AusNet

# Transmission Revenue Reset 2027 to 2032 (TRR 2027-32)

## Planning Report: Rowville GIL Replacement Project

Date: October 2025

AusNet

# Table of contents

# 1. Executive summary

There are two 300 m long gas insulated lines (GIL) at Rowville Terminal Station (ROTS) – Rowville to Thomastown 220 kV and Rowville to South Morang 500 kV. The Rowville to Thomastown GIL is insulated for 500 kV operation but is only used at 220 kV presently. Rowville to South Morang 500 kV is insulated for and operated at 500 kV. The main function of the 300 m long GILs are to avoid overhead line crossings within the terminal station.

Line crossings present a system security risk as a conductor drop from an overhead line crossing above another overhead line could impact the overhead line below it. AEMO's network planning standard is to plan and design the transmission network such that there is no overhead line span in the Victorian transmission network that cross above more than one other overhead line. The two GIL sections at ROTS ensures that AusNet complies with the planning standard given the large number of lines that connect at ROTS.

Both GILs are in a poor to very poor condition and have a history of frequent SF6 (sulphur hexafluoride) gas leaks. The chance of failure of the two GIL assets is forecast to increase, which poses the following major risks:

- Transmission system security risk, including involuntary load shedding when the ROTS-SMTS circuit is unavailable for service due to a GIL outage
- environmental risk as SF6 is a potent greenhouse gas
- financial risk as more expensive reactive replacement and/or repairs will be required following a failure

An economic cost benefit analysis concluded that it is economic to replace these two GILs based on the avoided market impact (including involuntary load shedding) and environmental risk cost.

The preferred replacement option is to replace the GIL circuit to TTS with a 220 kV underground cable, and the ROTS-SMTS GIL circuit with an above ground 500 kV cable, at an estimated cost of $62.3 million. This solution allows for the 220 kV underground cable to be replaced with a 500 kV cable in the future, when required for 500 kV operation, and thereby deferring the higher cost of a 500 kV cable until that need arises. Joint planning with AEMO established that 500 kV operation of the ROTS-TTS circuit is not expected in the next ten years.

The economic timing for this investment is 2029 and all expenditure for this investment will fall within the next transmission regulatory control period.

# 2. Background

There are two gas insulated lines (GIL) at Rowville Terminal Station (ROTS) – Rowville to Thomastown 220 kV and Rowville to South Morang 500 kV. The main function of the two 300 m long GILs is to avoid overhead line crossings as shown in Figure 1 where multiple 220 kV lines (blue lines) are crossing the two GILs. The two GIL sections (Rowville to Thomastown 220 kV and Rowville to South Morang 500 kV) at ROTS allows for multiple 220 kV lines supplying Springvale, Heatherton, East Rowville, Ringwood, Templestowe, Richmond and Malvern to cross the GIL sections safely and avoid a scenario where a conductor drop would result in multiple 220 kV lines below being impacted. This arrangement is compliant with the network security standard used by AEMO to plan and design the Victorian Transmission Network and which limits the collateral impact of a conductor drop to only one line where two lines cross paths.


**Figure 1: Aerial view of ROTS (left side) and closer view of the two GILs (right side)**

The ROTS-TTS line is insulated for 500 kV operation from ROTS to SMTS including the GIL section at ROTS but is operated at 220 kV. AEMO plans to use it for 500 kV operation in 10 to 15 years' time. The ROTS-SMTS line is operated at 500 kV and is more critical than the ROTS-TTS line as it is a key link of the Victorian 500 kV backbone. Figure 2 shows the Metropolitan Melbourne transmission network and the ROTS-TTS 220 kV and ROTS-SMTS 500 kV lines.

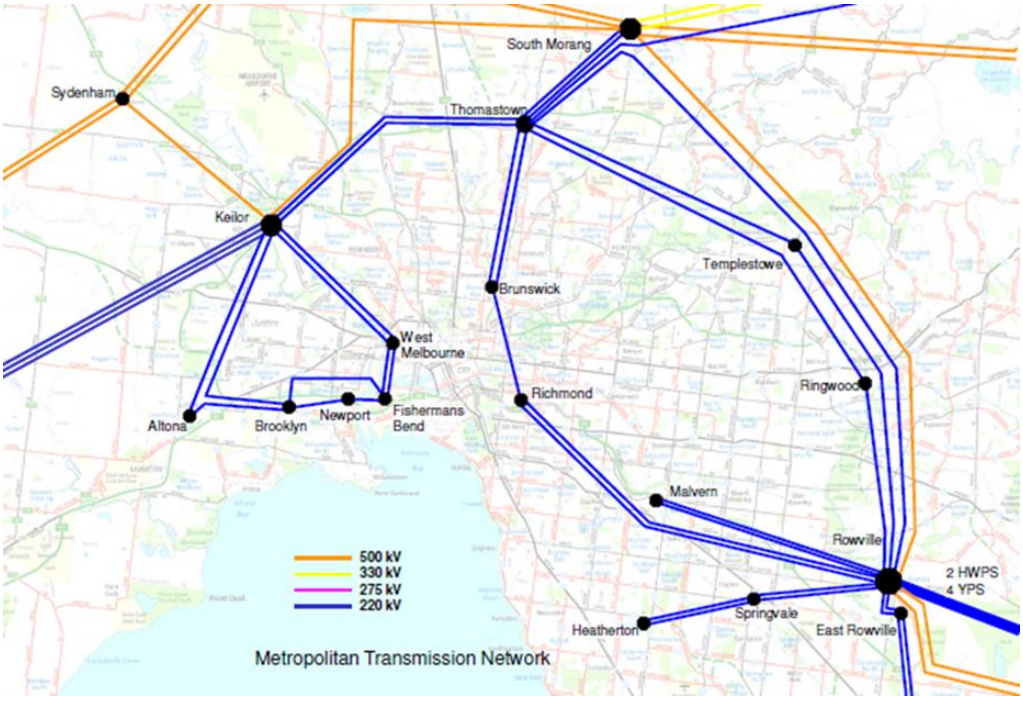


**Figure 2: Metropolitan Melbourne transmission network**

Both GILs are in a poor to very poor condition and have a history of frequent SF6 (sulphur hexafluoride) gas leaks. The chance of failure of the two GIL assets is forecast to increase, which poses the following major risks:

- Transmission system security risk, including involuntary load shedding when the ROTS-SMTS circuit is unavailable for service due to a GIL outage
- environmental risk as SF6 is a potent greenhouse gas
- financial risk as more expensive reactive replacement and/or repairs will be required following a failure

# 3. Asset Condition

The ROTS GIL systems are now 40 years old and are at the end of their expected technical life. There has been an increase in mechanical issues, gas leaks and failures on the system over the past decade including:

- an internal 500 kV flashover on one GIL phase in 2022
- a significant gas leak in 2023, which revealed cracks developing in the metal surface of the aluminium pipework

Limited generic technical support in terms of maintenance and repair is available from the original equipment manufacturer (OEM), however factory trained expertise on the equipment is no longer accessible, and it's not possible to source OEM components. The recent failure events highlighted this limited access to specialist support and availability of spares.

Repair efforts for the ROTS GIL system began in 2017 to fix gas leaks and keep the system running safely. These finished in 2022 but leaks in the surface of metal pressure vessels were subsequently found. Since 2023, work has started on installing jackets around the vessels to address these problems. So far, only one phase is finished, with six more to go. Progress is slow due to limited opportunities for network outages, and it could take up to five years to complete all repairs.

Whilst small leaks can be adequately managed with the gas monitoring system installed and top ups, the risk of a substantial leak requiring de-energisation of the line is a probable risk. The GIL system will continue to operate with ongoing repairs until it is replaced, which may not be a sustainable long-term approach from an economic perspective.

It is estimated there will be a 50% probability of significant failure, which will be difficult to recover from by mid-2029. This information has been incorporated into Probability Failure (PoF) and Consequence of Failure (CoF) analysis that forms part of the assessment for this investment decision.

Table 1 shows the forecast failure rates used for the ROTS GILs.

| Year | Major failures per year (λ) | Minor failures per year (λ) |
|---|---|---|
| 2026 | 0.021 | 0.163 |
| 2027 | 0.023 | 0.178 |
| 2028 | 0.025 | 0.192 |
| 2029 | 0.027 | 0.207 |
| 2030 | 0.029 | 0.221 |
| 2031 | 0.030 | 0.236 |
| 2032 | 0.032 | 0.250 |

**Table 1: 220kV GIS CB forecast failure rates**

Further information can be found in the ROTS 500kV GIL Replacement - Asset Condition Report.

# 4. Identified need

A reliable service from the two GILs at Rowville is essential to maintain the integrity of both the Rowville to Thomastown and Rowville to South Morang lines. The Rowville to Thomastown line is part of the Eastern Metropolitan 220 kV Ring, while the Rowville to South Morang line is part of the 500 kV Latrobe Valley to Melbourne flow path with two 500 kV lines on the Northern easement and two 500 kV lines on the Southern easement. The Rowville to South Morang 500 kV line is the last section of the two 500 kV lines forming the southern flow path. An outage of the ROTS-SMTS GIL will reduce the transmission capacity between the Latrobe Valley and Metropolitan Melbourne and involuntary load shedding will be needed at times of high demand to ensure that the Victorian Transmission network is operated withing AEMO's network secure operational standard[1].

The poor condition, of the GILs has increased the likelihood of one or both Rowville to Thomastown and Rowville to South Morang lines being unavailable for service.

Without remedial action, other than ongoing maintenance practice (business-as-usual), the GILs are expected to deteriorate further and more rapidly. This will increase the likelihood of a GIL failure that will in turn result in generation constraints, increasing wholesale market cost, and involuntary load shedding due to prolonged outages of the Rowville to Thomastown and Rowville to South Morang lines.

Minor and major failures of the GILs result in SF6[2] (sulphur hexafluoride) leakages with consequent environmental impact which has been valued as per the AER's "Valuing Emissions Reduction" guidance and explanatory statement[3].

The 'identified need' this project intends to address is to maintain reliable transmission network services at ROTS (ROTS-TTS and ROTS-SMTS lines) and reduce SF6 gas leakages.

The baseline risk for the two GILs are shown in Figure 3 with the blue line showing the forecast increased involuntary load shedding that would be required should no proactive investment be made to manage the risk of a GIL failure at ROTS.

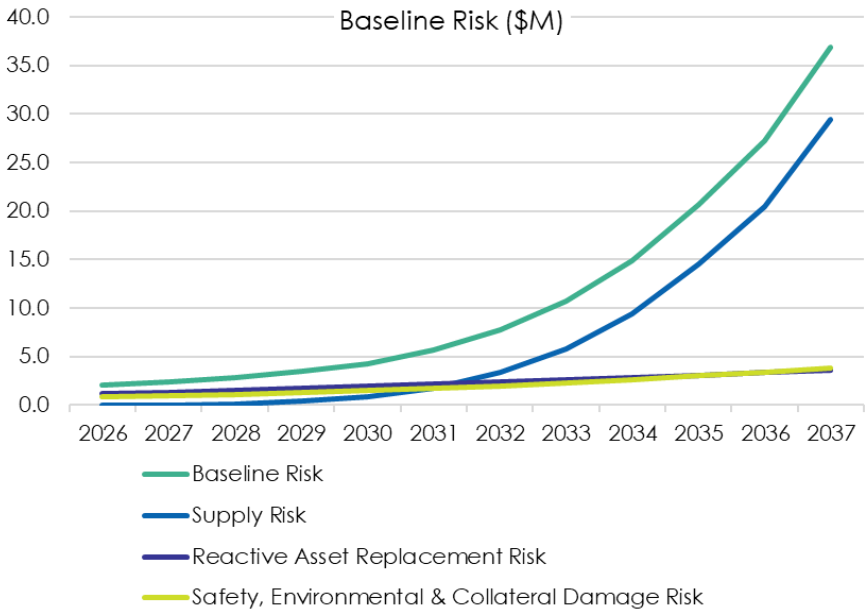


**Figure 3: Baseline risk**

[1] Network studies identified voltage collapse occurring during high demand periods when the ROTS-SMTS circuit is unavailable for service and the systems secure operation criteria is applied when modeling the network over the next ten years. Involuntary load shedding of metropolitan Melbourne load will be required for this scenario, and this market risk has been monetized based on the lates VCR rate and AEMO's 2024 VAPR Connection Point Forecast.

[2] SF6 is a synthetic, odourless gas used extensively in the AusNet Transmission network as an insulating medium. SF6 gas is a highly potent greenhouse gas with a global warming potential 23,500t CO2-e per tonne of SF69

[3] Australian Energy Regulator, "Valuing Emissions Reduction", May 2024

## 4.1. Key inputs and 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.

### Market impact (wholesale market and involuntary load shedding) risk costs

Network studies are used to assess the market impact of a failure of the GILs at ROTS. These studies are based on the latest network models, demand forecast, operational procedures and forecast transmission developments used by AEMO. Involuntary load shedding is valued at the latest Value of Customer Reliability (VCR)[4].

### Safety risk costs

The Electricity Safety Act 1998[5] requires AusNet Services to design, construct, operate, maintain, and decommission its 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 of managing those risks. By implementing this principle for assessing safety risks from asset failures, AusNet Services uses:

- a value of statistical life[6] to estimate the benefits of reducing the risk of death;
- a value of lost time injury[7]; and
- a disproportionality factor[8].

AusNet Services notes this approach, including the use of a disproportionality factor, is consistent with the practice notes[9] provided by the AER.

### Financial risk costs

As there is a lasting need for the services that the two ROTS GILs provide, the failure rate-weighted cost of replacing failed assets (or undertaking reactive maintenance or repairs) is included in the assessment.[10]

### Environmental risk costs

Changes in greenhouse gas emissions have been assessed based on variations in the leakage of Sulphur Hexafluoride ($SF_6$), an insulation gas used in the two GILs. A Global Warming Potential (GWP) factor of 23,500 — relative to carbon dioxide ($CO_2$)—has been applied to quantify the equivalent $CO_2$ emissions ($CO_2$-e). These emissions have been monetised using the Value of Emissions Reduction (VER), in accordance with guidance published by the AER[11].

# 5. Options assessed

AusNet Services considered both network and non-network options to address the identified need but did not find any suitable non-network solution. The 4 network options are presented below.

## 5.1. Option 1: Like-for-like GIL replacement

Option 1 involves replacing the two GIL circuits and spare phase with the same technology – GILs. The first stage of this option is to lay an underground 220 kV cable on a different route, allowing the TTS service to be temporarily diverted and creating space for the first replacement GIL. The ROTS-TTS GIL will be retired in the next stage, and this easement can then be used for the first replacement GIL. The SMTS service will then be transferred to the new GIL, which will then allow for the second new GIL to be constructed in the vacated easement.

4 In dollar terms, the Value of Customer Reliability (VCR) represents a customer's willingness to pay for the reliable supply of electricity. The values produced are used as a proxy, and can be applied for use in revenue regulation, planning, and operational purposes in the National Electricity Market (NEM).
5 Victorian State Government, Victorian Legislation and Parliamentary Documents, "Electricity Safe Act 1998"
6 Department of the Prime Minister and Cabinet, Australian Government, "Best Practice Regulation Guidance Note: Value of statistical life"
7 Safe Work Australia, "The Cost of Work-related Injury and Illness for Australian Employers, Workers and the Community: 2012-13"
8 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.
9 Australian Energy Regulator, "Industry practice application note for asset replacement planning"
10 The assets are assumed to have survived and their condition-based age increases throughout the analysis period.
11 Australian Energy Regulator, "Valuing Emissions Reductions Final Guidance – May 2024"

The estimated capital cost of this option is $83.8 million (direct expenditure with overheads and finance charges) and the change in operating, and maintenance cost is negligible. The estimated project delivery time is four years.

## 5.2. Option 2: Replace with one 220 kV and one 500 kV cable

Option 2 replaces the Rowville to Thomastown GIL with 220 kV underground cable and the Rowville to South Morang GIL with above ground 500 kV cable. The staging of this option is similar to Option 1, except that it uses a different technology – cables – and it does not require the last step, as the TTS service will remain on the initially installed 220 kV underground cable.

The estimated capital cost of this option is $62.3 million (direct expenditure with overheads and finance charges) and the change in operating, and maintenance cost is negligible. The estimated project delivery time is four years.

## 5.3. Option 3: Deferred replacement of one 220 kV and one 500 kV cable

Option 3 is the same as Option 2, but the project is deferred by five years. It is assumed that cost escalation will not be greater than inflation and for the project to cost $62.3 million (direct expenditure with overheads and finance charges). The change in operating, and maintenance cost is negligible. The estimated project delivery time is four years.

## 5.4. Option 4: Replacement with two 500 kV cables

Option 4 replaces both the Rowville to Thomastown and Rowville to South Morang GILs with above ground 500 kV cables. The staging of this option is similar to Option 1, except that it uses a different technology – cables rather than GILs.

The estimated capital cost of this option is $90 million and the change in operating, and maintenance cost is negligible. The estimated project delivery time is four years.

This option is unlikely to be the preferred option given the higher cost compared to the other options, AEMO's confirmation that the exiting ROTS-TTS 220 kV circuit is not planned to be operated at 500 kV within the next ten years, and not having any additional network benefits compared with Option 1 and 2.

## 5.5. Material inter-regional network impact

The proposed asset replacements at ROTS 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, 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 (counter factual) 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 cost.

## 6.1. Proposed scenarios and input assumptions

The robustness of the investment decision is tested using the range of input assumptions and scenarios described in the table below. This analysis involves variation of assumptions around the most likely values as per the IASR, AEMO's Victoria Annual Planning Report (VAPR) forecast, latest VCR rates, and AusNet Service's best estimate of project cost and forecast asset failure rates.

| Parameter | Lower Bound | Most likely (central) assumption or scenario | Upper Bound |
|---|---|---|---|
| VCR | 75% of central assumption | Published VCR | 125% of central assumption |
| Asset failure rate | 75% of central assumption | Assessed failure rate | 125% of central assumption |
| Demand Growth | 85% of central assumption | Connection Point Forecast provided with AEMO 2024 VAPR | 115% of central assumption |
| Discount rate[12] | WACC rate of a network business (3.0%) | Latest commercial discount rate from IASR (7%) | Upper Bound (10%) |
| Project Capital Cost | 85% of estimated cost | Estimated cost | 115% of estimated cost |

**Table 1 - Summary of input assumptions for range of scenarios**

## 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 classes of market benefits that are likely to be material include changes in involuntary load shedding and generation constraints.

## 6.3. Other classes of benefits

Although not formally classified as classes of market benefits under the NER, AusNet Services expects material reduction in: safety risks, 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 anyone of the three options described in Section 5 and included these other classes of benefits in the project justification.

## 6.4. 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:

- 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 being addressed by the options considered.
- 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.

12 Discount rates as recommended in the AEMO Inputs, Assumptions and Scenarios Report (IASR)

# 7. Options assessment

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 4, 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.

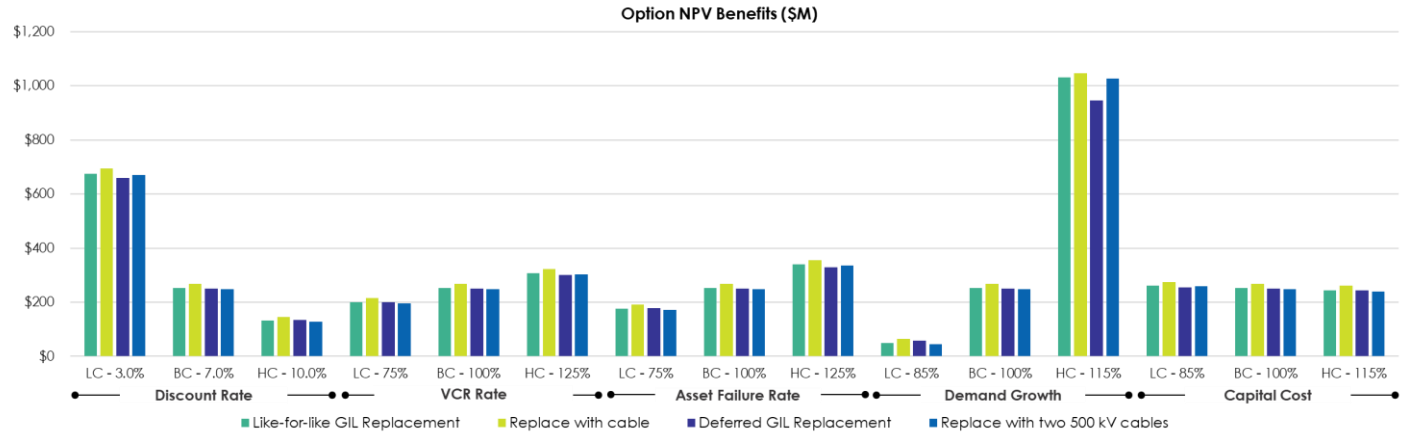


**Figure 1: Scenario and sensitivity study**

## 7.1. Preferred Option

Option 2 (Replace Rowville to Thomastown GIL with 220 kV cable and Rowville to South Morang GIL with 500 kV cable) has the highest net economic benefit for all of 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 except sensitivity studies.

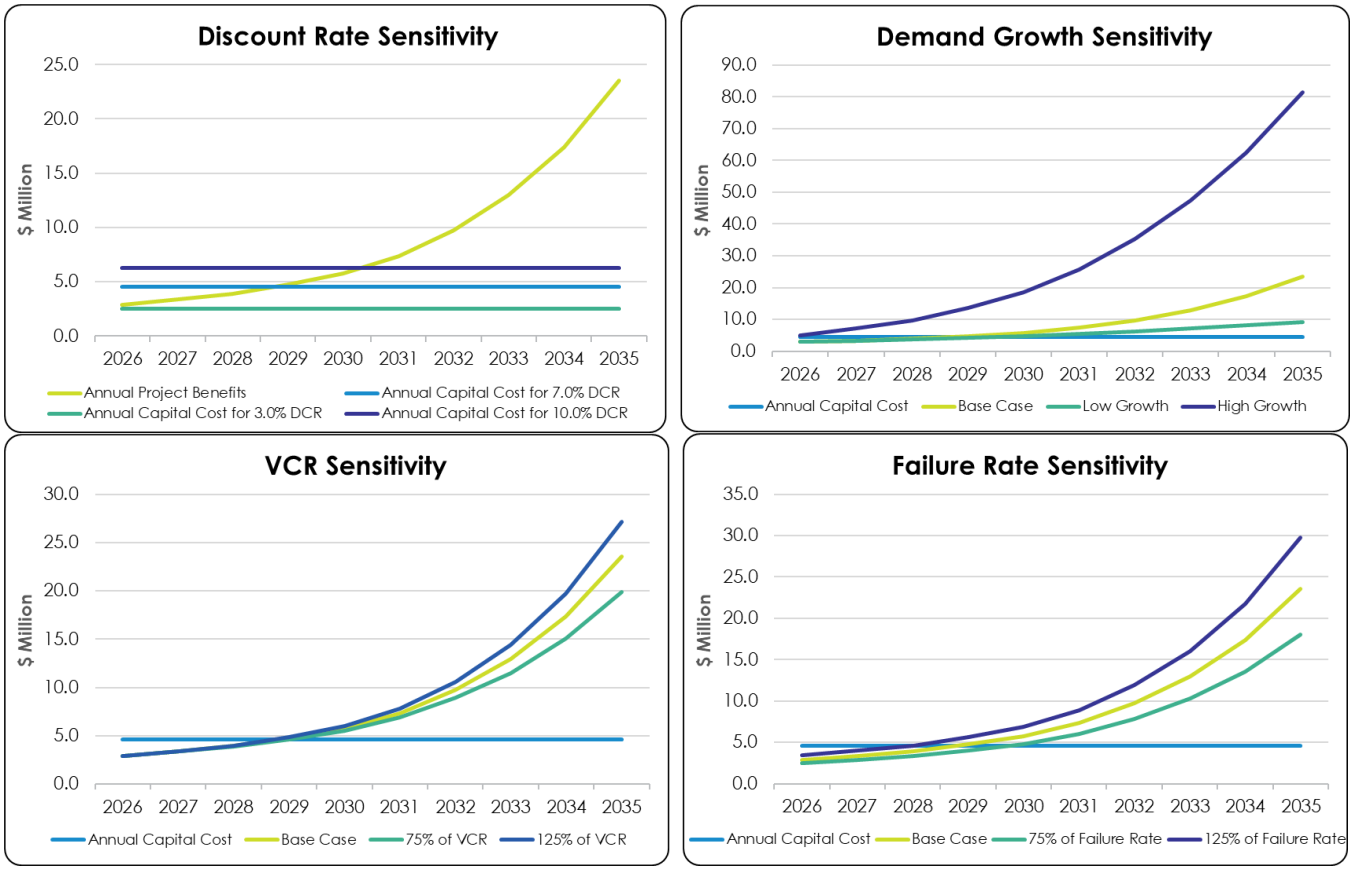


**Figure 5: Optimal investment timing sensitivity study**

## 7.2. Optimal timing of the preferred option

This section describes the optimal investment timing of the preferred option for different input assumptions. Figure 5 shows that the optimal timing of the preferred option (Option 2) is 2029 and that investment is needed within the 2027 to 2032 regulatory control period.

Figure 6 shows that the investment economic timing is only one year later for a 15% increase in investment cost.

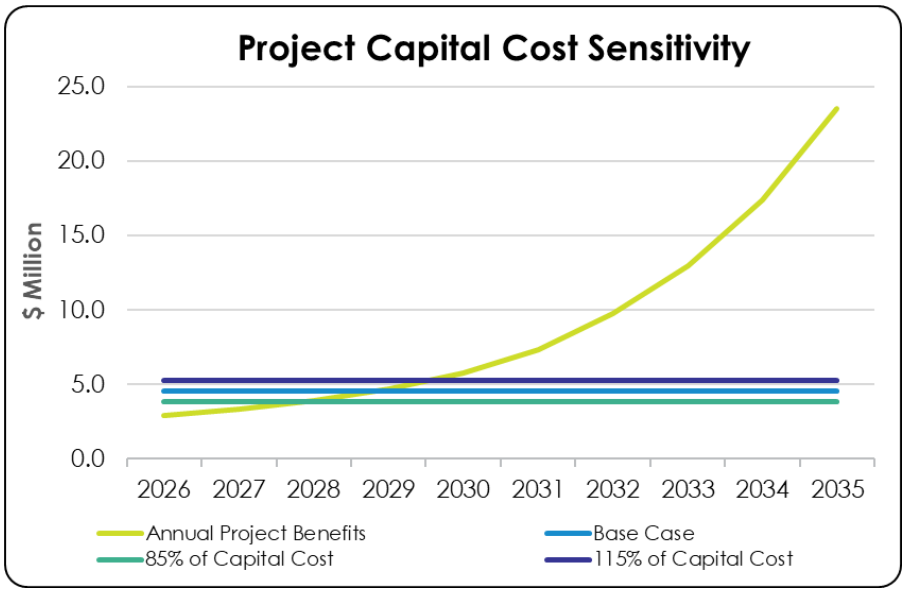


**Figure 6 - Optimal investment timing sensitivity study – Capex**

# 8. Conclusion

Both ROTS GILs are important components of the Victorian Transmission Network, particularly the ROTS-SMTS GIL circuit which is a critical link of the flow path between Latrobe Valley generation and the load centre in metropolitan Melbourne.

Prolonged outages and SF6 emissions of the two GILs are forecast to increase as the condition of these assets deteriorated and the PV risk has been assessed to be more than $290 M over the 45-year planning period.

All replacement options will have to be undertaken in a staged and careful manner so that the replacement projects do not introduce network security risks during the implementation phase. This requires staging the work so that space is created for the replacement options without having to remove a GIL from service for prolonged times. Whilst all options considered are technically feasible, they range in cost and has been assessed in an economic cost benefit analysis over 45 years.

Option 2 (Replace with cable) is the most economical option to address the identified need and is hence the preferred option. Option 2 involves replacing the Rowville to Thomastown GIL with 220 kV underground cable and the Rowville to South Morang GIL with above ground 500 kV cable.

The estimated capital cost of this option is $62.3 million (excluding management reserve) and the change in operating, and maintenance cost is negligible. The estimated project delivery time is four years.

The project is economic by 2029, and AusNet Services is targeting a commissioning date of 2030/31 with all cost falling within the 2027 to 2032 regulatory control period.

# 9. Appendix 1: Cost Estimate

Breakdown of the cost estimate for Option 2.

| | PROJECT EXPENDITURE FORECASTS | 2026 | 2027 | 2028 | 2029 | TOTAL |
|---|---|---|---|---|---|---|
| 1 | DESIGN & STUDIES | $ 1,217,125.00 | $ 1,217,125.00 | $ - | $ - | $ 2,434,250.00 |
| 2 | INTERNAL LABOUR | $ 513,600.00 | $ 1,027,200.00 | $ 1,027,200.00 | $ 770,400.00 | $ 3,338,400.00 |
| 3 | MATERIALS (AusNet Free Issue Materials) | $ - | $ 10,918,973.31 | $ - | $ - | $ 10,918,973.31 |
| 4 | PLANT & EQUIPMENT | $ - | $ 76,419.32 | $ 152,838.64 | $ 76,419.32 | $ 305,677.29 |
| 5 | CONTRACTS (Including incentives and insurance) | $ - | $ 9,926,302.73 | $ 19,852,605.45 | $ 9,926,302.73 | $ 39,705,210.91 |
| **6** | **PROJECT DIRECT EXPENDITURE P(50)** | **$ 1,730,725.00** | **$ 23,166,020.36** | **$ 21,032,644.10** | **$ 10,773,122.05** | **$ 56,702,511.51** |
| 7 | OVERHEADS | $ 86,882.40 | $ 1,162,934.22 | $ 1,055,838.73 | $ 540,810.73 | $ 2,846,466.08 |
| 8 | FINANCE CHARGES (IDC) | $ 19,060.61 | $ 748,711.71 | $ 1,177,241.31 | $ 854,585.56 | $ 2,799,599.20 |
| **9** | **PROJECT DIRECT EXPENDITURE (SAP)** | **$ 1,836,668.01** | **$ 25,077,666.30** | **$ 23,265,724.14** | **$ 12,090,255.16** | **$ 62,348,576.78** |
| 10 | MANAGEMENT RESERVE [P(90)-P(50)] | | | | | $ 2,979,091.15 |
| **11** | **TOTAL EXPENDITURE FOR APPROVAL (Including P(90))** | **$ 1,836,668.01** | **$ 25,077,666.30** | **$ 23,265,724.14** | **$ 12,090,255.16** | **$ 65,327,667.93** |

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