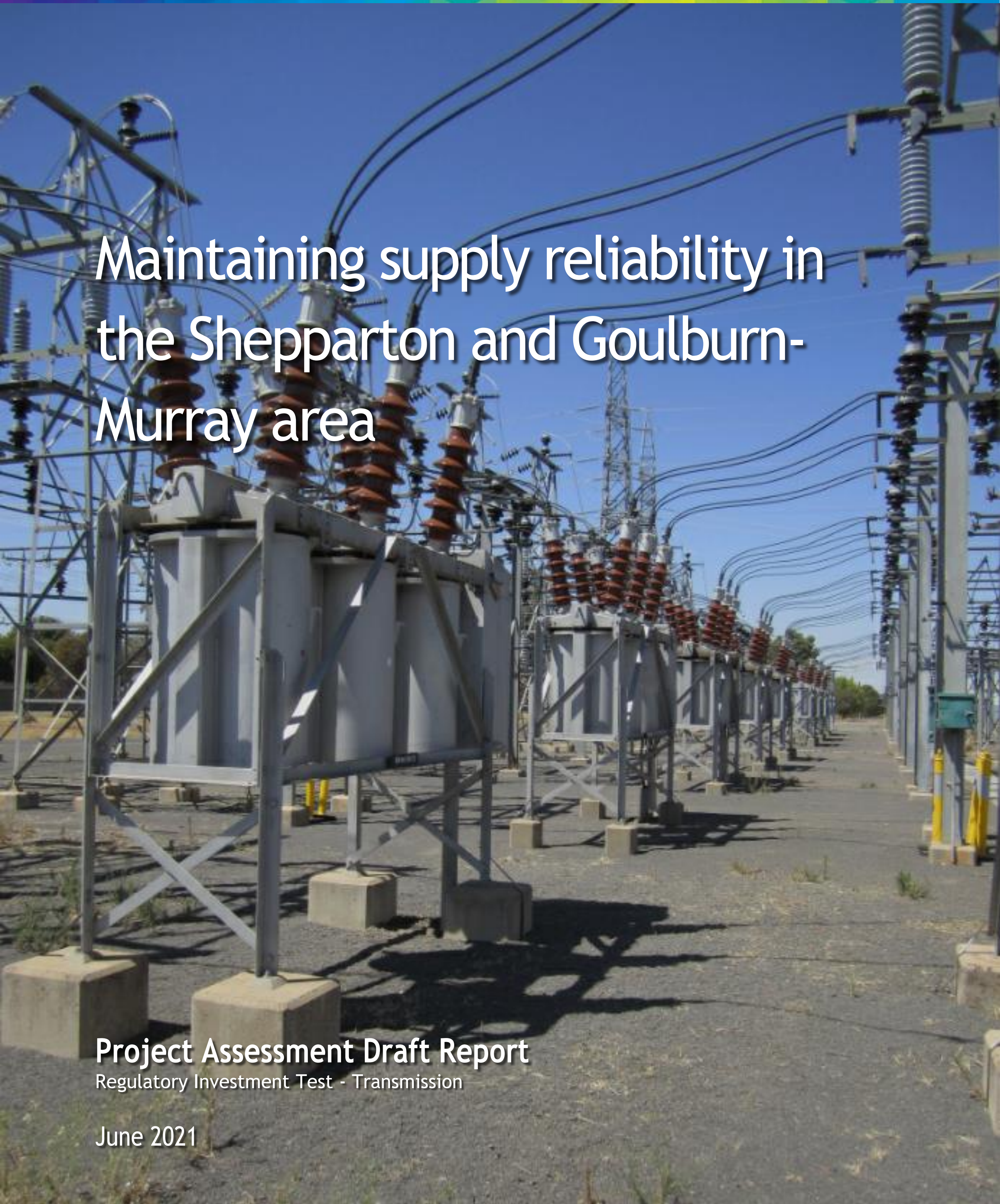

# Maintaining supply reliability in the Shepparton and Goulburn-Murray area

**Project Assessment Draft Report**

Regulatory Investment Test - Transmission

June 2021

# Important notice

## Purpose

AusNet Services has prepared this document to provide information about potential limitations in the Victoria transmission network and options that could address these limitations.

## Disclaimer

This document may or may not contain all available information on the subject matter this document purports to address. The information contained in this document is subject to review and may be amended any time.

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# Executive summary

AusNet Services is undertaking this Regulatory Investment Test for Transmission (RIT-T) to evaluate options to maintain supply reliability in the Shepparton and Goulburn-Murray area. Options investigated in this RIT-T will mitigate the risk of an asset failure at Shepparton Terminal Station.

The Project Specification Consultation Report (PSCR), which represents the first step in the RIT-T process in accordance with clause 5.16 of the National Electricity Rules (NER)[1] and section 4.2 of the RIT-T Application Guidelines[2] was published in December 2020. This report, the Project Assessment Draft Report (PADR), is the second stage of the RIT-T and provides information about the draft conclusions of the RIT-T.

Shepparton Terminal Station (SHTS) is owned and operated by AusNet Services and is located in Shepparton in Northern Victoria. It was commissioned in the late 1960's and serves as the main transmission connection point for distribution of electricity to approximately 72,525 customers. Peak demand at the station during the summer of 2020/21 reached 232.8 MW.

The RIT-T analysis shows that it is no longer economical to continue to provide supply with the existing assets at SHTS as the asset failure risk has increased to a level where investment to replace the selected assets presents a more economical option based on the value that consumers place on supply reliability (VCR).

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

The preferred option to address the asset failure risk at SHTS is an integrated replacement of two of the three 220/66 kV transformers and selected 66 kV switchgear.

## Identified need

As expected of assets that have been in service for an extended time, the condition of some of the transformers and circuit breakers at SHTS has deteriorated to a level where there is a material risk of asset failure, which could have an impact on electricity supply reliability, safety, environment, and potential costs of emergency replacements. Therefore, the 'identified need' this RIT-T intends to address is to maintain supply reliability in the Shepparton and Goulburn-Murray area and mitigate risks from asset failures.

The present value of the baseline risk costs associated with maintaining the existing assets in service is more than $48 million. Supply risk is the biggest component of the baseline risk and is borne by electricity consumers. AusNet Services is therefore proposing investment in asset replacement options that could allow continued delivery of safe and reliable electricity supply.

## Credible options

AusNet Services did not receive any proposals for non-network solutions and did not identify a credible, economical non-network solution for the identified need at SHTS.

The following network investments were evaluated and will deliver more economical and reliable solutions to maintaining supply reliability in the Shepparton and Goulburn-Murray area, compared with keeping the existing assets in service:

- Option 1 – Integrated replacement
- Option 2 – Staged replacement, with one transformer replacement deferred.

[1] Australian Energy Market Commission, *"National Electricity Rules Version 164"* available at https://www.aemc.gov.au/regulation/energy-rules/national-electricity-rules/current, viewed on 18 May 2021.
[2] Australian Energy Regulator, *"Application guidelines Regulatory investment test for transmission"* available at https://www.aer.gov.au/system/files/AER%20-%20Regulatory%20investment%20test%20for%20transmission%20application%20guidelines%20-%2025%20August%202020.pdf, viewed on 18 May 2021.

# Assessment approach

AusNet Services followed the AER's Industry practice application note for asset replacement planning to analyse and rank the economic cost and benefits of the investment options considered in this RIT-T.

None of the options considered will have a material impact on wholesale market cost and hence no market simulation studies have been conducted for this RIT-T. Scenario analysis as used in AEMO's Integrated System Plan (ISP) is not applicable for this RIT-T.

The robustness of the ranking and optimal timing of options have been investigated through sensitivity analysis that involve variations of assumptions around the values used in the base case.

# Options assessment and draft conclusion

AusNet Services' cost-benefit assessment confirms that an integrated replacement project that includes replacement of selected switchgear and both transformers that are in poor condition (Option 1) is the most economic option as it provides the highest present value of net economic benefits as illustrated by the results of the sensitivity analysis in Figure 1.

This option will not only maintain supply reliability, but also mitigates safety, environmental, and emergency replacement risk costs from deteriorating assets at SHTS.

The optimal timing of the preferred option is 2026/27 based on an estimated capital cost of $38.5 million.

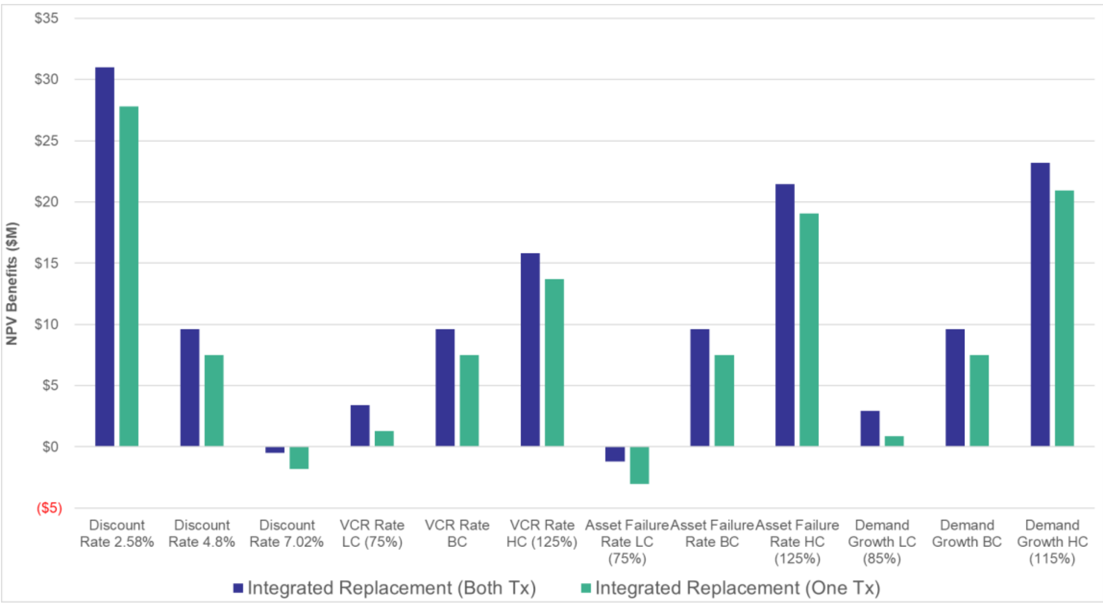


**Figure 1 - Option selection and sensitivity analysis**

# Submissions

AusNet Services welcomes written submissions on the issues and the credible options presented in this PADR. Submissions should be emailed to rittconsultations@ausnetservices.com.au on or before 23 July 2021. In the subject field, please reference 'RIT-T PADR Shepparton Terminal Station.'

# Next steps

Assessments of the options and responses to this PADR will be presented in the Project Assessment Conclusions Report (PACR) that is intended to be published before 20 August 2021.

## Table of Contents



## Figures

# Tables

# 1. Introduction

AusNet Services initiated this Regulatory Investment Test for Transmission (RIT-T) to evaluate options to maintain supply reliability in the Shepparton and Goulburn-Murray area given the poor condition of some of the assets at Shepparton Terminal Station (SHTS).

The Project Specification Consultation Report (PSCR) was published in December 2020 in accordance with clause 5.16 of the National Electricity Rules (NER)[3] and section 4.2 of the RIT-T Application Guidelines.[4] Publication of this Project Assessment Draft Report (PADR) represents the second step in the RIT-T process[5] and 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 SHTS is presented in AusNet Services Asset Renewal Plan that is published as part of AEMO's 2020 Victorian Annual Planning Report (VAPR)[6].

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[3] Australian Energy Market Commission, *"National Electricity Rules Version 164"* available at https://www.aemc.gov.au/regulation/energy-rules/national-electricity-rules/current, viewed on 18 May 2021.

[4] Australian Energy Regulator, *"Application guidelines Regulatory investment test for transmission"* available at https://www.aer.gov.au/system/files/AER%20-%20Regulatory%20investment%20test%20for%20transmission%20application%20guidelines%20-%2025%20August%202020.pdf, viewed on 18 May 2021.

[5] A RIT-T process will assess the economic efficiency and technical feasibility of proposed network and non-network options.

[6] Australian Energy Market Operator, *"Victorian Annual Planning Report"*. available at https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Victorian-transmission-network-service-provider-role/Victorian-Annual-Planning-Report, viewed on 18 May 2021.

# 2. Identified need

The role of SHTS in providing electricity supply services and the condition of key assets is discussed in this section. Quantification of the risk costs associated with the deterioration of these assets, and the need for the investments is also presented.

## 2.1. Supply to the Shepparton and Goulburn-Murray area

The 220/66 kV SHTS is owned and operated by AusNet Services and is in Shepparton, in Northern Victoria. Since it was commissioned in the late 1960's, SHTS served as the main transmission service connection point for distribution of electricity to communities in the towns of Shepparton, Echuca, Mooroopna, Yarrawonga, Kyabram, Cobram, Numurkah, Tatura, Rochester, Nathalia, Tongala, and Rushworth.[7]

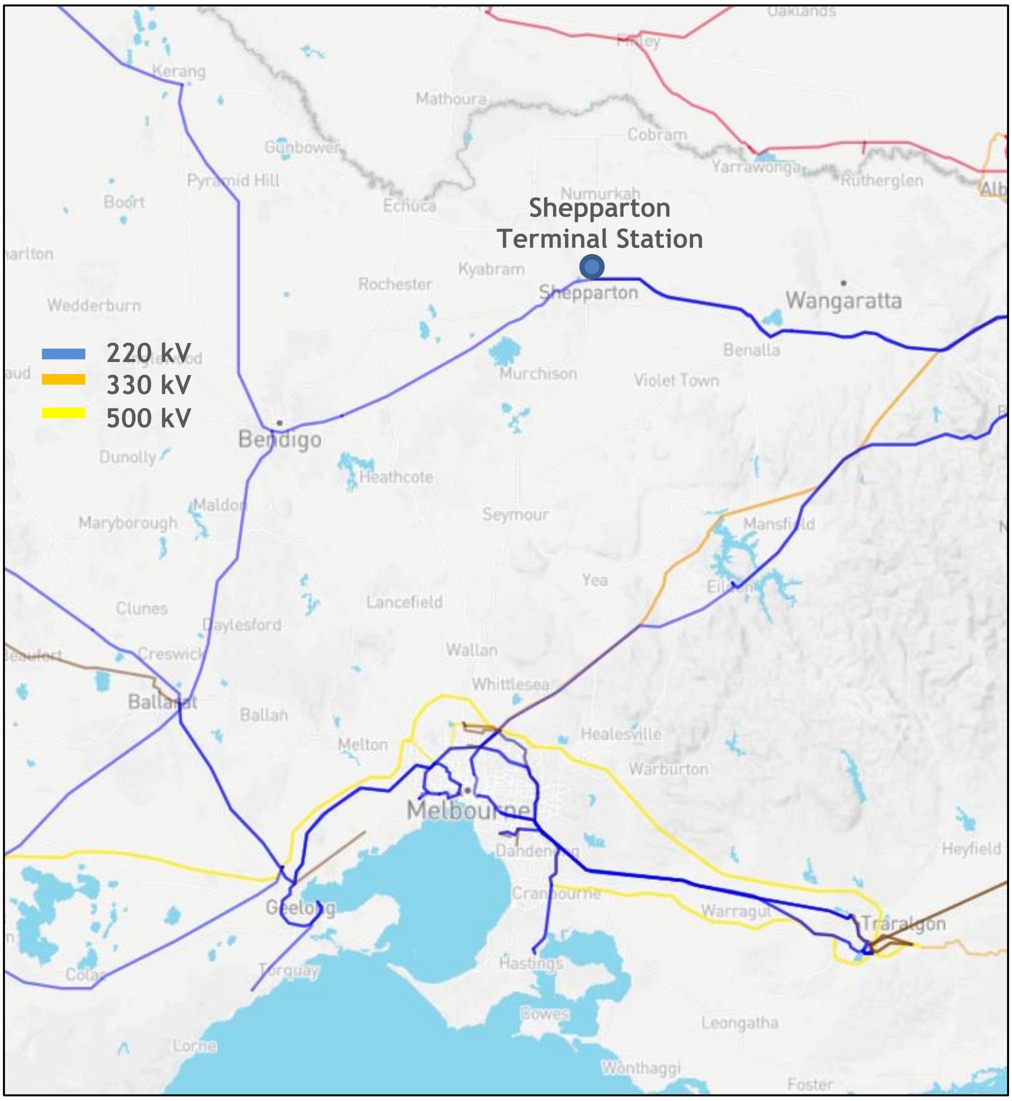


Figure 2 – Transmission network supplying Shepparton Terminal Station

[7] Powercor is responsible for distribution of electricity to relevant communities.

## Electricity demand

Approximately 72,525 customers depend on SHTS for their electricity supply. Commercial customers consume 56% and residential customers consume 27% of the total annual energy supplied at SHTS as illustrated in Table 1.

| Customer type | Share of consumption (%) |
|---|---|
| Commercial | 56% |
| Residential | 27% |
| Industrial | 9% |
| Agricultural | 9% |
| Total | 100% |

Table 1 - SHTS demand composition

Peak demand during the summer of 2020/21 at SHTS reached 232.79 MW. The Australian Energy Market Operator (AEMO) forecasts[8] that peak demand at SHTS will decrease at an average annual rate of 0.25% over the next nine years. Figure 3 shows the 10% probability of exceedance (POE10)[9] and the 50% probability of exceedance (POE50)[10] forecasts for peak demand during summer and winter periods.[11]

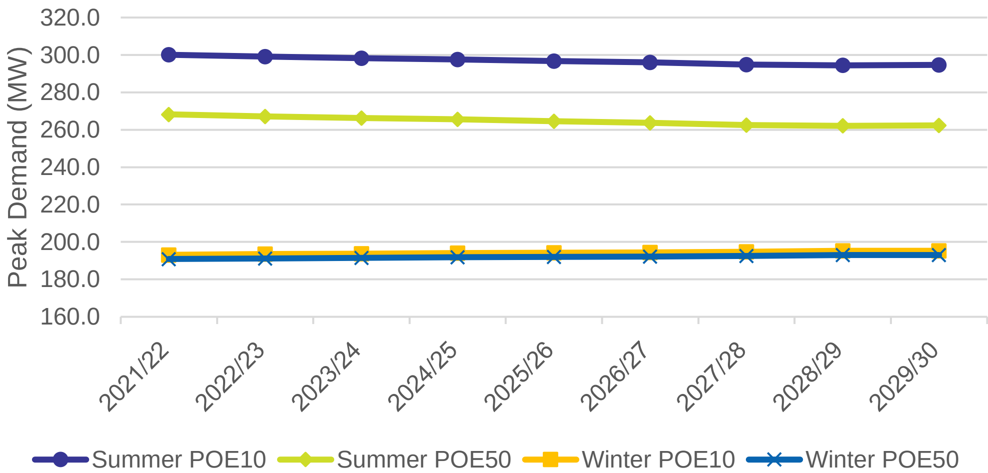


Figure 3 - Demand forecasts for Shepparton Terminal Station

AEMO and Powercor recognise there is an ongoing need for electricity supply services to communities in the Shepparton and Goulburn-Murray area as reflected in the various jurisdictional planning reports and demand forecasts.

[8] Australian Energy Market Operator (AEMO), *"2020 Transmission Connection Point Forecast for Victoria"* available at https://www.aemo.com.au/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-planning-data/transmission-connection-point-forecasting/victoria, viewed on 18 May 2021.

[9] A POE10 forecast indicates a level where there is 10 % likelihood that actual peak demand will be greater.

[10] A POE50 forecast indicates a level where there is 50 % likelihood that actual peak demand will be greater.

[11] Victorian electricity demand is sensitive to ambient temperature. Peak demand forecasts are therefore based on expected demand during extreme temperature that could occur once every ten years (POE10) and during average summer condition that could occur every second year (POE50).

## Embedded generation

There is one major embedded generator – the Numurkah Solar Farm - connected at SHTS 66 kV.

## Electricity network

SHTS sources its electricity supply from the 220 kV transmission network in the northern part of Victoria, as shown in Figure 1. It supplies nine 66 kV feeders (owned by Powercor) that distribute electricity to customers, as shown in Figure 4. The zone substations supplied from Shepparton Terminal Station include Kyabram (KYM), Echuca (ECM), Stanhope (SHP), Mooroopna (MNA), Shepparton (STN), Shepparton North (SHN), Numurkah (NKA) and Cobram East (CME).

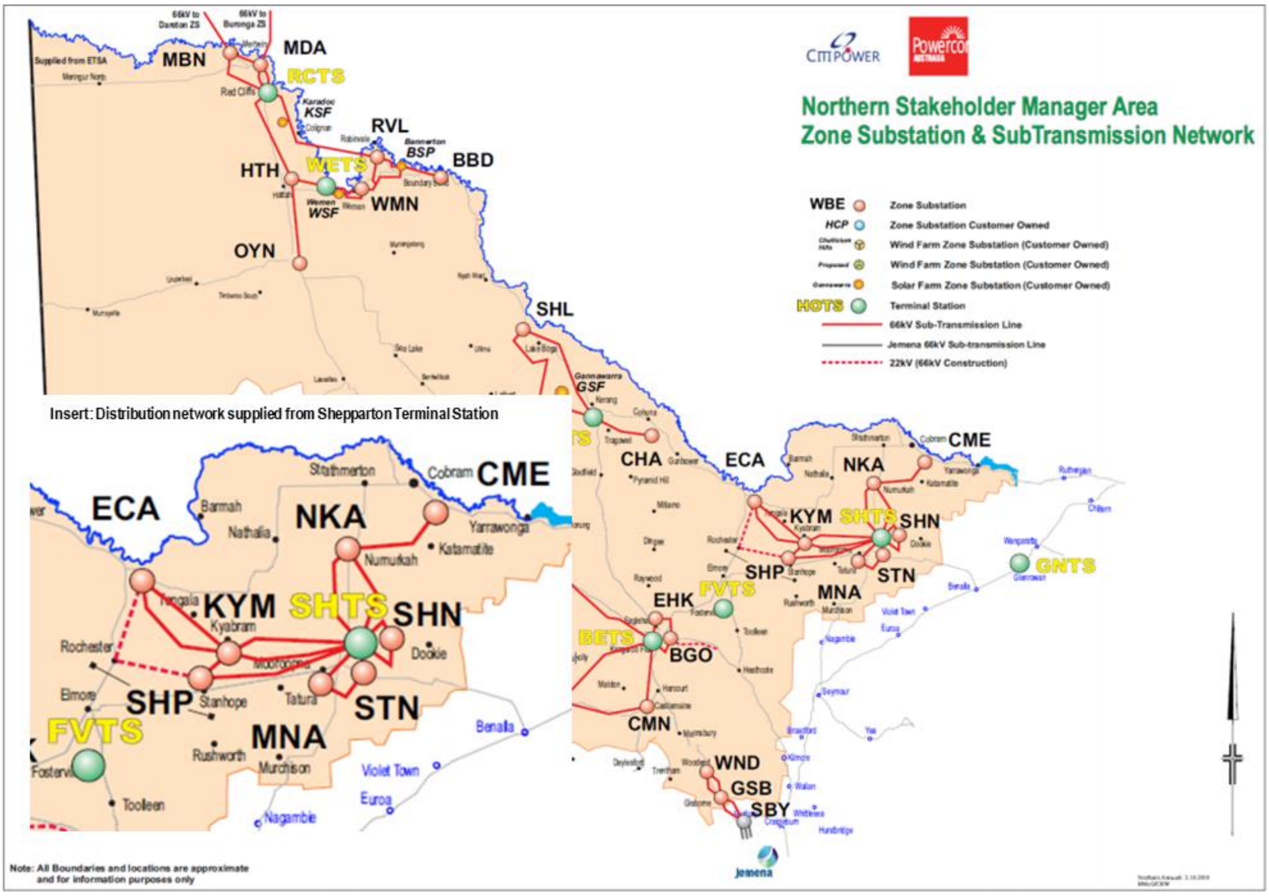


**Figure 4 – Distribution network supplied from Shepparton Terminal Station**

# 2.2. Asset condition

Several primary (power transformers and circuit breakers) and secondary (protection and control) assets at SHTS are in poor or very poor condition as expected of assets that have been in service for a long time.

AusNet Services classifies asset conditions using scores that range from C1 (initial service condition) to C5 (very poor condition) – as set out in Appendix C. The latest asset condition assessment for SHTS was conducted in 2019 and reveals some assets at the terminal station are in poor condition (C4) or very poor condition (C5). For the selected assets, the probability of failure is high, and is likely to increase further if no remedial action is taken. Table 2 provides a summary of the condition of relevant major equipment.

| Asset class | Condition scores | | | | |
|---|---|---|---|---|---|
| | C1 | C2 | C3 | C4 | C5 |
| Power transformers | 1 | | | 2 | |
| 66 kV circuit breakers | 4 | 10 | 4 | 7 | 5 |
| 66 kV current transformers | 3 | 10 | 26 | 7 | 0 |
| 66 kV voltage transformers | 9 | 25 | 32 | 9 | 1 |

**Table 2 - Summary of major equipment condition scores**

## Power transformers

There are three 150 MVA 220/66 kV transformers at SHTS. The B2 and B3 transformers were commissioned in late 1960's and are of a specific make and type that has significant design issues observed in the fleet of similar assets in AusNet Services' network. The B2 and B3 transformers have deteriorated significantly and according to the recent asset condition assessment report, are in poor condition. Assets in this condition (C4) requires remedial action within the next 2 to 10 years.

An investigation of a failure of a similar transformer in March 2016 revealed that it was as result of previous winding buckling, which is also a concern for the B2 and B3 transformers.

The 'B4' transformer is in very good condition and has a very low risk of failure.

AusNet Services considers that there is a high probability that a winding failure, major tap changer failure or bushing failure of either the B2 or B3 transformer will result in an extended service interruption and a subsequent need for emergency repairs or replacement. The probability of a transformer failure is forecast to increase over time as the condition of these two transformers deteriorates further.

## 66 kV circuit breakers

Twelve of the thirty 66 kV circuit breakers, including three bus tie circuit breakers, are in poor or very poor condition or have suffered extreme deterioration and are approaching their end of economic and technical life[12]. This is expected of assets that have been in service for a long time.

With condition scores of C4 and C5, these circuit breakers present challenges due to duty-related deterioration including erosion of arc control devices, bushing oil leakages, and wear of operating mechanisms and drive systems; intensive maintenance; lack of spares and manufacturer support; and lack of oil containment bunding.

## 66 kV instrument transformers

Several instrument transformers at SHTS are assessed to be in poor or very condition (C4 and C5). Management of safety risks from potential explosive failures[13] of instrument transformers of this type is costly due to the need for regular oil sampling and partial discharge condition monitoring.

# 2.3. Description of the identified need

SHTS provides electricity supply to the Shepparton and Goulburn-Murray area. AusNet Services expects that the services provided by the terminal station will continue to be required as shown by the demand forecast. However, the poor and deteriorating condition of some of the components at the terminal

[12] Australian Energy Regulator, *"Industry practice application note for asset replacement planning"* available at https://www.aer.gov.au/networks-pipelines/guidelines-schemes-models-reviews/industry-practice-application-note-for-asset-replacement-planning, viewed on 18 May 2021.

[13] Since 2002, two current transformers of this type have failed explosively in the Victorian network.

station has increased the likelihood of asset failures. Such failures would result in prolonged outages that could impact customers supplied from SHTS.

Without remedial action, other than ongoing maintenance practice (business-as-usual), the identified assets are expected to deteriorate further and more rapidly. This will increase the probability of failure, resulting in a higher likelihood of electricity supply interruptions, heightened safety risks due to potential explosive failure of the 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.

Therefore, the 'identified need' this RIT-T intends to address is to maintain supply reliability in the Shepparton and Goulburn-Murray area and to mitigate risks from asset failures.

The present value of the baseline risk costs is calculated to be more than $48 million over the forty-five-year period from 2021/2022. The key elements of the baseline risk are shown in Figure 5, with the largest component being the supply interruption risk that is borne by electricity consumers.

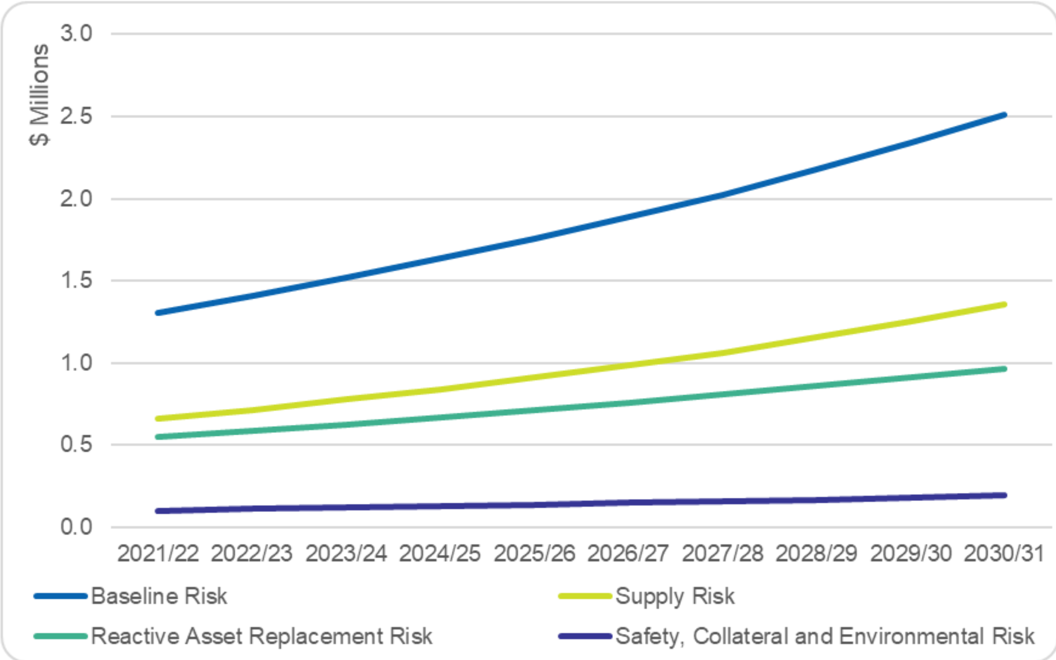


**Figure 5 - Baseline risk costs**

By undertaking one of the options identified in this RIT-T, AusNet Services will be able to maintain supply reliability in the Shepparton and Goulburn-Murray area and mitigate safety and environmental risks, as required by the NER and Electricity Safety Act 1998[14].

## 2.3.1. Assumptions

Aside from the failure rates (determined by the condition of the assets) and the likelihood of relevant consequences, AusNet Services has adopted further assumptions to quantify the risks associated with asset failure. These assumptions are detailed in the following subsections.

### Supply risk costs

In calculating the supply risk costs, AusNet Services has calculated the unserved energy based on the

[14] Victorian State Government, Victorian Legislation and Parliamentary Documents, *"Electricity Safety Act 1998,"* available at https://content.legislation.vic.gov.au/sites/default/files/2020-12/98-25aa081%20authorised.pdf, viewed on 18 May 2021.

most recent AEMO demand forecasts for Shepparton Terminal Station,[15] and has valued this expected unserved energy at an appropriate Value of Customer Reliability (VCR). The choice of VCR is based on those published by the AER and the composition of customers supplied by the terminal station. The resulting estimate of the weighted VCR applicable for affected customers at SHTS is $39,698/MWh.

The total supply risk cost is calculated by estimating the impacts of different combinations of relevant forced outages to reliability of supply and weighting them by their probabilities of occurrence.

## Safety risk costs

The Electricity Safety Act 1998[16] requires AusNet Services to design, construct, operate, maintain, and decommission its network to minimize 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.

In implementing this principle for assessing safety risks from explosive asset failures, AusNet Services uses:

- a value of statistical life[17] to estimate the benefits of reducing the risk of death;
- a value of lost time injury[18]; and
- a disproportionality factor[19].

AusNet Services notes this approach, including the use of a disproportionality factor, is consistent with the practice notes[20] provided by the AER.

## Financial risk costs

As there is a lasting need for the services that SHTS provides, the failure rate-weighted cost of replacing failed assets (or undertaking reactive maintenance) is included in the assessment.[21]

## 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 $30,000 per event while risks from transformers with oil containing poly-chlorinated biphenyls (PCB), such as those at SHTS, are valued at $100,000 per event.

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[15] Australian Energy Market Operator (AEMO), *"2020 Transmission Connection Point Forecast for Victoria"* available at https://www.aemo.com.au/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-planning-data/transmission-connection-point-forecasting/victoria, viewed on 18 May 2021.

[16] Victorian State Government, Victorian Legislation and Parliamentary Documents, *"Electricity Safety Act 1998,"* available at https://content.legislation.vic.gov.au/sites/default/files/2020-12/98-25aa081%20authorised.pdf, viewed on 18 May 2021.

[17] Department of the Prime Minister and Cabinet, Australian Government, *"Best Practice Regulation Guidance Note: Value of statistical life,"* available at https://www.pmc.gov.au/resource-centre/regulation/best-practice-regulation-guidance-note-value-statistical-life, viewed on 18 May 2021.

[18] Safe Work Australia, "The Cost of Work-related Injury and Illness for Australian Employers, Workers and the Community: 2012-13," available at https://www.safeworkaustralia.gov.au/system/files/documents/1702/cost-of-work-related-injury-and-disease-2012-13.docx.pdf, viewed on 18 May 2021.

[19] 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 public inquiry conducted between January 1983 and March 1985 into a proposal to construct a nuclear power station in the UK.

[20] Australian Energy Regulator, *"Industry practice application note for asset replacement planning,"* available at https://www.aer.gov.au/networks-pipelines/guidelines-schemes-models-reviews/industry-practice-application-note-for-asset-replacement-planning, viewed on 18 May 2021.

[21] The assets are assumed to have survived and their condition-based age increases throughout the analysis period.

# 3. Credible network options

AusNet Services considered both network and non-network options to address the identified need caused by the deteriorating assets at SHTS, but did not find any suitable non-network solution.

The two network options AusNet Services has identified are presented below.

## 3.1. Option 1 – Replace B2 transformer, B3 transformer and switchgear in an integrated project

Option 1 involves replacement of two 220/66 kV transformers, switchgear, and secondary assets in a single integrated project. It includes:

- Sequential replacement of the B2 and B3 transformers; and
- Replacement of twelve 66 kV circuit breakers and associated primary and secondary equipment.

The estimated capital cost of this option is $38.5 million with no material change in the operating cost. AusNet Services' preliminary analysis shows that the optimal timing is to deliver a solution by 2026/27.

## 3.2. Option 2 – Staged replacement with one transformer replacement deferred

Option 2 is a staged replacement option that would reduce the failure risk of the assets in a staged approach. In the first stage, the secondary assets and all deteriorated primary assets except one of the 220/66 kV transformers will be replaced. The remaining 220/66 kV transformer will then be replaced six years after the completion of the first stage.

The estimated capital cost of the first and second stage of this option is $33.4 million and $8.3 million respectively. The change in operating cost is negligible. AusNet Services' preliminary analysis shows that the optimal timing is to deliver a solution by 2026/27.

## 3.3. Material inter-regional network impact

As the 66 kV supply from SHTS is electrically radial, and the network impact is confined to the Shepparton and Goulburn-Murray area, none of the network options being 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."*

# 4. Assessment approach

Consistent with the RIT-T requirements and practice notes on risk-cost assessment methodology[22], AusNet Services undertook a cost-benefit analysis to evaluate and rank the net economic benefits of the 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 benefits from implementing the option become greater than the annualised investment costs.

## 4.1. Input assumptions and sensitivity studies

The robustness of the investment decision is tested using the range of input assumptions described in Table 3. This analysis involves variations of assumptions from those used for the base case.

**Table 3 - Input assumptions used for the sensitivity studies**

| Parameter | Lower Bound | Base Case | Higher Bound |
|---|---|---|---|
| Asset failure rate | AusNet Services assessment – 25% | AusNet Services assessment | AusNet Services assessment + 25% |
| Demand forecast | AEMO 2020 Transmission Connection Point Forecasts - 15% | AEMO 2020 Transmission Connection Point Forecasts | AEMO 2020 Transmission Connection Point Forecasts + 15% |
| Value of customer reliability | Latest AER VCR figures - 25% | Latest AER VCR figures | Latest AER VCR figures + 25% |
| Discount rate | 2.58% - the WACC rate of a network business | 4.80% - the latest commercial discount rate | 7.02% - a symmetrical adjustment upwards |

## 4.2. 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.

## 4.3. Other classes of benefits

Although not formally classified as classes of market benefits under the NER, AusNet Services expects material 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 of the options considered in this RIT-T.

[22] Australian Energy Regulator, *"Industry practice application note for asset replacement planning,"* available at https://www.aer.gov.au/networks-pipelines/guidelines-schemes-models-reviews/industry-practice-application-note-for-asset-replacement-planning, viewed on 18 May 2021.

## 4.4. Classes of market benefits that are not material

AusNet Services estimates that the following classes of market benefits are unlikely to be material for any of the options considered in this RIT-T:

- Changes in fuel consumption arising through different patterns of generation dispatch - as the network is sufficiently radial to the extent that asset failures cannot be remediated by re-dispatch of generation and the wholesale market impact is expected to be the same for all options.
- 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.
- 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.
- Competition benefits – there is no competing generation affected by the limitations and risks being addressed by the options considered for this RIT-T.
- 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.

# 5. Options assessment

This section presents the results of the economic cost benefit analysis and the economic timing of the preferred option.

All the options considered in this RIT-T will deliver a reduction in supply risk, safety risk, environmental risk, collateral risk and risk cost of emergency replacement in the event of asset failure.

Presented in Figure 6, the total risk cost reduction outweighs the investment cost for both options for most sensitivities where input variables are varied one at a time, except for the higher bound discount rate and lower bound asset failure rate.

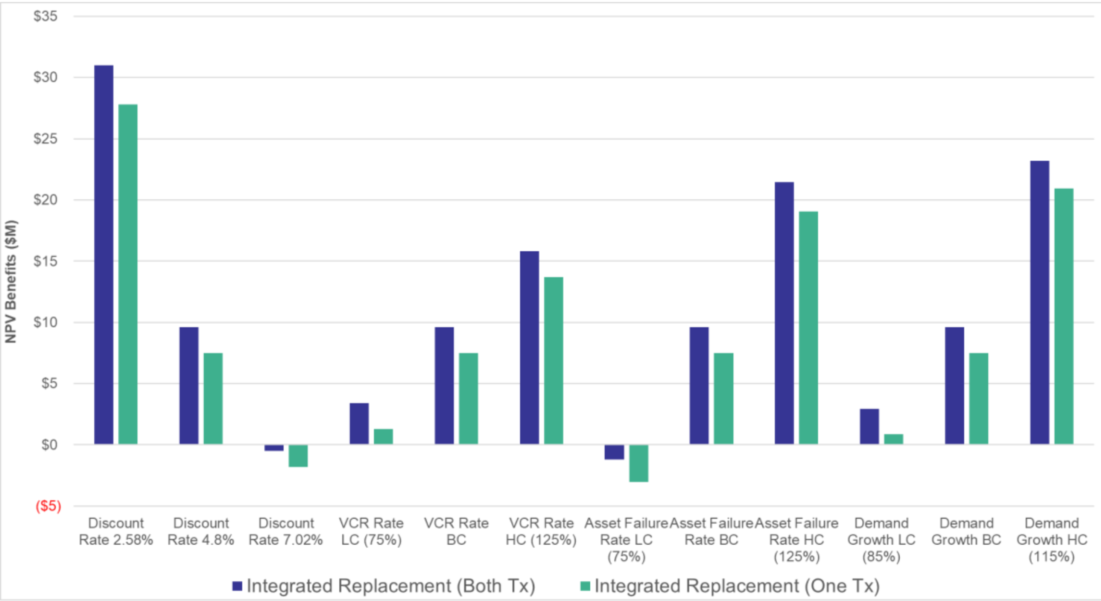


Figure 6 - Option selection and sensitivity analysis (NPV Benefits $M)

## 5.1. Preferred option

Option 1 (Integrated Replacement) has the greatest net economic benefit for most of the sensitivities considered and is therefore the preferred option.

## 5.2. Optimal timing of the preferred option

This section describes the optimal timing of the preferred option for different assumptions of key variables. Figure 7 shows that the economical time for the preferred option - Option 1 is 2026/27 for the base case assumptions.

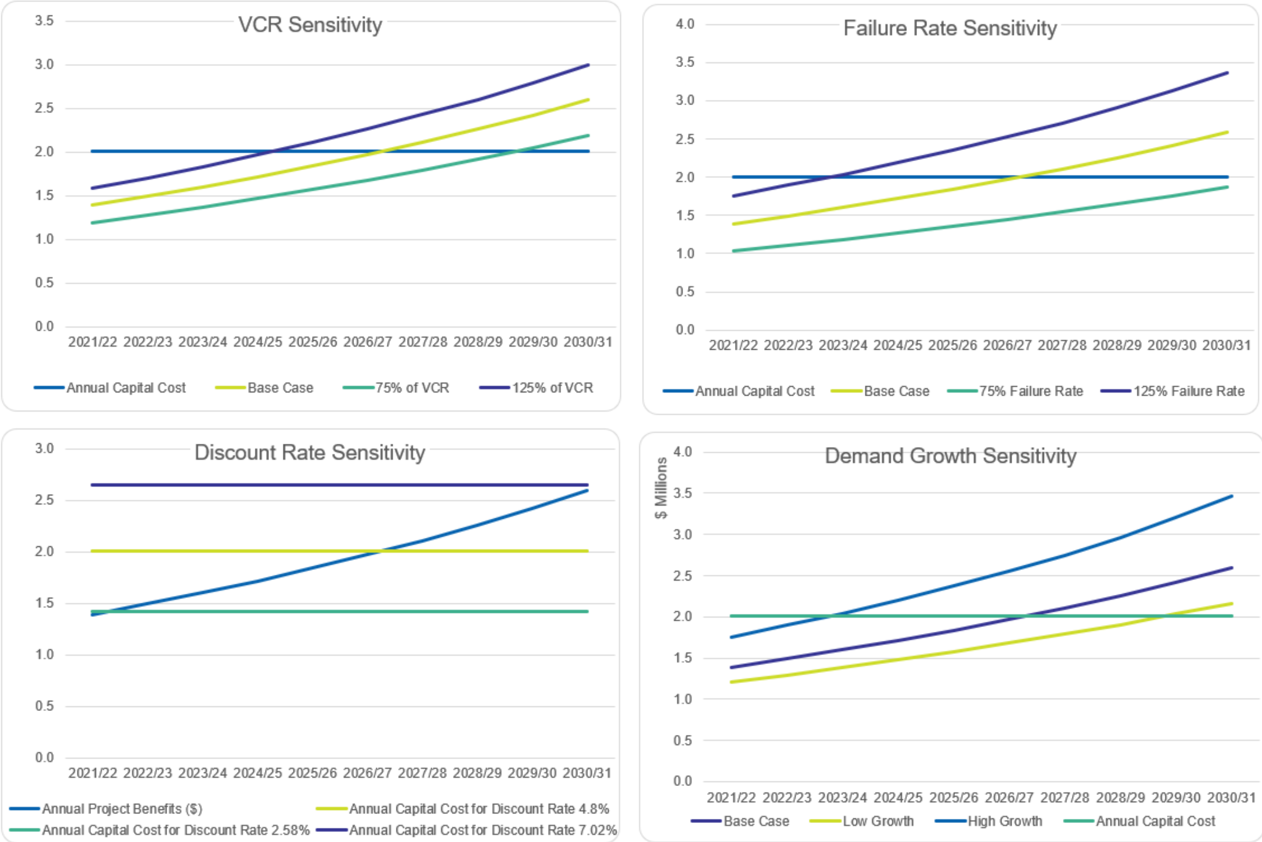


**Figure 7 - Sensitivity of the optimal timing with respect to variation of key parameters**

# 6. Draft conclusion and next steps

Amongst the options considered in this RIT-T, Option 1 is the most economical option to maintain supply reliability in the Shepparton and Goulburn-Murray area and manage safety, environmental and emergency replacement risks at Shepparton Terminal Station.

This preferred option involves the following scope of work in a single integrated project:

- Sequential replacement of the B2 and B3 transformers; and
- Replacement of twelve 66 kV circuit breakers and associated primary and secondary equipment.

The estimated capital cost of this option is $38.5 million with no material change in operating cost.

Based on AusNet Services' preliminary analysis, this option is economical to proceed by 2026/27.

## 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 23 July 2021. In the subject field, please reference 'RIT-T PADR Shepparton Terminal Station.'

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 lodgment.

# Appendix A - RIT-T assessment and consultation process

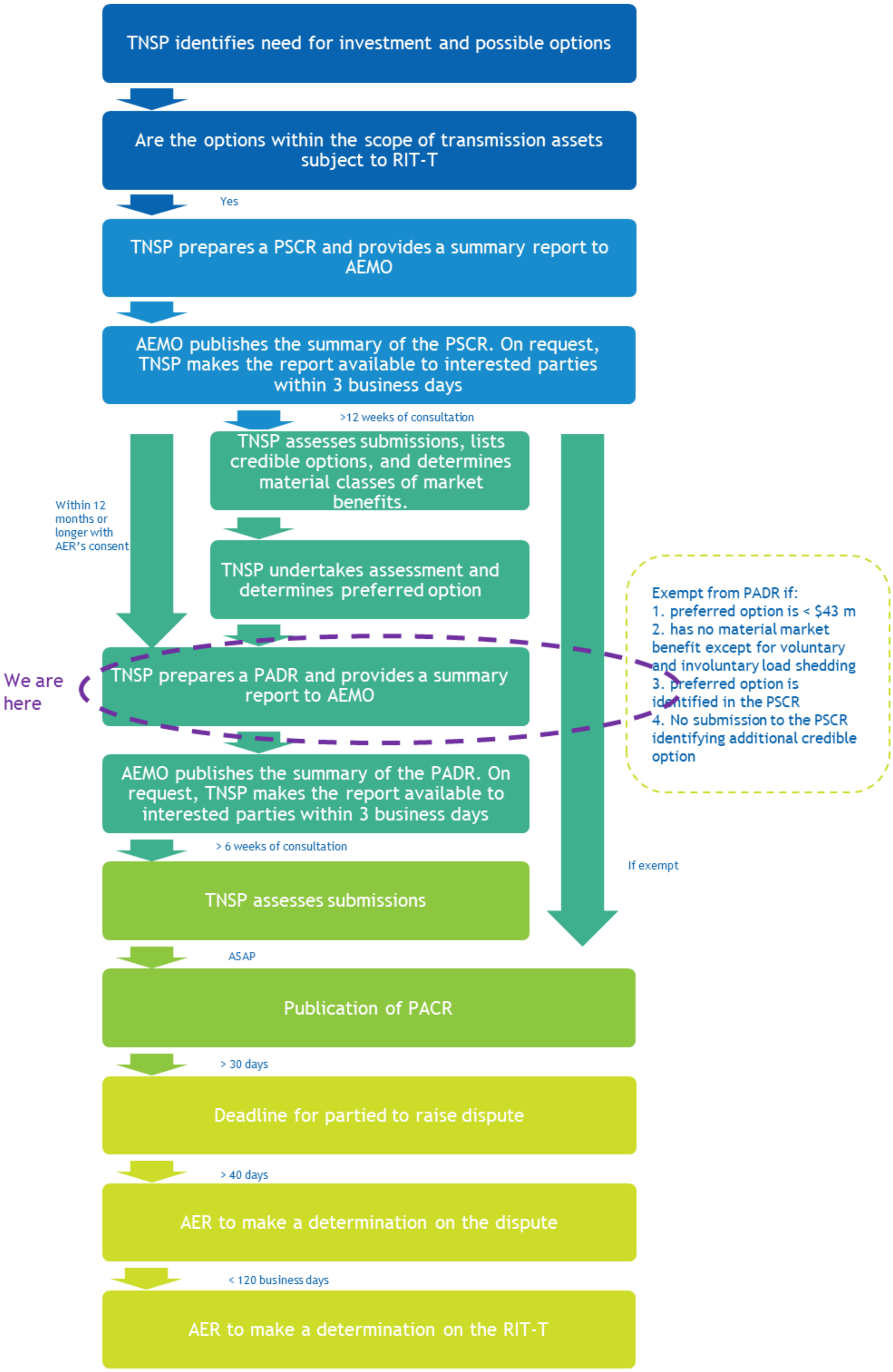


Figure 8 - RIT-T Process

# Appendix B - Asset condition framework

AusNet Services uses an asset health index, on a scale of C1 to C5, to describe asset condition. The condition range is consistent across asset types and relates to the remaining service potential. The table below provides an explanation of the asset condition scores used.

Table 4 - Condition scores framework

| Condition score | Likert scale | Condition description | Recommended action | Remaining service potential (%) |
|---|---|---|---|---|
| C1 | Very Good | Initial service condition | No additional specific actions required, continue routine maintenance and condition monitoring | 95 |
| C2 | Good | Better than normal for age | | 70 |
| C3 | Average | Normal condition for age | | 45 |
| C4 | Poor | Advanced deterioration | Remedial action or replacement within 2-10 years | 25 |
| C5 | Very Poor | Extreme deterioration and approaching end of life | Remedial action or replacement within 1-5 years | 15 |

## Asset failure rates

AusNet Services uses the hazard function of a Weibull two-parameter distribution to estimate the probability of failure of an asset in a given year. The asset condition scores are used to establish a condition-based age which is used to calculate the asset failure rates using a two-parameter Weibull Hazard function (h(t)), as presented below.

$$h(t) = \beta.\frac{t^{\beta-1}}{\eta^{\beta}}$$

Equation 1: Weibull Hazard Function

where:

t = Condition-based age (in years)

η = Characteristic life (Eta)

β = Shape Parameter (Beta)

Hazard functions are defined for the major asset classes including power transformers, circuit breakers, and instrument transformers. All assets in the substation risk-cost model use a Beta (β) value of 3.5 to calculate the failure rates. The characteristic life represents that average asset age at which 63% of the asset class population is expected to have failed.

The condition-based age (t) depends on the specific asset's condition and characteristic life (η).