PSCR[24], and an upper bound discount rate of 8.95 per cent (a symmetrical adjustment upwards) were used.

6.3 Approach to estimating option costs

TransGrid has estimated the capital costs of the options based on the scope of works necessary together with costing experience from previous projects of a similar nature. TransGrid estimates that the actual cost is within +/- 25 per cent of the central capital cost.

Routine operating and maintenance costs are expected to be approximately two per cent of the capital expenditure for each option and relate to planned routine checks and maintenance of the transformer by TransGrid field staff.

---

21 TransGrid notes that the final updated December 2018 AER RIT-T Guidelines state that the base case is where the RIT–T proponent does not implement a credible option to meet the identified need, but rather continues its 'BAU activities'. The AER define 'BAU activities' as ongoing, economically prudent activities that occur in the absence of a credible option being implemented. See: AER, *Regulatory Investment Test for Transmission Application Guidelines,* December 2018. 21.

22 The use of a 'commercial' discount rate is consistent with the RIT-T and is distinct from the regulated cost of capital (or 'WACC') that applies to network businesses like TransGrid.

23 Available at https://www.energynetworks.com.au/rit-t-economic-assessment-handbook Note the lower bound discount rate of 2.85 per cent is based on the most recent final decision for a TNSP revenue determination which was TasNetworks in April 2019.

24 See 2019-24 TasNetworks' Post-tax Revenue Model (PTRM) cashflow derived pre-tax real WACC available at: https://www.aer.gov.au/networks-pipelines/determinations-access-arrangements/tasnetworks-determination-2019-24

6.4 Three different scenarios have been modelled to address uncertainty

The assessment was conducted under three net economic benefits scenarios. These are plausible scenarios which reflect different assumptions about the future market development and other factors that are expected to affect the relative market benefits of the options being considered. All scenarios (low, central and high) involve a number of assumptions that result in the lower bound, the expected, and the upper bound estimates for present value of net economic benefits respectively.

A key expected driver of the net economic benefits is the Value of Customer Reliability (VCR) and the underlying demand forecast since avoided EUE is the primary market benefit. TransGrid has applied a VCR estimate of $43.03/kWh in the central scenario and +/- 30 per cent for the other two scenarios, which is consistent with the AER's VCR review released in December 2019.[25]

A summary of the key variables in each scenario is provided in Table 5-1.

Table 5-1 Summary of scenarios

Variable	Central	Low net economic benefits	High net economic benefits
Capital and operating costs	Base estimate	Base estimate + 25%	Base estimate - 25%
Demand forecasts	Based on POE50 demand forecast	Based on POE90 demand forecast	Based on POE10 demand forecast
VCR	The AER's VCR	The AER's VCR – 30%	The AER's VCR + 30%
Discount rate	5.90%	8.95%	2.85%

TransGrid considers that the central scenario is most likely since it is based primarily on a set of expected assumptions. TransGrid therefore assigned this scenario a weighting of 50 per cent, with the other two scenarios being weighted equally with 25 per cent each.

[25] The central estimate of $43.03/kWh reflects an inflation adjustment to the load weighted VCR estimate for NSW and ACT ($42.12/kWh). The confidence interval selected is also drawn from the AER's VCR review. AER, *Value of Customer Reliability Review – Final report*, December 2019, pp 71 (Table 5.22) & 84. https://www.aer.gov.au/system/files/AER%20-%20Values%20of%20Customer%20Reliability%20Review%20-%20Final%20Report%20-%20December%202019.pdf.

7. Assessment of credible options

This section outlines the assessment TransGrid has undertaken of the credible network option. The assessment compares the option against a base case option.

7.1 Estimated gross benefits

The table below summarises the present value of the gross benefit estimates for each credible option relative to the base case under the three scenarios. The gross benefits have been calculated for the scenarios outlined in the section above and the variation in gross benefit reflects that combination of changes in VCR, demand forecast and discount rate across the scenarios.

Table 7-1 Estimated gross benefits from credible options relative to the base case, present value ($m 2019/20)

Option	Low benefits scenario	Central scenario	High benefits scenario
Option 1 – Installation of a second 330/66 kV transformer at Macarthur substation	8.6	71.2	256.8
Option 2 - Permanent transfer Campbelltown load to the Ingleburn BSP[26]	8.6	71.2	256.8

7.2 Estimated costs

The table below summarises the capital and operating costs of the option considered, relative to the base case, in present value terms. The costs of the option have been calculated for each of the three reasonable scenarios.

Table 7-2 Estimated costs of credible options relative to the base case, present value ($m 2019/20)

Option	Low benefits scenario	Central scenario	High benefits scenario
Option 1 – Installation of a second 330/66 kV transformer at Macarthur substation	10.8	8.6	6.1
Option 2 - Permanent transfer Campbelltown load to the Ingleburn BSP	42.5	33.8	24.2

7.3 Estimated net economic benefits

The net economic benefit is the gross benefits (as set out in section 7.1 above) minus the costs (as outlined in section 7.2 above), all expressed in present value terms. The table below summarises the present value of the net economic benefit for each credible option across the three scenarios, as well as on a weighted basis.

The table below demonstrates that the option considered provides an expected net economic benefit under the central and high benefits scenario, as well as on a weighted basis.

[26] With Option 2, residual risks of unserved energy will re-emerge from 2023, based on current forecasts by Endeavour Energy. This has not been quantified in this RIT-T, as Option 2 is not the preferred option and additional risk of unserved energy will make it less favourable.

While the net economic benefits are marginally negative under the low scenario, TransGrid notes that this scenario comprises an extreme combination of assumptions, including low avoided unserved energy, high capital costs and a high commercial discount rate.

Table 7-3 Estimated net economic benefits relative to the base case, present value ($m 2019/20)

Option	Low benefits scenario	Central scenario	High benefits scenario	Weighted	Ranking
Option 1 – Installation of a second 330/66 kV transformer at Macarthur substation	-2.2	62.7	250.7	93.5	1
Option 2 - Permanent transfer Campbelltown load to the Ingleburn BSP	-33.9	37.5	232.7	68.4	2

7.4 Sensitivity testing

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

In particular, TransGrid has undertaken two sets of sensitivity tests – namely:

> step 1 – testing the sensitivity of the optimal timing ('trigger year') to different assumptions in relation to key variables
> step 2 – once a trigger year has been determined, testing the sensitivity of the total NPV benefit associated with the investment proceeding in that year, in the event that actual circumstances turn out to be different

TransGrid has therefore undertaken sensitivity analysis to first determine the optimal timing of the project, to conclude that a particular year represents the 'most likely' date at which the project will be needed.

Having assumed to have committed to the project by this date, TransGrid has also looked at the consequences of 'getting it wrong' under step 2 of the sensitivity testing. That is, if demand growth is not as high as expected, for example, what the impact would be on the net economic benefit associated with the project continuing to go ahead on that date.

TransGrid outlines how each of these two steps have been applied to test the sensitivity of the key findings below.

7.4.1 Step 1 – Sensitivity testing of the assumed optimal timing for each credible option

TransGrid has estimated the optimal timing for each credible option based on the year in which the NPV is maximised. This process was undertaken for both the central set of assumptions and also a range of alternative assumptions for key variables.

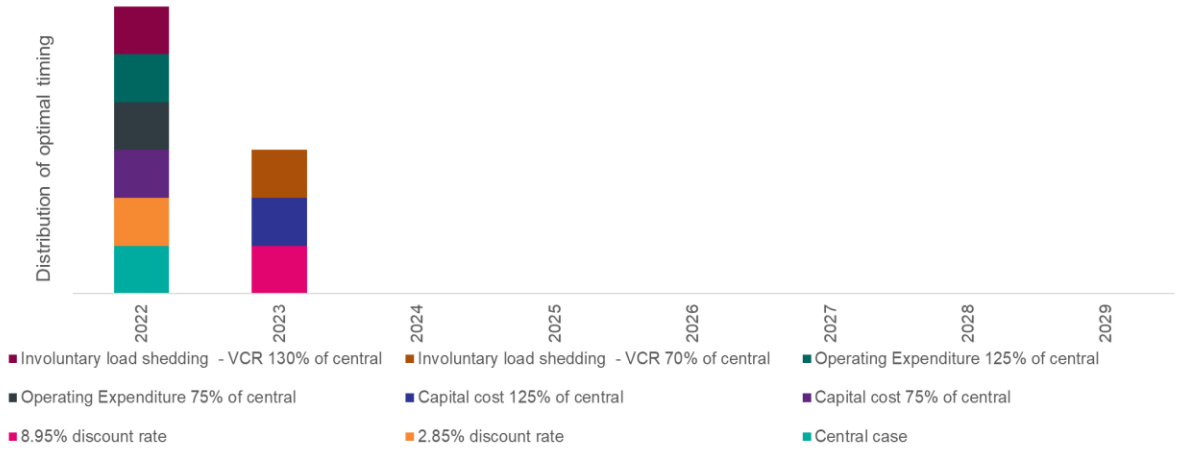
This section outlines the sensitivity of the identification of the commissioning year to changes in the underlying assumptions. In particular, the optimal timing of the option is found to be invariant to the assumptions of:

> a 30 per cent increase in the assumed VCR
> a 25 per cent decrease in the assumed network capital costs
> a 25 per cent increase/decrease in the assumed network operating costs
> lower discount rate of 2.85 per cent

The figure below outlines the impact on the optimal commissioning year, under a range of alternative assumptions, and illustrates that the optimal timing is 2021/22. In the scenario where the commercial discount rate is assumed to be high (8.95 per cent), the scenario where load shedding is assumed to be low (70 per cent of the central estimate), and the scenario where capital cost is assumed to be high (130 per cent of the central estimate), the optimal timing is delayed by one year to 2022/23.

Please note that the figure below shows the optimal financial year to commission the project, whilst recognising that it will take one year to complete the installation works (i.e., the earliest the transformer can be installed and operational is 2021/2022, with capital expenditure occurring in 2020/2021).

Figure 7-1 Distribution of optimal timing for Option 1 under a range of different key assumptions



7.4.2 Step 2 – Sensitivity of the overall net economic benefit

TransGrid also conducted sensitivity analysis on the overall NPV of the net economic benefit, based on the optimal option timing established in step 1.

Specifically, TransGrid investigated the same sensitivities under this second step as in the first step, ie:

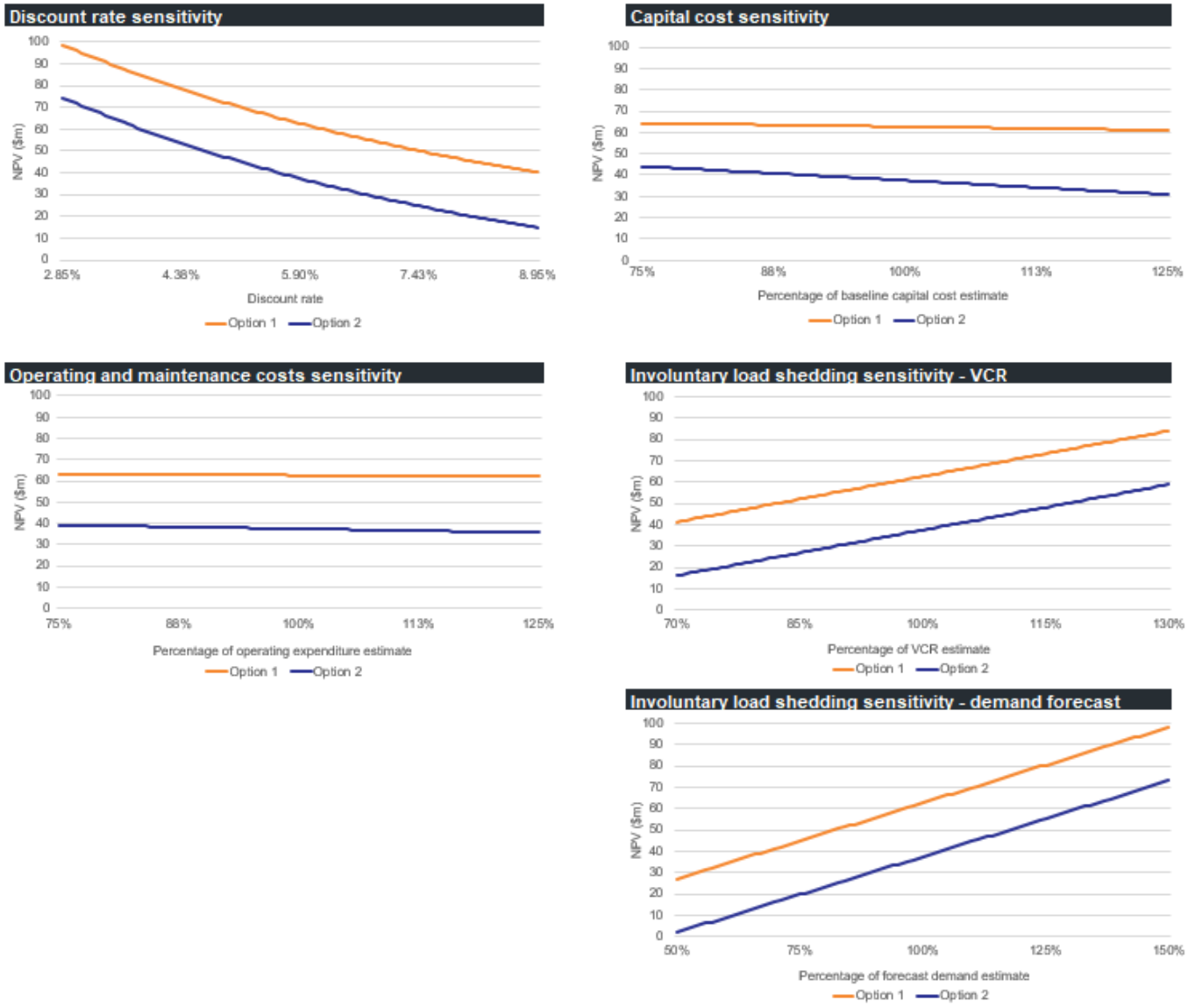
> a 30 per cent increase/decrease in the assumed VCR
> 50 per cent higher and lower demand growth forecasts
> a 25 per cent increase/decrease in the assumed network capital costs
> a 25 per cent increase/decrease in the assumed network operating costs
> lower discount rate of 2.85 per cent as well as a higher rate of 8.95 per cent.

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

The figures below illustrate the estimated net economic benefits for the option if TransGrid vary five separate key assumptions in the central scenario individually. Importantly, for all sensitivity tests shown below, the estimated net economic benefit of the option considered are found to be strongly positive and Option 1 delivers the most benefit under all scenarios.

The results are found to be most sensitive to the assumed VCR and demand forecast, i.e., the factors that contribute to the benefits derived from a reduction in involuntary load shedding. TransGrid extended the sensitivity exercise to better understand how net economic benefits vary with changes in either VCR or forecasted demand, and have found that either would need to decrease by approximate 88 per cent from the base scenario to result in no net economic benefits (ie, to result in an NPV of zero), holding all else constant. TransGrid considers it extremely unlikely that the central estimates for the VCR and load growth have been this overestimated.

Figure 7-2 Sensitivity testing of the NPV of net economic benefits ($m 2019/20)



8. Draft conclusion and exemption from preparing a PADR

Option 1 has been identified as the preferred option for addressing the identified need in this PSCR. Option 1 involves the installation of a second 330/66 kV transformer at the Macarthur substation. This option is described in section 3 and is estimated to have a capital cost of $8.88 million.

Option 1 is the preferred option in accordance with NER clause 5.16.1(b) because it is the credible option that maximises the net present value of the net economic benefit to all those who produce, consume and transport electricity in the market.

NER clause 5.16.4(z1) provides for a TNSP to be exempt from producing a Project Assessment Draft Report (PADR) for a particular RIT-T application, in the following circumstances:

- if the estimated capital cost of the preferred option is less than $43 million;
- if the TNSP identifies in its PSCR its proposed preferred option, together with its reasons for the preferred option and notes that the proposed investment has the benefit of the clause 5.16.4(z1) exemption; and
- if the TNSP considers that the proposed preferred option and any other credible options in respect of the identified need will not have a material market benefit for the classes of market benefit specified in clause 5.16.1(c)(4), with the exception of market benefits arising from changes in voluntary and involuntary load shedding.

TransGrid considers that its investment in relation to Option 1 is exempt from producing a PADR under NER clause 5.16.4(z1).

In accordance with NER clause 5.16.4(z1)(4), the exemption from producing a PADR will no longer apply if TransGrid considers that an additional credible option that could deliver a material market benefit is identified during the consultation period. Accordingly, if TransGrid considers that any additional credible options are identified, TransGrid will produce a PADR which includes a net present value (NPV) assessment of the net economic benefits of each additional credible option.

Should TransGrid consider that no additional credible options were identified during the consultation period, TransGrid intends to produce a Project Assessment Conclusions Report (PACR) that addresses all submissions received including any issues in relation to the proposed preferred option raised during the 12-week consultation period. [27]

TransGrid welcomes written submissions on materials contained in this PSCR. Submissions are due on or before 31 August 2020.

Submissions should be emailed to TransGrid's Regulation team via RIT-TConsultations@transgrid.com.au. In the subject field, please reference 'PSCR Greater Macarthur Area project'.

At the conclusion of the consultation process, all submissions received will be published on the TransGrid's website. If you do not wish for your submission to be made public, please clearly specify this at the time of lodgement.

Subject to submissions received on this PSCR, a Project Assessment Conclusions Report (PACR), including full option analysis, is expected to be published in September 2020.

[27] In accordance with NER clause 5.16.4(z2).

Appendix A - Compliance checklist

This section sets out a checklist which demonstrates the compliance of this PSCR with the requirements of the National Electricity Rules version 140.

Rules clause	Summary of requirements	Relevant section
5.16.4(b)	A RIT-T proponent must prepare a report (the project specification consultation report), which must include:	–
	(1) a description of the identified need;	2
	(2) the assumptions used in identifying the identified need (including, in the case of proposed reliability corrective action, why the RIT-T proponent considers reliability corrective action is necessary);	2
	(3) the technical characteristics of the identified need that a non-network option would be required to deliver, such as: (i) the size of load reduction of additional supply; (ii) location; and (iii) operating profile;	4
	(4) if applicable, reference to any discussion on the description of the identified need or the credible options in respect of that identified need in the most recent National Transmission Network Development Plan;	NA
	(5) a description of all credible options of which the RIT-T proponent is aware that address the identified need, which may include, without limitation, alterative transmission options, interconnectors, generation, demand side management, market network services or other network options;	3 & 4
	(6) for each credible option identified in accordance with subparagraph (5), information about: (i) the technical characteristics of the credible option; (ii) whether the credible option is reasonably likely to have a material inter-network impact; (iii) the classes of market benefits that the RIT-T proponent considers are likely not to be material in accordance with clause 5.16.1(c)(6), together with reasons of why the RIT-T proponent considers that these classes of market benefits are not likely to be material; (iv) the estimated construction timetable and commissioning date; and (v) to the extent practicable, the total indicative capital and operating and maintenance costs.	3 & 5

5.16.4(z1)	A RIT-T proponent is exempt from [preparing a PADR] paragraphs (j) to (s) if: 1. the estimated capital cost of the proposed preferred option is less than $35 million[28] (as varied in accordance with a cost threshold determination); 2. the relevant Network Service Provider has identified in its project specification consultation report: (i) its proposed preferred option; (ii) its reasons for the proposed preferred option; and (iii) that its RIT-T project has the benefit of this exemption; 3. the RIT-T proponent considers, in accordance with clause 5.16.1(c)(6), that the proposed preferred option and any other credible option in respect of the identified need will not have a material market benefit for the classes of market benefit specified in clause 5.16.1(c)(4) except those classes specified in clauses 5.16.1(c)(4)(ii) and (iii), and has stated this in its project specification consultation report; and 4. the RIT-T proponent forms the view that no submissions were received on the project specification consultation report which identified additional credible options that could deliver a material market benefit.	8

[28] Varied to $43m based on the AER Final Determination: Cost threshold review November 2018.14. Accessed 8 May 2020 https://www.aer.gov.au/networks-pipelines/guidelines-schemes-models-reviews/cost-thresholds-review-for-the-regulatory-investment-tests-2018

Appendix B - Existing supply in the Greater Macarthur area