AusNet

Maintaining reliable 330/220 kV transformation network services at South Morang Terminal Station

Regulatory Investment Test for Transmission (RIT-T)

Project Assessment Draft Report

February 2025

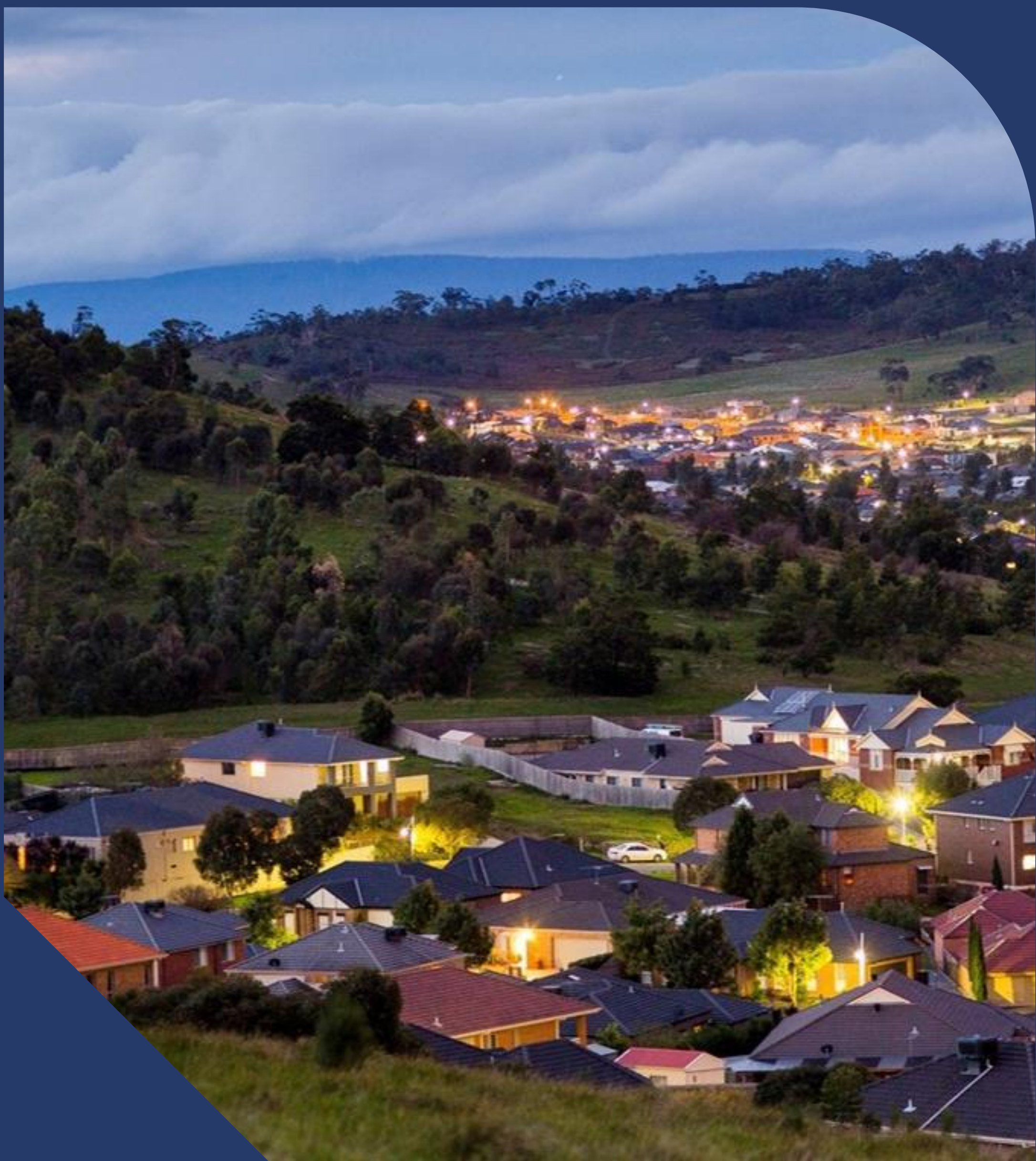


Table of contents

1. Executive summary 2
2. Introduction 3
3. Background 4
   3.1. Victorian transmission network 4
   3.2. Asset condition 4
4. Identified need 5
   4.1. Description 5
   4.2. Assumptions 5
5. Credible Options 7
   5.1. Option 1: Replace with a new transformer and a spare transformer bank 7
   5.2. Option 2: Replace with a new transformer and a single-phase spare transformer 7
   5.3. Option 3: Deferred replacement with a new transformer and a single-phase spare transformer 7
   5.4. Material inter-regional network impact 7
6. Assessment approach 8
   6.1. Proposed sensitivity analysis and input assumptions 8
   6.2. Material classes of market benefits 8
   6.3. Other classes of benefits 8
   6.4. Classes of market benefits that are not material 8
7. Economic assessment of options 10
   7.1. Material classes of market benefits 10
   7.2. Option selection 10
   7.3. Preferred Option 11
   7.4. Optimal timing of the preferred option 11
8. Draft conclusion and next steps 13
   8.1. Submissions 13

Appendix A – Asset probability of failure methodology 14

Appendix B – RIT-T assessment and consultation process 15

1. Executive summary

South Morang Terminal Station (SMTS) is owned and operated by AusNet and is in South Morang north of Melbourne's CBD. It forms part of the main Victorian 500 kV, 330 kV and 220 kV transmission network with ties to Tasmania and major generation in the Latrobe Valley, the Victoria-South Australia interconnector, the interconnector between Victoria and New South Wales and the Melbourne metropolitan 220 kV network.

This Regulatory Investment Test for Transmission (RIT-T) investigates options that could allow continued delivery of safe and reliable transmission services. Publication of this Project Assessment Draft Report (PADR) represents the second step in the RIT-T process in accordance with clause 5.16 of the National Electricity Rules (NER) and section 4.2 of the RIT-T Application Guidelines.

The RIT-T analysis shows that it is no longer economical to continue to provide transmission network services with the existing assets at SMTS as the asset failure risk has increased to a level where investment to replace the selected assets presents a more economical option.

The preferred option to address the asset failure risk at SMTS is an integrated replacement of the H1 and H2 transformers that are in very poor condition by 2029, with one of the new transformers being used as a hot spare.

No non-network proposals were received during the RIT-T PSCR consultation.

AusNet Services welcomes written submissions on the credible options presented in this PADR. Submissions should be emailed to rittconsultations@ausnetservices.com.au on or before 11 April 2025. In the subject field, please reference 'RIT-T – Maintaining reliable 330/220 kV transformation network services at SMTS'. Submissions will be published on AusNet Services' and AEMO's websites. If you do not wish for your submission to be made public, please clearly stipulate this at the time of lodgement.

Three credible network options to replace the H1 and H2 330/220 kV transformers that are likely to deliver an economical solution to the identified need are considered in this RIT-T.

- Option 1 – Replace the H1 and H2 transformers with an in-service and a hot spare transformer
- Option 2 – Replace the H1 and H2 transformers with an in-service and a cold spare single-phase transformer
- Option 3 – Deferred replacement with a new transformer and a single-phase spare transformer

2. Introduction

This Regulatory Investment Test for Transmission (RIT-T) evaluates options to maintain reliable transmission network services at South Morang Terminal Station (SMTS). Publication of this Project Assessment Draft Report (PADR) represents the second step in the RIT-T process in accordance with clause 5.16 of the National Electricity Rules (NER) and section 4.2 of the RIT-T Application Guidelines. The Project Specification Consultation Report (PSCR), which represents the first step in the RIT-T process, was published in August 2024. The PADR describes the following:

- credible network options that may address the identified need;
- a summary of the submissions to the PSCR;
- the assessment approach and assumptions that AusNet Services employed for this RIT-T assessment as well as the specific categories of market benefits that are unlikely to be material; and
- the identification of the preferred option

The need for investment to address risks from the deteriorating assets at SMTS is presented in AusNet Services Asset Renewal Plan that is published as part of AEMO's 2024 Victorian Annual Planning Report (VAPR)[1].

1 Australian Energy Market Operator, "Victorian Annual Planning Report".

3. Background

3.1. Victorian transmission network

SMTS is owned and operated by AusNet and is north of greater Melbourne. SMTS is one of the major terminal stations in Victoria which connects six other terminal stations and has four voltage levels – 500 kV, 330 kV, 220 kV and 66 kV. The 500 kV side connects three 500 kV lines from hazelwood and Rowville terminal stations in the east and three 500 kV lines to Sydenham and Keilor terminal stations in the west. Two 1,000 MVA transformers steps the voltage down from 500 kV to 330 kV. There are three 700 MVA transformers (H1, H2 and H3) that steps the voltage down from 330 kV to 220 kV and two transformers that step the voltage down from 220 kV to 66 kV.

The H3 transformer was installed in 2018 to address the risk of a transformer failure given that AusNet did not have a suitable spare transformer at the time, and it was the first stage of a staged replacement of the 330/220 kV transformers.

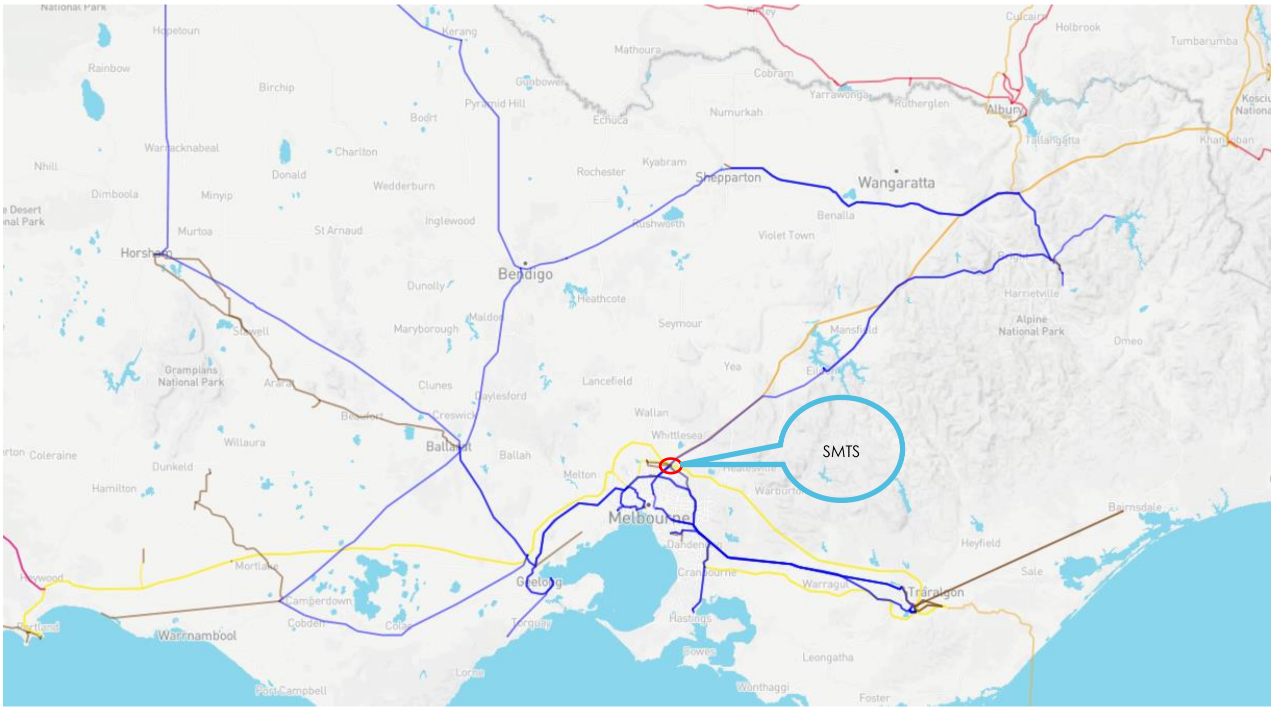


Figure 1 – SMTS and the Victorian transmission network

3.2. Asset condition

AusNet conducted a condition assessment of the H1 and H2 Transformers where the components were evaluated across a range of criteria including physical condition, spares availability, estimated rate of deterioration, and manufacturer support. The assessment revealed that the H1 and H2 transformers are in very poor condition as expected of assets that have been in service since 1967 / 1968.

No alternative maintenance strategies have been identified that would materially reduce the failure rate or address the lack of manufacturer support for these two transformers.

4. Identified need

4.1. Description

SMTS is part of the main transmission network which provides major transmission network services in Victoria.

The poor condition of the H1 and H2 330/220 kV transformers has increased the likelihood of asset failure. Without remedial action, other than ongoing maintenance practice (business-as-usual), the assets are expected to deteriorate further and more rapidly. This will increase the market impact risk due to prolonged outages of the 330/220 kV transformers. In addition, there is also increased safety, environmental, collateral damage and emergency replacement risks due to the poor condition of these assets.

Therefore, the 'identified need' this RIT-T intends to address is to maintain reliable 330/220 kV transformation network services at SMTS and to mitigate risks from asset failures.

AusNet Services calculated the present value of the baseline risk costs to be more than $700 million over the forty-five year period from 2025. The key elements of these risk costs are shown in Figure 2. The largest component of the baseline risk costs is the supply interruption risk, which is borne by electricity consumers.

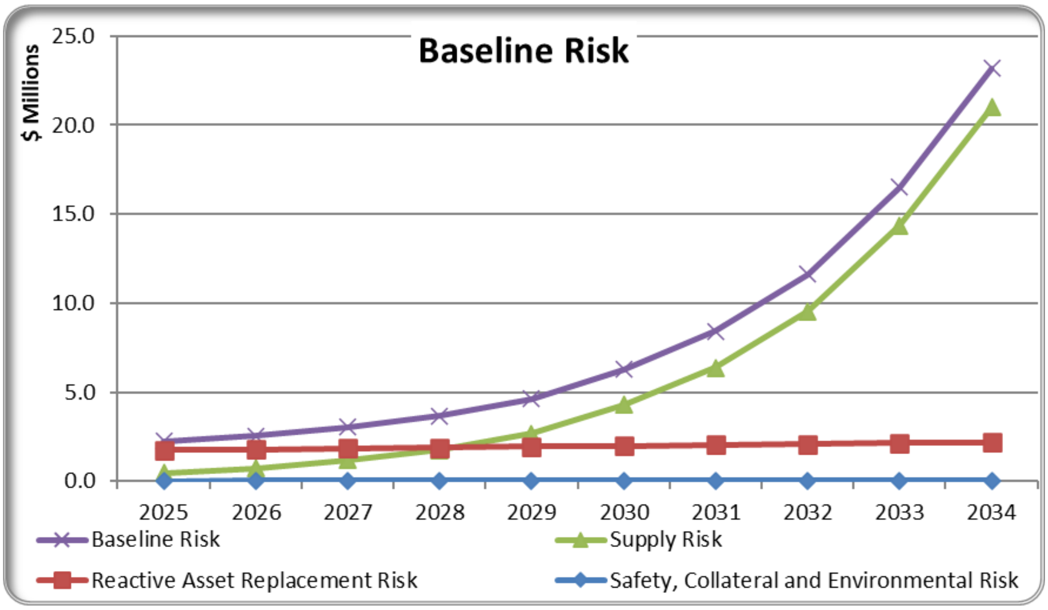


Figure 2 – Baseline risk

4.2. Assumptions

The identified need is underpinned by several assumptions, including the risk of asset failure (determined by the condition of the assets), the likelihood of the relevant consequences, and several assumptions adopted from the latest Inputs Assumptions and Scenarios Report (IASR). These assumptions are outlined below.

4.2.1. Failure rate and repair time

Both quantitative and qualitative analysis is used to assess the condition of the asset so that an estimate of how long an asset can remain in service can be made. Figure 2 shows the failure rates applied in this analysis.

Transformer Failure Rates	2025	2026	2027	2028	2029	2030	2031	2032
H1 (Hot Spare Transformer)	0.088	0.090	0.092	0.094	0.095	0.097	0.099	0.101
H2	0.078	0.080	0.082	0.083	0.085	0.087	0.089	0.091
H3	0.009	0.010	0.010	0.011	0.012	0.012	0.013	0.013

Table 1 – 330/220 kV Transformer failure rates

The mean time to replace a transformer following a major failure has been assumed to be 24 months when no spare is available.

4.2.2. Market impact costs

Market modelling and network studies are used to assess the market impact of transformer failures at SMTS. These studies use the latest assumptions from AEMO's Inputs Assumptions and Scenarios Report (IASR) which includes demand forecasts, generation cost forecasts, generation retirement schedules, and forecast transmission developments.

Involuntary load shedding is valued at the latest Value of Customer Reliability (VCR)[2].

4.2.3. Safety risk costs

The Electricity Safety Act 1998[3] requires AusNet to design, construct, operate, maintain, and decommission the network to minimise hazards and risks to the safety of any person as far as reasonably practicable or until the costs become disproportionate to the benefits from managing those risks.

By implementing this principle for assessing safety risks from explosive failure, AusNet uses:

- a value of statistical life[4] to estimate the benefits of reducing the risk of death;
- a value of lost time injury[5]; and
- a disproportionality factor[6].

AusNet notes that this approach, including the use of a disproportionality factor, is consistent with the RIT-T Industry Practice Notes [7] provided by the AER.

4.2.4. Financial risk costs

There is an ongoing need for the services provided at SMTS and emergency asset replacement or repairs would be required to continue the service should a transformer fail. The failure rate weighted emergency asset replacement cost (or undertaking reactive maintenance) is included in the assessment.[8]

4.2.5. Environmental risk costs

Environmental risks from plant that contains large volumes of oil, which may be released in an event of asset failure, is valued at $100,000 per event.

2 In dollar terms, the Value of Customer Reliability (VCR) represents a customer's willingness to pay for the reliable supply of electricity
3 Victorian State Government, Victorian Legislation and Parliamentary Documents, "Energy Safe Act 1998"
4 Department of the Prime Minister and Cabinet, Australian Government, "Best Practice Regulation Guidance Note: Value of statistical life"
5 Safe Work Australia, "The Cost of Work-related Injury and Illness for Australian Employers, Workers and the Community: 2012-13"
6 Health and Safety Executive's submission to the1987 Sizewell B Inquiry suggesting that a factor of up to 3 (i.e. costs three times larger than benefits) would apply for risks to workers; for low risks to members of the public a factor of 2, for high risks a factor of 10. The Sizewell B Inquiry was a public inquiry conducted between January 1983 and March 1985 into a proposal to construct a nuclear power station in the UK.
7 Australian Energy Regulator, "Industry practice application note for asset replacement planning"
8 The assets are assumed to have survived and their condition-based age increases throughout the analysis period.

5. Credible Options

This section describes the credible options that have been considered to address the identified need, including:

- the technical characteristics of each option;
- the estimated construction time and commissioning date; and
- the total indicative capital and operating and maintenance costs.

The purpose of the RIT-T is to identify the credible option that maximises the net market benefit for most scenarios. An important aspect of this task is to consider non-network and network options on an equal footing, to ensure an efficient outcome for all network users. None of the options considered are expected to have an inter-regional impact.

5.1. Option 1: Replace with a new transformer and a spare transformer bank

Option 1 replaces the H1 and H2 transformers with two new 330/220 kV transformers; utilising one as an in-service unit and the other as a hot spare. The project also replaces associated secondary equipment. The old H1 and H2 transformers will be retired as part of the project. The estimated capital cost of this option is $160 million and the change in operating and maintenance cost is negligible. The estimated project delivery time is 4 to 5 years.

5.2. Option 2: Replace with a new transformer and a single-phase spare transformer

Option 2 replaces the H1 and H2 transformers with one new 330/220 kV transformers and a cold spare single-phase transformer. The project also replaces associated secondary equipment. The old H1 and H2 transformers will be retired as part of the project. The estimated capital cost of this option is $116 million and the change in operating and maintenance cost is negligible. The estimated project delivery time is 4 to 5 years.

5.3. Option 3: Deferred replacement with a new transformer and a single-phase spare transformer

Option 3 is similar to Option 1 except it defers the investment with 5 years. This option replaces the H1 and H2 transformers with one new 330/220 kV transformers and a cold spare single-phase transformer. The project also replaces associated secondary equipment. The old H1 and H2 transformers will be retired as part of the project. The estimated capital cost of this option is $160 million and the change in operating and maintenance cost is negligible. The estimated project delivery time is 4 to 5 years.

5.4. Material inter-regional network impact

The proposed asset replacements at SMTS will not change the transmission network configuration and none of the network options considered are likely to have a material inter-regional network impact. A 'material inter- regional network impact' is defined in the NER as:

> "A material impact on another Transmission Network Service Provider's network, which may include (without limitation): (a) the imposition of power transfer constraints within another Transmission Network Service Provider's network; or (b) an adverse impact on the quality of supply in another Transmission Network Service Provider's network."

6. Assessment approach

Consistent with the RIT-T requirements and practice notes on risk-cost assessment methodology[9], AusNet Services undertook a cost-benefit analysis to evaluate and rank the net economic benefits of all credible options over a 45-year period.

All options considered have been assessed against a business-as-usual case where no proactive capital investment to reduce the increasing baseline risks is made.

Optimal timing of an investment option is the year when the annual benefit from implementing the option exceeds the annualised investment costs.

6.1. Proposed sensitivity analysis and input assumptions

The robustness of the investment decision and the optimal timing of the preferred option have been tested by a sensitivity analysis. This analysis involves variation of assumptions from those employed for the central (most likely) scenario.

Parameter	Lower Bound	Most likely (central) assumption or scenario	Upper Bound
VCR	75% of central assumption	Latest AER published VCR	125% of central assumption
Asset failure rate	75% of central assumption	Assessed failure rate	125% of central assumption
Demand Growth	90% of central assumption	AEMO Connection Point Forecast	110% of central assumption
Discount rate[10]	WACC rate of network business (3.0%)	Latest commercial discount rate from IASR (7%)	Upper Bound (10%)
Project Capital Cost	75% of estimated cost	Estimated cost	125% of estimated cost

Table 2 - Input assumptions used for the sensitivity studies

6.2. Material classes of market benefits

NER clause 5.16.1(c)(4) formally sets out the classes of market benefits that must be considered in a RIT-T. AusNet Services estimates that the only class of market benefits that is likely to be material is the change in involuntary load shedding. AusNet Services' proposed approach to calculate the benefits of reducing the risk of load shedding is set out in section 2.3.

6.3. Other classes of benefits

Although not formally classified as classes of market benefits under the NER, AusNet Services expects reduction in safety risks from potential explosive failure of deteriorated assets, environmental risks from possible oil spillage, collateral damage risks to adjacent plant, and the risk of increased costs resulting from the need for emergency asset replacements and reactive repairs by implementing any one of the options considered in this RIT-T.

6.4. Classes of market benefits that are not material

The following classes of market benefits are unlikely to be material for the options considered in this RIT-T:

- Changes in costs for parties, other than the RIT-T proponent – there is no other known investment, either generation or transmission, that will be affected by any option considered.
- Changes in ancillary services costs – the options are not expected to impact on the demand for and supply of ancillary services.
- Competition benefits – there is no competing generation affected by the limitations and risks to be addressed by the options considered for this RIT-T.

9 Australian Energy Regulator, "Industry practice application note for asset replacement planning,"
10 Discount rates as recommended in the AEMO Inputs, Assumptions and Scenarios Report (IASR)

- Option value – as the need for and timing of the investment options are driven by asset deterioration, there is no need to incorporate flexibility in response to uncertainty around any other factor.

Change in network losses –while changes in network losses are considered in the assessment, they are estimated to be small and unlikely to be a material class of market benefits for any of the credible options.

7. Economic assessment of options

7.1. Material classes of market benefits

Clause 5.16.4 (b)(6)(iii) of the NER requires the RIT-T proponent to consider whether each credible option provides the classes of market benefits described in clause 5.15A.2(b)(4). To address this requirement, the table below discusses our approach to each of the market benefits listed in that clause for each credible option.

Class of Market Benefit	Analysis
(i) changes in fuel consumption arising through different patterns of generation dispatch;	The options assessed do not influence the costs of dispatch materially
(ii) changes in voluntary load curtailment;	Any changes in voluntary load curtailment have been valued in accordance with any applicable network support agreements.
(iii) changes in involuntary load shedding with the market benefit to be considered using a reasonable forecast of the value of electricity to consumers;	All options considered reduce involuntary load shedding by removing asset failure risk. Our approach to estimating this market benefit is explained in section 4.
(iv) changes in costs for parties, other than the RIT-T proponent, due to differences in: *(A) the timing of new plant;* *(B) capital costs; and* *(C) the operating and maintenance costs;*	There is not expected to be any difference between the credible options.
(v) differences in the timing of expenditure;	There is not expected to be any difference in timing of expenditure
(vi) changes in network losses;	The credible options are not expected to result in material changes to electrical energy losses.
(vii) changes in ancillary services costs	The credible options will not have any impact on ancillary service costs.
(viii) competition benefits	The credible options will not provide any competition benefits.
(ix) any additional option value (where this value has not already been included in the other classes of market benefits) gained or foregone from implementing the credible option with respect to the likely future investment needs of the National Electricity Market;	There will be no impact on the option value in respect of the likely future investment needs of the NEM.
(x) any other class of market benefit determined to be relevant by the AER.	There are no other classes of market benefit that are relevant to the credible options.

Table 3: Analysis of Market Benefits

7.2. Option selection

This section presents the results of the economic cost benefit analysis that has been conducted to determine the preferred option and its economic timing.

All the options considered will deliver a reduction in market impact risk (including supply risk), safety risk, environmental risk, collateral risk and risk cost of emergency replacement in the event of asset failure.

Presented in Figure 3, the total risk cost reduction or project benefits outweighs the investment cost for all options for all of the sensitivities where input variables are varied one at a time. The uptake of new data centers has not been considered in the demand forecast and the low demand growth sensitivity is hence considered unlikely to occur.

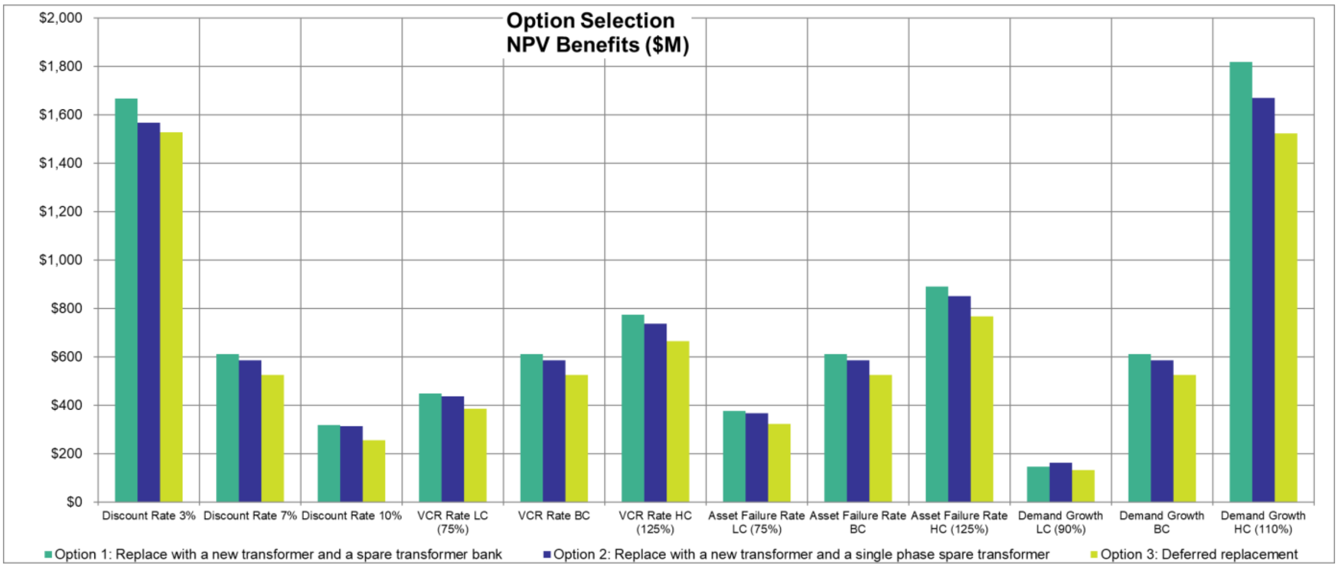


Figure 3 – Option selection and sensitivity study

7.3. Preferred Option

Option 1 (Replace with a new transformer and a spare transformer bank) has the highest net economic benefit for all the scenarios and sensitivities considered except the low demand growth scenario and is therefore the preferred option. Scenario weighting will not make a difference to the preferred option as Option 2 has the highest net benefits for 11 of the 12 sensitivity studies considered.

7.4. Optimal timing of the preferred option

This section describes the optimal investment timing of the preferred option for different assumptions of key variables. Figure 4 shows that the optimal timing of the preferred option (Option 1) is 2029 and that investment is needed within the 2027 to 2032 regulatory control period.

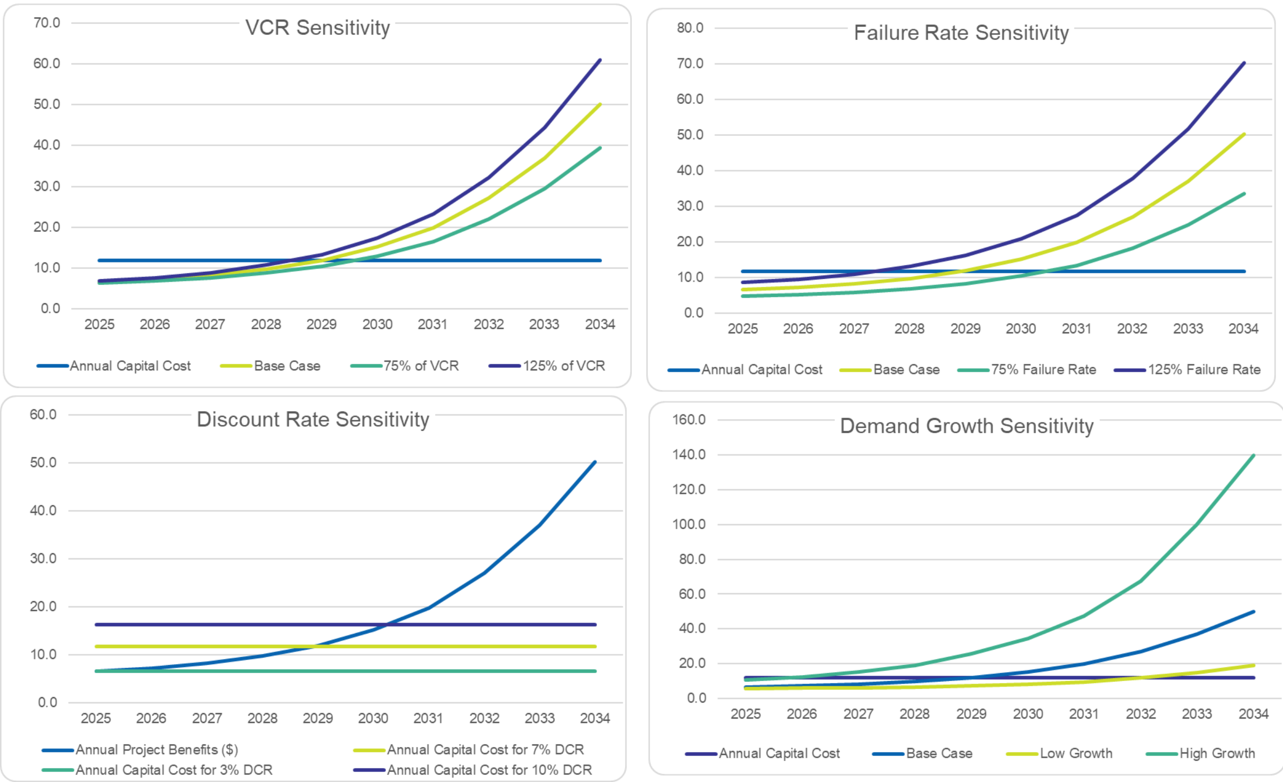


Figure 4 - Optimal investment timing sensitivity study

Figure 5 shows that the investment economic timing is only one year later for a 25% increase in investment cost.

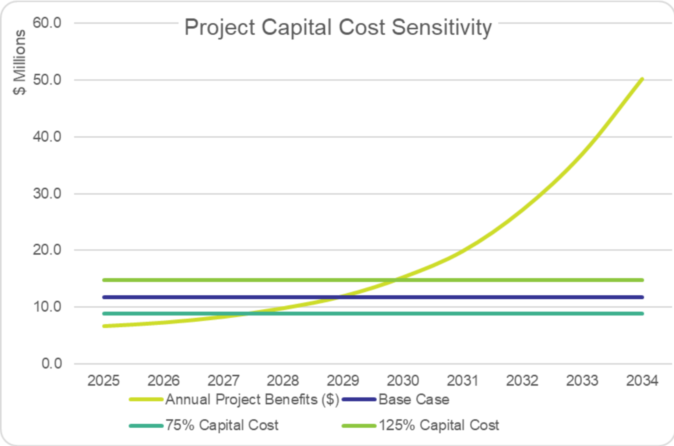


Figure 5 - Optimal investment timing sensitivity study

8. Draft conclusion and next steps

Amongst the options considered in this RIT-T, Option 1 is the most economical option to maintain reliable 330/220 kV transformation network services at SMTS and manage safety, environmental, collateral and emergency replacement risks. The preferred option involves selective replacement of assets that are in poor condition, including two 330/220 kV transformers with one of the new transformers to be used as a hot spare, as well as protection relays and secondary assets that are in poor or very poor condition.

The estimated capital cost of this option is $160 million with no material change in operating and maintenance cost. The project is economic by 2029 based on a total investment cost of $160 million and AusNet Services is targeting a commissioning date of June 2030.

8.1. Submissions

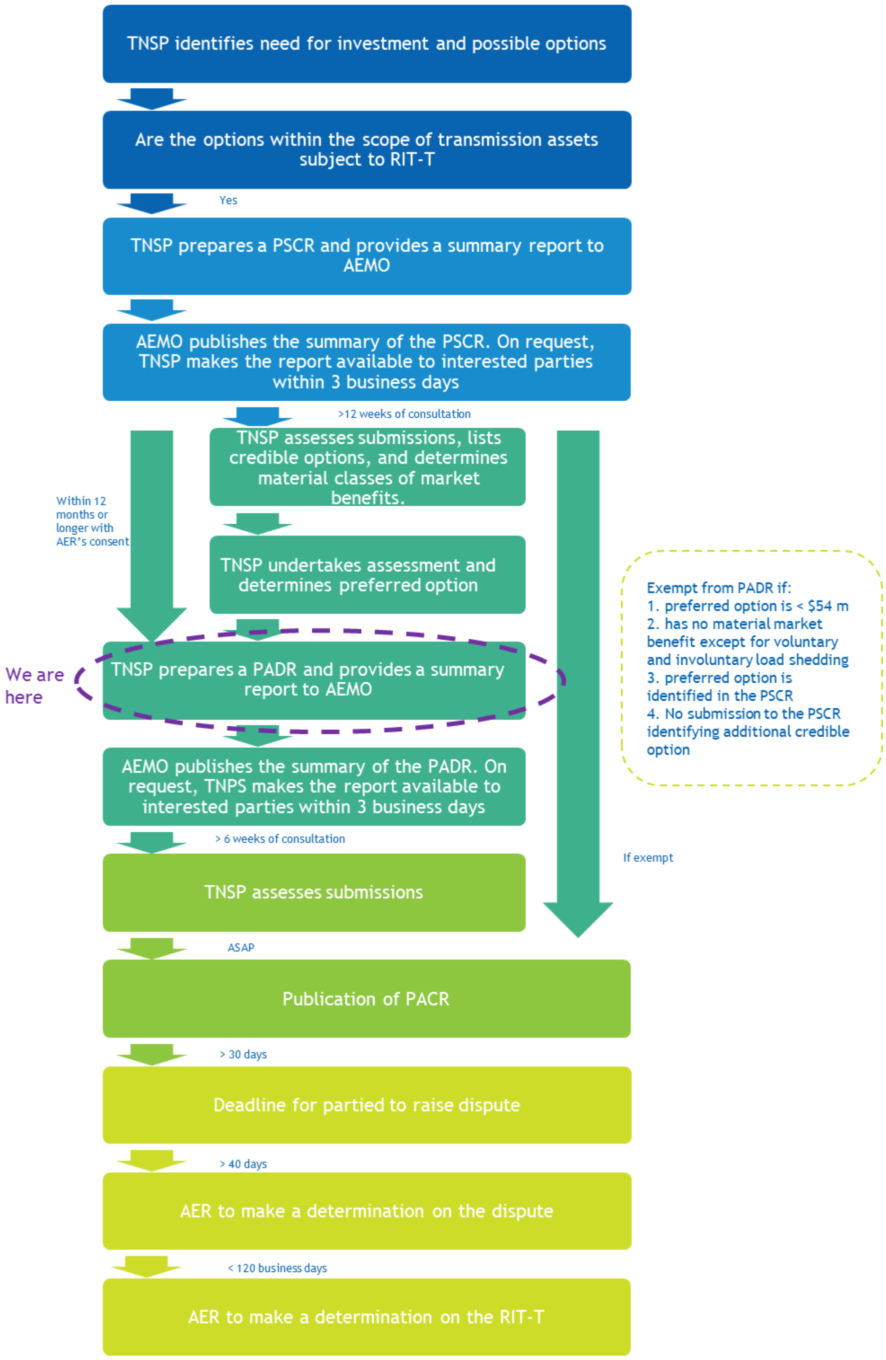
AusNet Services welcomes written submissions on the topics and the credible options presented in this PADR. Submissions should be emailed to rittconsultations@ausnetservices.com.au on or before 11 April 2025. In the subject field, please reference 'RIT-T – Maintaining reliable 330/220 kV transformation network services at SMTS'.

Submissions will be published on AusNet Services' and AEMO's websites. Please clearly stipulate at the time of lodgment should the submission not be made public.

Appendix A – Asset probability of failure methodology

Likelihood Estimation - Assessment Categories		
Category	**Description**	**Data Source**
Asset Life	Ratio of current service age to normal expected Life	Design, Maintenance records
Asset Utilisation/Duty factor	Loading, strength, capacity, number of operations	Maintenance records
Location factor	Corrosivity, geographic climate, environment	Design/Operations
Asset Physical Condition	Observed conditions, measured conditions	Inspections/Testing

Appendix B – RIT-T assessment and consultation process



AusNet

Level 31
2 Southbank Boulevard
Southbank VIC 3006
T +613 9695 6000
F +613 9695 6666
Locked Bag 14051 Melbourne City Mail Centre Melbourne VIC 8001
www.AusNetservices.com.au

Follow us on

@AusNetServices
@AusNetServices
@AusNet.Services.Energy

AusNet