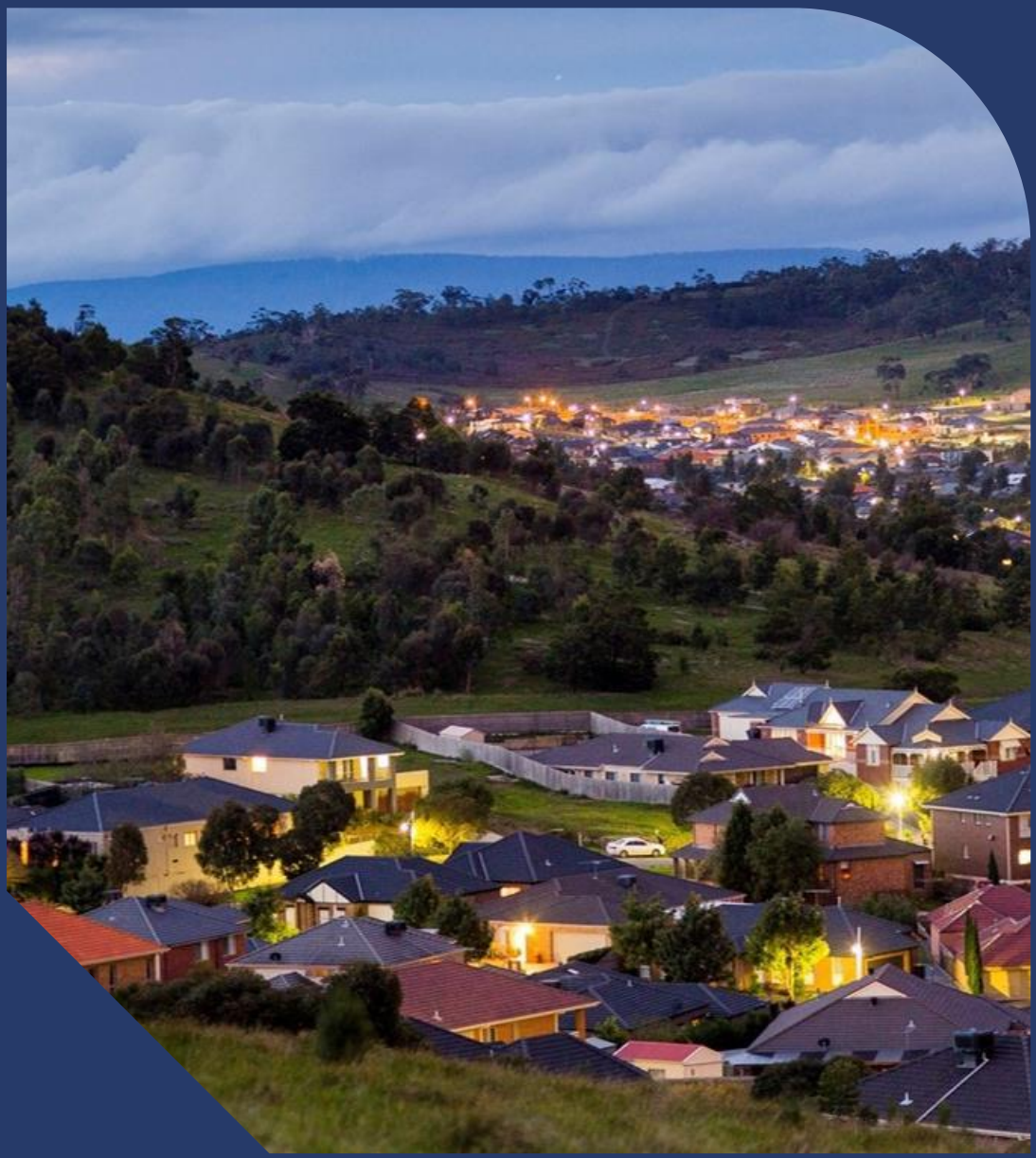
AusNet

Maintaining reliable transmission network services at Keilor Terminal Station

Regulatory Investment Test for Transmission (RIT-T)

Project Assessment Draft Report

May 2025



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1. Executive summary

Keilor Terminal Station (KTS) is owned and operated by AusNet Services and is in Keilor northwest of Melbourne's CBD. It was commissioned in 1970 and forms part of the main Victorian 500 kV and 220 kV transmission system with transformation from 500 kV to 220 kV and 220 kV to 66 kV.

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 KTS as the asset failure risk has increased to a level where investment to replace the selected assets presents a more economical option.

Three credible network options to replace the A2, A3 and A4 500/220 kV transformers and B4 220/66 kV transformer that are likely to deliver an economical solution to the identified need are considered in this RIT-T.

- Option 1 – Like for like replacement of the A2, A3 and A4 500/220 kV transformers
- Option 2 – Replacement of the A2, A3 and A4 transformers with standard metro 1000 MVA 500/220 kV transformers
- Option 3 – Deferred replacement with standard metro 1000 MVA 500/220 kV transformers

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

The preferred option to address the asset failure risk at KTS is Option 2. Option 2 includes replacing all three A transformers with 1000 MVA units and the B4 transformer with a 150 MVA 220/66 kV transformer by 2030.

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 30 June 2025. In the subject field, please reference 'RIT-T – Maintaining reliable transmission network services at KTS'. 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.

2. Introduction

This Regulatory Investment Test for Transmission (RIT-T) evaluates options to maintain reliable transmission network services at Keilor Terminal Station (KTS). 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 KTS 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

KTS is owned and operated by AusNet Services and is in the northwest of Greater Melbourne. KTS is one of the major terminal stations in Victoria with three voltage levels – 500 kV, 220 kV and 66 kV. Three 750 MVA 500/220 kV transformer and five 150 MVA 220/66 kV transformers are in services at KTS. KTS 66 kV supplies a total of approximately 196,275 customers in the areas of Sunbury, Sydenham, Tullamarine, Airport West, St. Albans, Woodend, Gisborne, Pascoe Vale, Essendon and Braybrook

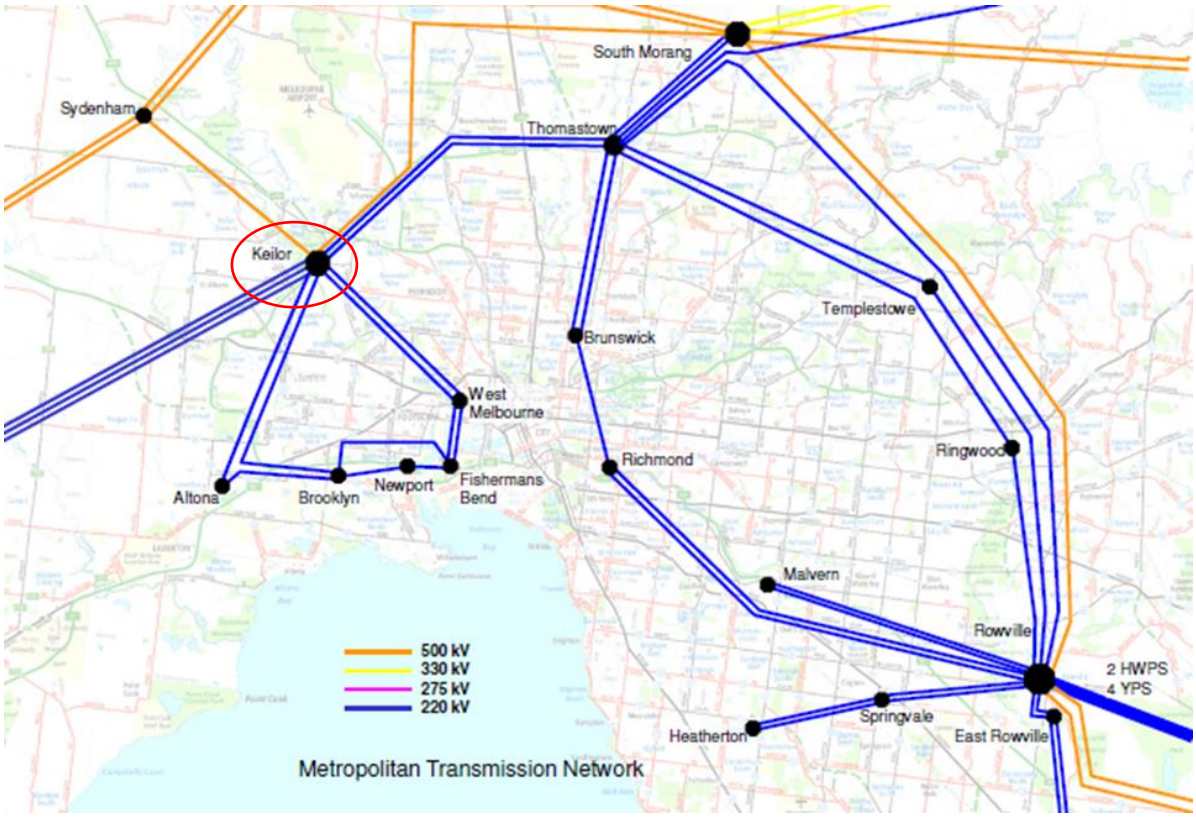


Figure 1 – KTS and the Victorian transmission network

3.2. Asset condition

The condition of the three 500/220 kV transformers (A2, A3 and A4) and one of the 220/66 kV transformers (B4) is in poor to very poor condition with increased risk of failure. Refurbishment is not an option as the core and windings of these transformers have been assessed to be in a poor to very poor condition.

4. Identified need

4.1. Description

KTS is part of the main transmission network which provides major transmission network services in Victoria. AusNet Services expects that the services that the terminal station provides will continue to be required given the transmission network developments that are foreshadowed in AEMO's Integrated System Plan and Victorian Annual Planning Report (VAPR) as well as the Distribution Business' Transmission Connection Planning Report (TCPR).

The poor condition of some of the components at the terminal station has increased the likelihood of asset failures. Such failures would result in prolonged outages.

Without remedial action, other than ongoing maintenance practice (business-as-usual), affected assets are expected to deteriorate further and more rapidly. This will increase the probability of asset failure resulting in a higher likelihood of an impact on users of the transmission network, heightened safety risks, increased environment risks, increased collateral damage risks to adjacent plant, and the risk of increased costs resulting from the need for emergency asset replacements and reactive repairs.

The 'identified need' this RIT-T intends to address is to maintain reliable transmission network services at KTS and to mitigate risks from asset failures.

AusNet Services calculated the present value of the baseline risk costs to be more than $1000 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.

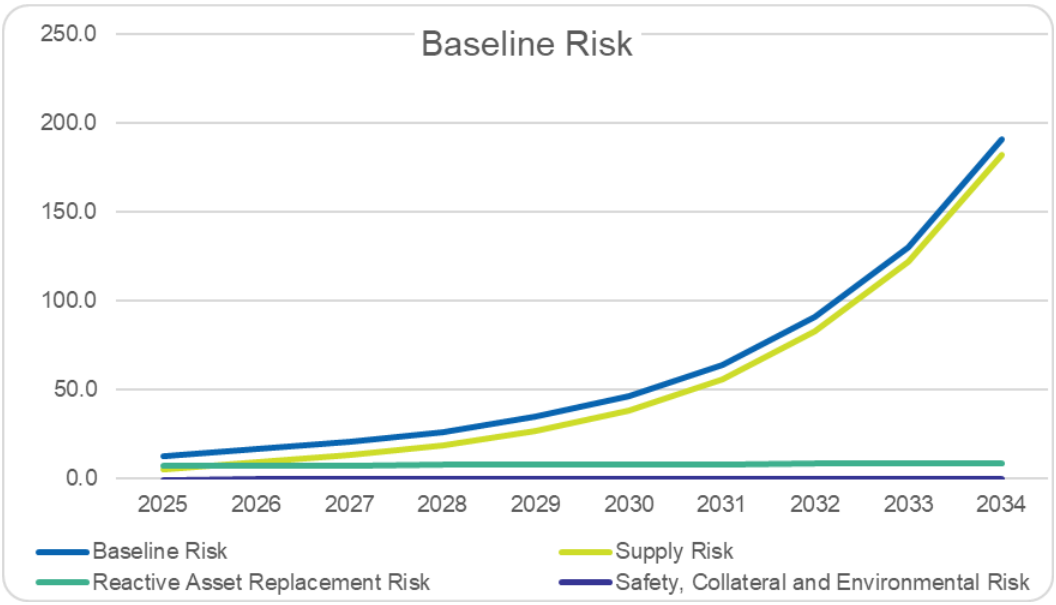


Figure 2 – Baseline risk

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	2025	2026	2027	2028	2029	2030	2031	2032
A2	7.2%	7.4%	7.6%	7.7%	7.9%	8.1%	8.3%	8.4%
A3	8.2%	8.4%	8.5%	8.7%	8.9%	9.1%	9.3%	9.4%
A4	5.8%	6.0%	6.1%	6.3%	6.4%	6.6%	6.8%	6.9%
B4	5.5%	5.7%	5.8%	6.0%	6.1%	6.3%	6.4%	6.6%

Table 1 –Transformer failure rates

The mean time to replace a transformer following a major failure has been assumed to be between 12 and 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 KTS. These studies use the latest assumptions from AEMO's Inputs Assumptions and Scenarios Report (IASR) and Connection point demand forecast.

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 KTS 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.

4.2.6. Approach to estimating option costs

The costs for each option have been calculated by AusNet's cost estimation team based on recent similar project costs and scope. Costs are expected to be within +/-25 per cent of the actual cost.

The costs presented are comprehensive including escalations, overheads and financing charges. All cost estimates are escalated to real 2025 dollars based on the information available at the time of preparing this report.

No contingency allowance has been included in the cost estimates.

We note that social license costs have not been included as they are not expected to be material for this RIT-T.

Operating and maintenance costs are negligible as far as this RT-T is concerned.

Where capital components have asset lives greater than ten years, we have adopted a residual value approach to incorporating capital costs in the assessment, which ensures that the capital costs of long-lived options are appropriately captured in the assessment period.

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: Like for like replacement of the A2, A3 and A4 500/220 kV transformers

Option 1 replaces the three 500/220 kV transformer banks with the same size and includes one spare phase. The B4 220/66 kV transformer is replaced with the same size transformer. The estimated capital cost of this option is $280.9 million and the change in operating and maintenance cost is negligible. The estimated project delivery time is 5 years.

5.2. Option 2: Replacement of the A2, A3 and A4 transformers with standard metro 1000 MVA 500/220 kV transformers

Option 2 replaces the three 500/220 kV transformer banks with 1000 MVA units. A spare is not needed as the larger units will allow for in-service spare capacity and a shared spare phase is also available from Moorabool Terminal Station. The B4 220/66 kV transformer is replaced with the same size transformer. The estimated capital cost of this option is $279.3 million and the change in operating and maintenance cost is negligible. The estimated project delivery time is 5 years.

5.3. Option 3: Deferred replacement with standard metro 1000 MVA 500/220 kV transformers

Option 3 is similar to Option 2 except it defers the investment with 5 years. It replaces the three 500/220 kV transformer banks with 1000 MVA units. A spare is not needed as the larger units will allow for in-service spare capacity and a shared spare phase is also available from Moorabool Terminal Station. The estimated capital cost of this option is $279.3 million and the change in operating and maintenance cost is negligible. The estimated project delivery time is 5 years.

5.4. Material inter-regional network impact

The proposed asset replacements at KTS 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. 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	70% of central assumption	Latest AER published VCR	130% of central assumption
Asset failure rate	75% of central assumption	Assessed failure rate	125% of central assumption
Demand Growth	95% of central assumption	AEMO Connection Point Forecast	105% 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	70% of estimated cost	Estimated cost	130% 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

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.

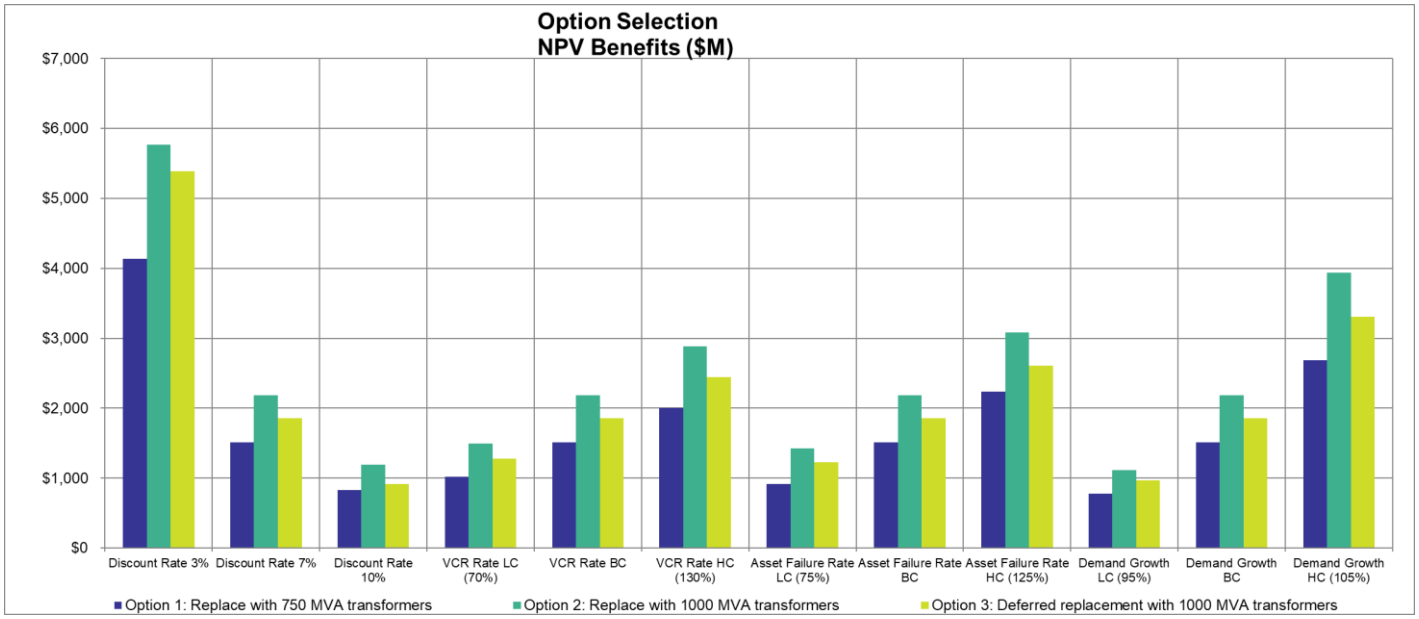


Figure 3 – Option selection and sensitivity study

7.1. Preferred Option

Option 2 (Replace with standard 1000 MVA transformers) has the highest net economic benefit for all the scenarios and sensitivities considered 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 all sensitivity studies considered.

7.2. 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 2028 and that investment is needed within the 2027 to 2032 regulatory control period.

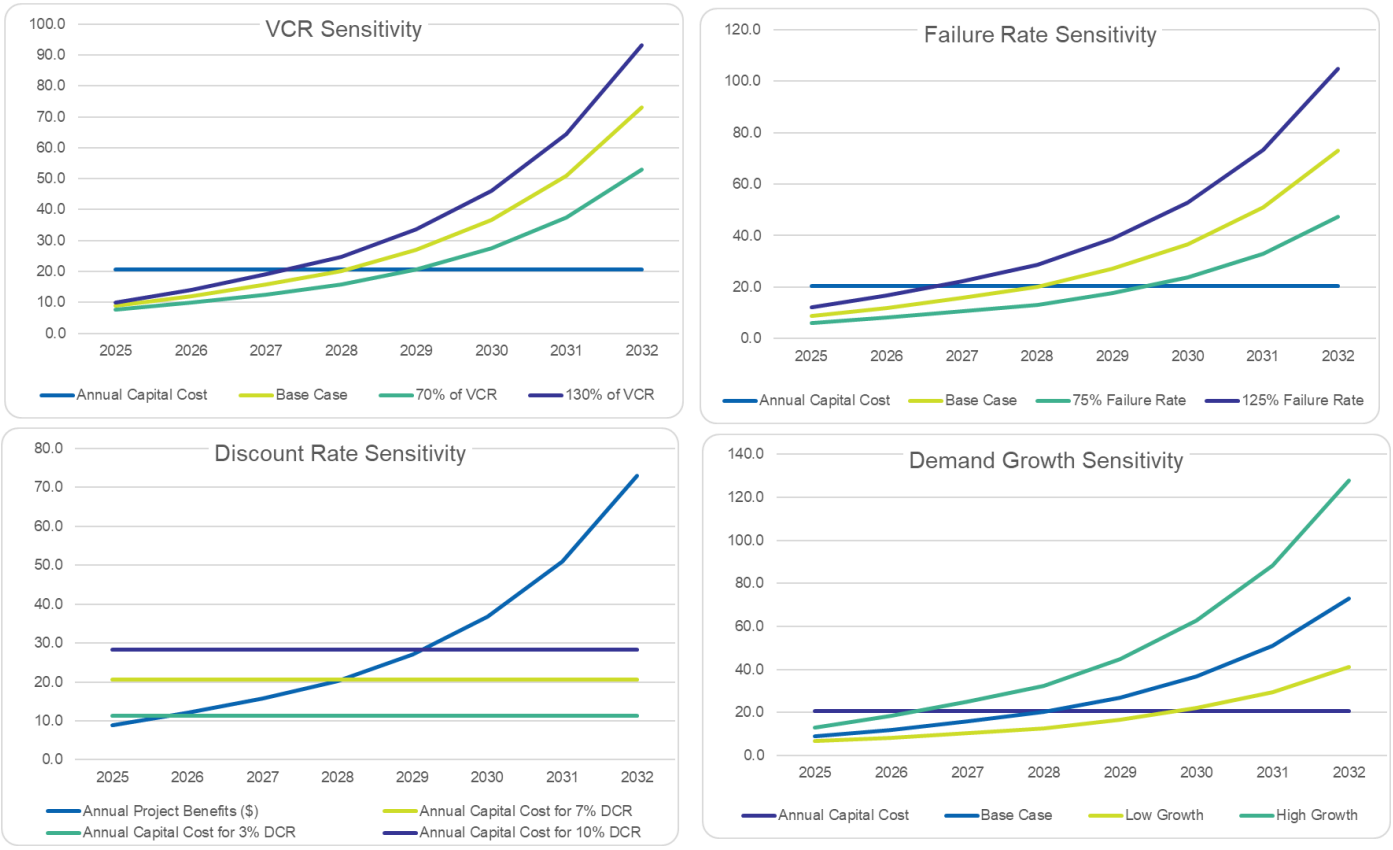


Figure 4 - Optimal investment timing sensitivity study

Figure 5 shows that the investment economic timing is only one year later for a 30% increase in investment cost.

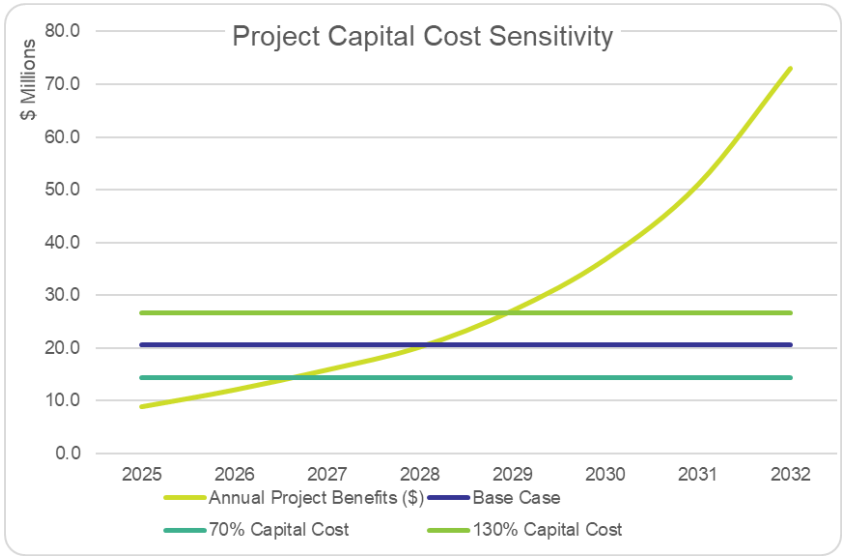


Figure 5 - Optimal investment timing sensitivity study – Capital cost

7.3. Capital and operating cost of the preferred option

The direct capital expenditure of the preferred option (Option 2) is $249.6 M and the main elements are as follows:

- Design and studies $5.3 million
- Internal labour $16.2 million
- Materials $129.1 million
- Plant and equipment $3.3 million

- Contracts $95.7 million
- Other including overheads and finance charges $29.7 million

7.4. Proposed RIT-T re-opening triggers

Under the updated Rules relating to a Material Change in Circumstance (MCC), AusNet is required to set out re-opening triggers for this RIT-T. Consistent with these new requirements and drawing on the results of the sensitivity assessments outlined, AusNet considered the impact of changes in key underlying assumptions to identify reopening triggers.

Since the cost of Option 1 is estimated to be slightly higher than Option 2 and the benefits of Option 2 is higher than Option 1 there need to be a reversal of these factors, or a significant change in one of the assumptions for the preferred option to change from what has been concluded in the RIT-T.

The proposed re-opening trigger for this RIT-T is as follows:

- AusNet will use the 2025 AEMO and 2025 Distribution Business (DB) demand forecasts once published in 2025 to assess whether the preferred option remains the same. Should both forecasts show that there will be either no load growth or negative load growth at the key terminal stations supplied from the Western Metropolitan 220 kV ring that includes the following stations – Keilor, West Melbourne, Fishermans Bend, Brooklyn and Altona – the reopening of this RIT-T reopening will be triggered.

Should these occur, AusNet would prepare a letter to the AER advising of actions proposed to take in response and timeframes to take such actions.

Consideration will also be given to any committed and sunk costs should the updated forecasts not be available before the project starts and costs are committed and whether new step loads such as data centres are probable but not included as committed projects in the official demand forecasts. This project plans to execute contracts for the replacement transformers by end 2025 (after the RIT-T process is expected to be finalised) by which time a change in the preferred option can no longer be made without incurring sunk costs.

8. Draft conclusion and next steps

Amongst the options considered in this RIT-T, Option 2 is the most economical option to maintain reliable transmission network services at KTS and manage safety, environmental, collateral and emergency replacement risks. The preferred option involves selective replacement of assets that are in poor condition, including three 500/220 kV transformers and one 220/66 kV transformer.

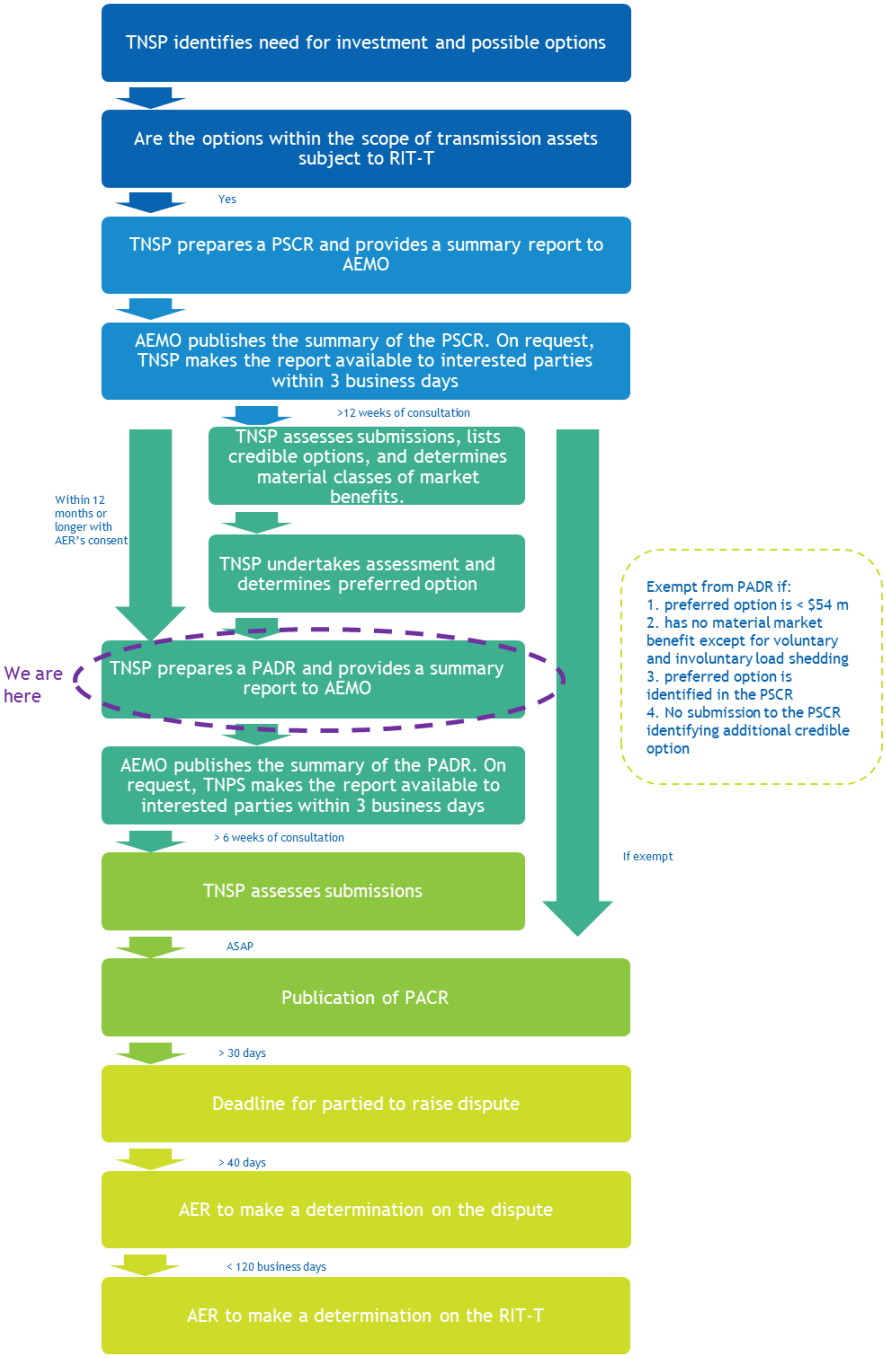
The estimated capital cost of this option is $279.3 million with no material change in operating and maintenance cost. The project is economic by 2028 based on a total investment cost of $279.3 million and AusNet Services is targeting a commissioning date of end 2030 given the project delivery lead time of 5 years from business case approval.

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 30 June 2025. In the subject field, please reference 'RIT-T – Maintaining reliable transmission network services at KTS'.

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 – RIT-T assessment and consultation process



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