Final Project Assessment Report (Glen Waverley Zone Substation Secondary Assets, Switchgear and Control Building Condition)

Project No. UE-RCA-N-25-001

united energy

Disclaimer
The master document is controlled electronically.
Ensure latest version prior to use.

Based on document template: UE-TP-2202.5 Final Project Assessment Report Template Revision 221216
Document controlled in accordance with ST-1750 INMS Document Management Standard

Document Control

Version	Amendment Overview
1	Initial Version

Table of Contents

1. Executive Summary 1

1.1 Purpose 1
1.2 Notice of Determination Report 1
1.3 Draft Project Assessment Report 1
1.4 Final Project Assessment Report 1
1.5 The Identified Need 2
1.6 Credible Options for Addressing the Identified Need 3
1.7 Scenarios and Sensitivities Considered 4
1.8 Net Present Value Analysis Results 5
1.9 Preferred Option 6
1.10 Next Steps 6

2. Introduction 7

3. Referenced Documents 7

4. Definitions 8

5. Identified Need 10

5.1 Network Overview 10
5.2 Description of the Identified Need 12
5.2.1 Protection and Control Equipment Condition 12
5.2.2 Circuit Breaker Condition 13
5.2.3 Control Building Condition 13
5.3 Quantification of the Identified Need 14

6. Key Assumptions on the Identified Need 15

6.1 Method for Quantifying the Identified Need 15
6.1.1 Safety 15
6.1.2 Reliability 15
6.2 Forecast Maximum Demand 16
6.3 Characteristic of Load Profile 16
6.4 Load Transfer Capacity and Supply Restoration Times 18
6.5 Asset Ratings 18
6.6 Value of Customer Reliability 18
6.7 Asset Failure Rates 18
6.8 Value of Safety Consequence 19
6.9 Discount Rates 19

7. Credible Options 20

8. Submissions to the DPAR 21

9. Market Modelling Methodology 22

9.1 Classes of Market Benefits Considered Material 22
9.1.1 Changes in Safety Risk Cost 22
9.1.2 Changes in Involuntary Load Shedding 22
9.2 Classes of Market Benefits Not Expected to be Material 22

9.2.1 Changes in Load Transfer Capacity and the Capacity of Embedded Generating Units 23
9.2.2 Changes in Electrical Energy Losses 23
9.2.3 Changes in Voluntary Load Curtailment 23
9.2.4 Changes in Costs to Other Parties 23
9.2.5 Difference in Timing of Expenditure 23
9.2.6 Additional Option Value 23
9.3 Costs of Credible Options 24
9.4 Scenarios 24
9.5 Sensitivities 25
10. Results of Analysis 25
10.1 Gross Market Benefits 25
10.2 Net Market Benefits 26
10.3 Sensitivity Assessment 27
10.4 Economic Timing 28
11. Preferred Option 28
12. Next Steps 28
13. Checklist of Compliance with NER Clauses 29
14. Appendix A GW Asset Photos 30

List of Figures

Figure 1: GW Electrical Single Line Diagram 10
Figure 2: GW Supply Area 11
Figure 3: Annual Load Profile at GW 16
Figure 4: Load Profile on Day of Annual Maximum Demand at GW 17
Figure 5: Annual Load-Duration Curve at GW 17
Figure 6: Gross Market Benefits: Central Scenario ($'000, Real 2024) 26
Figure 7: In-Service Secondary Systems, 22 kV Circuit Breakers & Control Building at GW 30

List of Tables

Table 1: Forecast Impact of the Identified Need – Safety and Reliability ($'000, Real 2024) 2
Table 2: Base Case 3
Table 3: Credible Options Assessed in this RIT-D 3
Table 4: Sensitivity Analysis Variables 4
Table 5: Scenario Variables and Weightings 4
Table 6: Present Value of Net Market Benefits of Credible Options - Scenarios ($'000, Real 2024) 5
Table 7: Present Net Market Benefits of Credible Options - Sensitivities ($'000, Real 2024) 5
Table 8: Expected Timing of the Preferred Option 6
Table 9: Referenced Documents 7
Table 10: Terms and Definitions 8
Table 11: GW Protection & Control Relay Failure History 12
Table 12: GW Circuit Breaker Defects History 13
Table 13: GW Control Building Defects History 13
Table 14: Base Case GW Reliability and Safety Risk Quantification ($'000, Real 2024) 14
Table 15: Base Case 15
Table 16: GW Maximum Demand Forecast (MVA) 16
Table 17: Summary of GW Ratings (MVA) 18
Table 18: Summary of Location Specific VCR 18
Table 19: Summary of Asset Failure Rates and Hazard Function (Weibull Distribution Parameters) 18
Table 20: Summary of Asset Reliability Consequence Probability 19
Table 21: Summary of Asset Safety Consequence Probability 19
Table 22: Summary of Safety Consequence Values 19
Table 23: Credible Options Assessed in this RIT-D 20
Table 24: Capital and Operating Costs of Credible Options ($'000, Real 2024) 24
Table 25: Present Value of Costs of Credible Options ($'000, Real 2024) 24
Table 26: Scenario Variables and Weightings 24
Table 27: Sensitivity Analysis Variables 25
Table 28: Gross Market Benefits Option 1 - Proactive Relay, Control Building and Switchyard Replacement 25
Table 29: Gross Market Benefits Option 2 - Proactive Relay and Control Building Replacement. 25
Table 30: Net Market Benefits of Credible Options for the Weighted Scenario 26
Table 31: Present Net Market Benefits of Credible Options - Sensitivities ($'000, Real 2024) 27
Table 32: Present Value of Net Market Benefits of Credible Options - Scenarios ($'000, Real 2024) 27
Table 33: Expected Timing of the Preferred Option 28
Table 34: NER Requirements Checklist 29

1. Executive Summary

United Energy (UE) is a regulated Victorian electricity distribution business. UE distributes electricity to more than 727,000 customers across Melbourne's east and south-east metropolitan area, and the Mornington Peninsula. The UE network consists of more than 215,000 poles and over 13,590 kilometres of overhead lines and underground cables. Electricity is received via 92 sub-transmission lines at 47 zone substations, where it is transformed from sub-transmission voltages down to distribution voltages.

The area of the UE network that is the subject of this Regulatory Investment Test for Distribution (RIT-D) is the Glen Waverley Zone Substation (GW) supply area (i.e. GW supply area) that supplies the area of Glen Waverley and parts of Mount Waverley, Notting Hill, and Wantirna South. GW is owned and operated by UE, providing power to approximately 19,592 customers, comprising of mainly residential with some commercial/light industrial customers.

The condition of the secondary assets[1], switchgear[2] and control building[3] at GW, necessary for the provision of a safe and reliable power supply to customers within the GW supply area, are deteriorating and technically obsolete, being unsupported by equipment suppliers with no spares.

1.1 Purpose

This Final Project Assessment Report (FPAR) has been prepared by UE in accordance with the requirements of clause 5.17.4, paragraph (r) of the National Electricity Rules (NER) version 214.

The purpose of this report is to identify the preferred option to address the Glen Waverley Zone Substation Secondary Assets, Switchgear and Control Building Condition identified need, associated with the network safety and reliability limitations within the GW supply area.

This report has been prepared following the publication of the Notice of Determination and consultation on the Draft Project Assessment Report (DPAR) and represents the final stage of the RIT-D process.

The preferred option is to renew GW's secondary systems and the 22 kV switchyard in a new control and switchgear building at a cost of $14.80 million (Real, 2024), and is required to be commissioned by November 2026.

1.2 Notice of Determination Report

On 26th June 2024, UE published a Notice of Determination in accordance with clause 5.17.4, paragraphs (c) and (d) of the NER. The purpose of that report was to present the potential credible options considered, and to explain the reasons for concluding that there would unlikely be any potential credible non-network or Standalone Power System (SAPS) options (or any combination of those options, or with a network option) that could adequately and economically address the identified need within the GW supply area.

1.3 Draft Project Assessment Report

On 15th July 2024, UE published a DPAR in accordance with clause 5.17.4, paragraph (i) of the NER. The purpose of that report was to present the economic evaluation of the credible options and to identify the proposed preferred option that satisfies the requirements of the RIT-D for the identified need within the GW supply area. No submissions were received during the DPAR consultation period.

1.4 Final Project Assessment Report

Following publication of the Notice of Determination Report and at the conclusion of the DPAR consultation, UE is required to prepare and publish a Final Project Assessment Report (FPAR), as required under NER clause 5.17.4, paragraph (o). The NER requires that the FPAR includes matters detailed in NER clause 5.17.4, paragraph (r)(1), summarised as follows:

- Provide background information on the network servicing the GW supply area and its limitations.
- Describe the need which UE is seeking to address, together with the assumptions used in identifying that need.
- Describe the credible options that are considered in this RIT-D assessment.

[1] protection, control, monitoring and communications equipment.
[2] 22kV circuit breakers and associated outdoor switchyard equipment.
[3] housing the secondary assets.

- Explain the materiality of each class of market benefit and the methods used in quantifying material market benefits.
- Quantify costs, high-level cost breakdowns, and material market benefits for each of the credible options.
- Present the results of a Net Present Value (NPV) analysis, with explanatory statements regarding the results.
- Identify the preferred option, its costs, optimum timing and its technical characteristics.
- A summary of any submissions received on the DPAR and the responses to those submissions.

1.5 The Identified Need

The identified need at GW is to protect power sector workers and members of the public from harm caused by asset failure (Safety), and to continue to maintain a reliable power supply to the residences and businesses that are dependent on the supply from this distribution network (Reliability).

The condition of the secondary assets, switchgear and control building at GW, necessary for the provision of a safe and reliable power supply to customers within the GW supply area, are deteriorating. UE has assessed there is now an unacceptable risk of asset failure, with significant consequences for safety, and the reliability of electricity supply to UE's customers within the GW supply area.

The protection relays at GW are at end of life, have a history of failure, and are obsolete with limited spares and no manufacturer support.

UE's fleet of 354GC 22 kV outdoor circuit breaker switchgear is approaching end of life, with an increasing number of defects being found across the UE fleet. There are 18 of these circuit breakers installed at GW, with one currently not fit for service as the welds on the circuit breaker mechanism tank have started to crack and cannot be cost effectively repaired.

The original asbestos fibre cement clad control building at GW installed in the 1960s, has an increasing number of serious defects, which is putting at risk the safe and reliable operation of the secondary assets housed within it.

Solutions to the identified need shall manage and mitigate the increasing risk of secondary asset failure, switchgear failure, and control building defects, to maintain safety and reliability of electricity supply to UE's customers and workforce within the GW supply area.

Table 1 summarises the forecast financial impact of the identified need on reliability and safety for customers within the GW supply area, expressed as the Expected Unserved Energy (EUE) cost and the safety risk cost respectively.

Table 1: Forecast Impact of the Identified Need – Safety and Reliability ($'000, Real 2024)

Financial Year	EUE Cost	Safety Risk Cost[4]	Total Risk Cost
2024	348	459	807
2025	376	483	859
2026	407	507	914
2027	438	533	970
2028	468	558	1,027
2029	500	585	1,085
2030	534	612	1,146
2031	572	639	1,210
2032	611	666	1,277
2033	651	694	1,345
2034	686	722	1,408
2035	721	750	1,470
2036	756	777	1,533
2037 - 2050	792 p.a.	805 p.a.	1,597 p.a.

[4] For simplicity, no AFAP disproportionate factors have been applied to the Safety Risk Cost.

For the purposes of this RIT-D, economic evaluations are undertaken over a 25-year analysis period.

Table 2 provides a summary of the base case option, using the risk costs presented in Table 1.

Table 2: Base Case

Option	Description
Do Nothing (status quo)	This base case option involves running the GW secondary systems, circuit breakers and control building to failure. That is, continue with existing maintenance of this equipment, coupled with replacement upon failure. Given this option does not address the identified need at all, the cost of unplanned asset failures is represented by the full value of both the EUE and the safety risk costs. The present value of all costs (EUE and safety risk) is $21.12 million (Real, 2024).

1.6 Credible Options for Addressing the Identified Need

The following options in Table 3 have been included as credible options in the RIT-D assessment.

Table 3: Credible Options Assessed in this RIT-D

Option	Description
1 - Proactive Relay, Control Building and Switchyard Replacement. (i.e. Indoor switchboard).	This option involves a renewal of secondary systems and the 22 kV switchyard in a new control and switchgear building. This option is the most economically viable option. It addresses network reliability and safety risks to AFAP. It realises synergies and economies of scale by combining secondary and 22 kV switchyard replacement and provides a reduction in commissioning risk. The total capital cost of this option is $14.80 million (Real, 2024). The present value of all costs (capital, O&M, EUE and safety risk) is $16.24 million (Real, 2024).
2 - Proactive Relay and Control Building Replacement. (i.e. Switchyard status-quo).	This option involves a renewal of the secondary systems only in a new control room. This option addresses secondary systems and control building risks only. The total capital cost of this option is $11.58 million (Real, 2024). The present value of all costs (capital, O&M, EUE and safety risk) is $16.84 million (Real, 2024).

The purpose of the RIT-D is to identify the preferred option, being the credible option that maximises the present value of net market benefit to all those who produce, consume and transport electricity in the National Electricity Market (NEM). In order to quantify the net market benefits of each credible option, the value of EUE and safety risk cost under the base case (where no action is taken by UE) is compared against the value of EUE and safety risk cost with each of the credible options in place.

1.7 Scenarios and Sensitivities Considered

In order to test the robustness of the RIT-D preferred option to changes in assumptions, a set of sensitivities to key input variables of the analysis has been applied. Table 4 lists the variables and respective ranges adopted for the purpose of defining sensitivities.

Table 4: Sensitivity Analysis Variables

Sensitivity Testing	Lower Bound	Base Value	Upper Bound
Maximum demand	90%	100%	105%
Capital and operational costs	80%	100%	120%
Value of customer reliability	80%	100%	120%
Discount rate	2.22%	4.43%	6.65%
Asset failure rates	85%	100%	115%

The NER stipulates that the RIT-D must be based on a cost-benefit analysis that considers a number of reasonable scenarios of future supply and demand[5]. For the identified need in this RIT-D assessment, the major input variables that impact future reliability and safety outcomes within the GW supply area, are changes in the demand for electricity and changes in the asset failure rates. The scenarios and their weightings that are used in the economic evaluation to identify the preferred option, are summarised in Table 5.

Table 5: Scenario Variables and Weightings

Scenario Definition	Low Scenario	Central Scenario	High Scenario
Weighting	25%	50%	25%
Maximum demand	90%	100%	105%
Asset failure rate	85%	100%	115%

Four scenarios are considered:

- Central scenario (Maximum demand and Asset failure rate set to the base values in Table 4)
- Low scenario (Maximum demand and Asset failure rate set to the lower bound values in Table 4)
- High scenario (Maximum demand and Asset failure rate set to the upper bound values in Table 4)
- Weighted scenario (Comprising 25% worth of low scenario; 50% worth of central scenario; and 25% of high scenario).

[5] NER: clause 5.17.1(c) paragraph 1

1.8 Net Present Value Analysis Results

Table 6 sets out a comparison of the present value of net market benefits of each option under all reasonable scenarios, over a 25-year period.

Table 6: Present Value of Net Market Benefits of Credible Options - Scenarios ($'000, Real 2024)

Scenario	Do Nothing		Option 1		Option 2	
	Net Market Benefit	Ranking	Net Market Benefit	Ranking	Net Market Benefit	Ranking
Weighted	0	3	4,822	1	4,230	2
Central	0	3	4,883	1	4,284	2
Low	0	3	1,314	1	1,304	2
High	0	3	8,207	1	7,049	2

The RIT-D assessment summarised in Table 6, demonstrates that Option 1 maximises the present value of net market benefits under the Weighted Scenario (i.e. a weighting of the Central, Low and High Scenarios).

For all reasonable scenarios considered, Option 1 maximises the present value of net market benefits for all scenarios.

Based on the Weighted Scenario, the preferred option for investment in the GW supply area is therefore Option 1 (i.e. Proactive Relay, Control Building and Switchyard Replacement). Option 1 satisfies the requirements of the RIT-D.

The robustness of the preferred option to credible changes in input variables is summarised in the sensitivity analysis results of Table 7.

Table 7: Present Net Market Benefits of Credible Options - Sensitivities ($'000, Real 2024)

Sensitivity for Central Scenario	Option 1	Option 2
All Variables: Base values	4,883	4,284
Maximum demand: Lower bound	3,990	3,502
Maximum demand: Upper bound	5,330	4,675
Capital and operational costs: Lower bound	7,663	6,524
Capital and operational costs: Upper bound	2,103	2,044
Value of customer reliability: Lower bound	3,096	2,720
Value of customer reliability: Upper bound	6,670	5,848
Discount rate: Lower bound	10,822	9,224
Discount rate: Upper bound	1,752	941
Asset failure rates: Lower bound	2,073	1,968
Asset failure rates: Upper bound	7,693	6,600

Option 1 has a present value of net market benefit that remains positive under all credible sensitivities, and when compared with Option 2, clearly maintains its status as the preferred option.

Although the choice of the preferred option is clear, the optimum timing of this investment is not, given a number of reasonable scenarios are investigated. The economic timing of the preferred option is when the annualised value of EUE and safety risk cost (i.e. the annualised cost of the total risk) exceeds the annualised cost of the preferred option (i.e. the annualised investment cost). Table 8 shows the expected optimum timing of the preferred option under each reasonable scenario.

Table 8: Expected Timing of the Preferred Option

Scenario	Annualised cost of total risk minus investment costs ('000, Real 2024)				Optimum Timing Before Summer[6]
	2025	2026	2027	2028	
Weighted	202	256	312	368	2024/25
Central	203	258	314	371	2024/25
Low	2	43	85	128	2024/25
High	398	466	535	604	2024/25

Although the optimum timing is identified as 2024/25, it is not practical to complete the works by this time. Therefore, considering the lead time, under the Weighted Scenario, the optimum timing of Option 1 is prior to summer 2026/27 (i.e. November 2026).

1.9 Preferred Option

The preferred option is Option 1 as it maximises the present value of the net economic benefit to all those who produce, consume and transport electricity in the NEM, considering a set of reasonable state-of-the-world scenarios and their weightings.

The preferred option was tested under a range of sensitivities. In each case, Option 1 was confirmed to provide positive economic benefits and is the highest-ranked option in all sensitivities.

The optimum timing for commissioning of the preferred option is no later than November 2026.

The preferred option has a capital cost of $14.8 million (Real, 2024).

The 25-year present value of net market benefits associated with the preferred option is $4.9 million (Real, 2024).

1.10 Next Steps

This FPAR represents the final stage of the RIT-D process.

In accordance with the provisions set out in clause 5.17.5, paragraph (c) of the NER, Registered Participants or interested parties may, within 30 days after the publication of this report, dispute the conclusions made by UE in this report with the Australian Energy Regulator (AER).

Accordingly, Registered Participants and interested parties who wish to dispute the recommendation outlined in this report must do so by 10th October 2024. Any parties raising such a dispute are also required to notify UE at planning@ue.com.au. If no formal dispute is raised, UE will commence with the investment activities necessary to proceed with the implementation of the preferred option.

For the purposes of referencing this RIT-D, this RIT-D is referred to as the "*Glen Waverley Zone Substation Secondary Assets, Switchgear and Control Building Condition*" identified need.

[6]The economic analysis concludes the optimum timing is 2024/25 however the preferred option cannot be constructed within this timeframe. Instead it can be constructed before the 2026/27 summer.

2. Introduction

United Energy (UE) is a regulated Victorian electricity distribution business. UE distributes electricity to more than 727,000 customers across Melbourne's east and south-east metropolitan area, and the Mornington Peninsula. The UE network consists of more than 215,000 poles and over 13,590 kilometres of overhead lines and underground cables. Electricity is received via 92 sub-transmission lines at 47 zone substations, where it is transformed from sub-transmission voltages down to distribution voltages.

The area of the UE network that is the subject of this Regulatory Investment Test for Distribution (RIT-D) is the Glen Waverley Zone Substation (GW) supply area (i.e. GW supply area) that supplies the area of Glen Waverley and parts of Mount Waverley, Notting Hill, and Wantirna South. GW is owned and operated by UE, providing power to approximately 19,592 customers, with the majority of the load at GW comprising of mainly residential with some commercial/light industrial customers.

This Final Project Assessment Report (FPAR) has been prepared by UE in accordance with the requirements of clause 5.17.4, paragraph (r) of the National Electricity Rules (NER) version 214 and is consistent with the Australian Energy Regulator's (AER) RIT-D Application Guidelines[7] and the Industry Practice Application Note for Asset Replacement Planning[8].

The publication of this FPAR represents the final stage of the consultation process in relation to the application of the RIT-D as required under clause 5.17.4(o) of the NER, for addressing the identified need, associated with the network safety and reliability risks within the GW supply area. It sets out the matters detailed in the DPAR, and summarises the submissions received on that report. The NER requires that the FPAR includes matters detailed in NER clause 5.17.4, paragraph (r)(1), summarised as follows:

- Provide background information on the network servicing the GW supply area and its limitations.
- Describe the need which UE is seeking to address, together with the assumptions used in identifying that need.
- Describe the credible options that are considered in this RIT-D assessment.
- Explain the materiality of each class of market benefit and the methods used in quantifying material market benefits.
- Quantify costs, high-level cost breakdowns, and material market benefits for each of the credible options.
- Present the results of a Net Present Value (NPV) analysis, with explanatory statements regarding the results.
- Identify the preferred option, its costs, optimum timing and its technical characteristics.
- A summary of any submissions received on the DPAR and the responses to those submissions.

3. Referenced Documents

Table 9: Referenced Documents

Title	Document No.
UE Asset Risk Quantification Guide	UE-GU-2011

[7] AER: "AER – RIT-D Application Guidelines – October 2023". Available at: https://www.aer.gov.au/system/files/2023-10/AER%20-%20RIT-D%20guidelines%20-%20final%20amendments%20%28marked%20up%29%20-%206%20October%202023_0.pdf

[8] AER: "AER – Industry Practice Application Note – Asset Replacement Planning – January 2019". Available at: https://www.aer.gov.au/system/files/D19-2978%20-%20AER%20-Industry%20practice%20application%20note%20Asset%20replacement%20planning%20-%2025%20January%202019.pdf

4. Definitions

Table 10: Terms and Definitions

Term	Definition
A.C.	Alternating Current
AER	Australian Energy Regulator
AEMO	Australian Energy Market Operator
AFAP	As Far As Practicable
CPI	Consumer Price Index
DAPR	Distribution Annual Planning Report
D.C.	Direct Current
DPAR	Draft Project Assessment Report
EB	East Burwood Zone Substation
EUE	Expected Unserved Energy (MWh pa)
FPAR	Final Project Assessment Report
GW	Glen Waverley Zone Substation
IASR	Inputs, Assumptions and Scenarios Report
ISP	Integrated System Plan
LTI	Lost Time Injury
MGE	Mulgrave Zone Substation
NCC	Network Control Centre
NEM	National Electricity Market
NER	National Electricity Rules
NO	Notting Hill Zone Substation
NPV	Net Present Value
O&M	Operating and Maintenance
PoE	Probability of Exceedance
RIT-D	Regulatory Investment Test for Distribution
RTU	Remote Terminal Unit
RWT	Ringwood Terminal Substation
SAPS	Standalone Power System
SCADA	Supervisory Control and Data Acquisition
UE	United Energy
VCR	Value of Customer Reliability ($/MWh)
VSL	Value of Statistical Life
50% PoE	The forecast maximum demand has a 50% probability of exceedance (PoE). That is, the forecast maximum demand is expected, on average, to be exceeded once in two years.
10% PoE	The forecast maximum demand has a 10% probability of exceedance (PoE). That is, the forecast maximum demand is expected, on average, to be exceeded once in ten years.

Term	Definition
Credible option	An option that addresses the 'identified need', is commercially and technically feasible, and can be implemented in sufficient time to meet the 'identified need'.
Expected Unserved Energy (EUE)	The expected amount of energy that is not supplied each year expressed in MWh pa, because there are network limitations in meeting the demand, taking into account asset failures and malfunctions.
Identified need	Any capacity, voltage, or safety limitation on the distribution system.
Limitation	Any limitations on the operation of the distribution system that will give rise to Expected Unserved Energy or safety risk consequences.
Network option	A means by which an 'identified need' can be fully or partly addressed by expenditure on distribution network assets.
Non-network or SAPS option	A means by which an 'identified need' can be fully or partially addressed other than by a network option.
Non-network service provider	A party who provides a non-network or SAPS option.
Potential credible option	An option has the potential to be a credible option based on an initial assessment of its ability to address the 'identified need'.
Preferred network option	A credible network option that maximises the present value of net economic benefit to all those who produce, consume and transport electricity in the NEM. The preferred network option can be a network option, or do nothing (i.e. status quo).
Preferred option	A credible option that maximises the present value of net economic benefit to all those who produce, consume and transport electricity in the NEM. The preferred option can be a network option, non-network or SAPS option, combination of both, or do nothing (status quo).
Value of Customer Reliability (VCR)	The value customers place on having a reliable supply of energy, expressed in $/MWh.

5. Identified Need

5.1 Network Overview

The area of UE's distribution network that is the subject of this Regulatory Investment Test for Distribution (RIT-D), is the Glen Waverley Zone Substation (GW) supply area. It supplies the area of Glen Waverley and parts of Mount Waverley, Notting Hill, and Wantirna South.

GW is owned and operated by UE, providing power to approximately 19,592 customers, with the majority of the load at GW comprising of mainly residential with some commercial /light industrial customers.

GW is bounded in the north by adjacent 22 kV zone substations EB (East Burwood) and RWT (Ringwood), in the south by NO (Notting Hill) and MGE (Mulgrave), providing load transfer capacity to be able to reduce load on the zone substation in the event of an emergency (such as a major asset failure, for example). The load transfer capability away from GW is 18.5 MVA.

GW zone substation is served by 66 kV sub-transmission lines from the Springvale terminal station (SVTS) and transforms electricity down to 22 kV via two 20/27 MVA transformers and one 20/30 MVA transformer.

The cyclic rating of GW with all transformers in service is 103.2 MVA, and with one transformer out of service the rating reduces to 68.8 MVA. This compares to a forecast 10% PoE maximum demand of 62.1 MVA for summer 2024/25, rising to 64.8 MVA by 2027/28.

The electrical single line diagram for GW, showing the 66 kV assets, 66/22 kV transformers, and 22 kV assets (including distribution feeder exits) is illustrated in Figure 1.

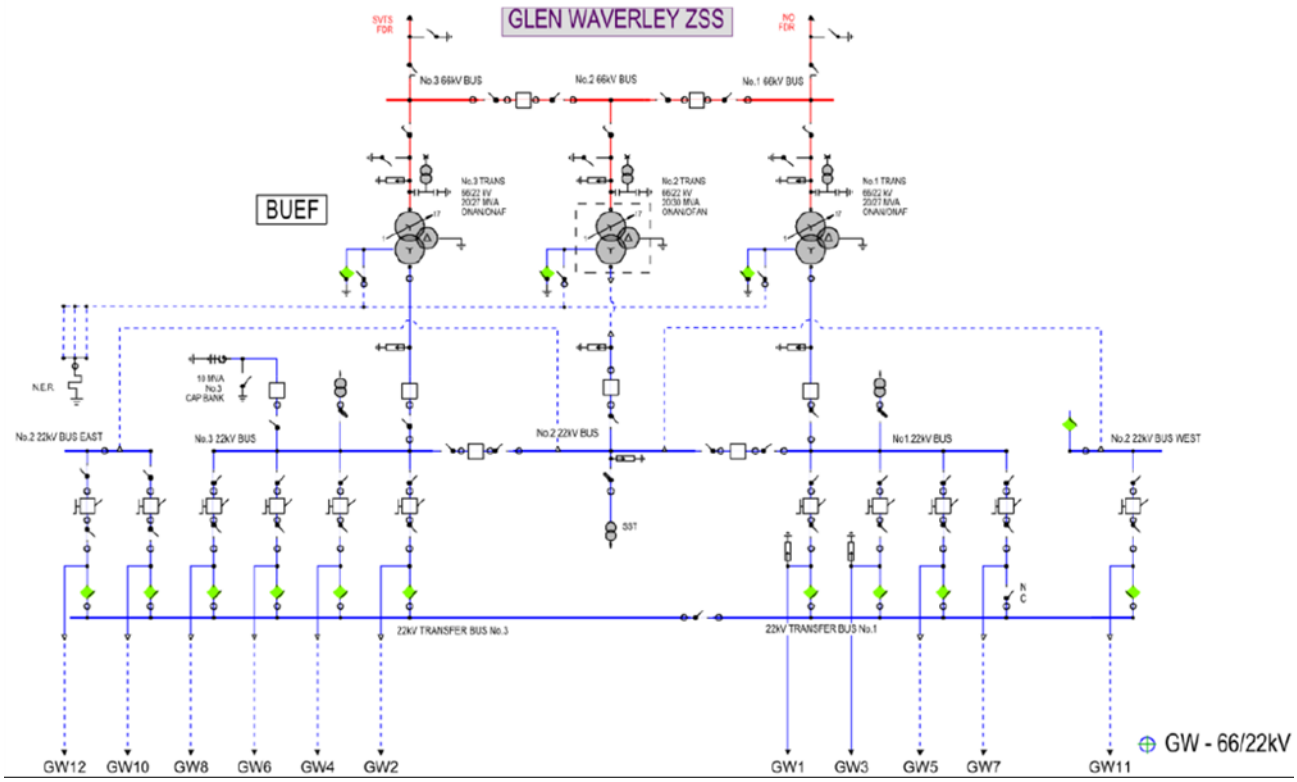

Figure 1: GW Electrical Single Line Diagram

The power supply coverage of GW is illustrated in Figure 2.

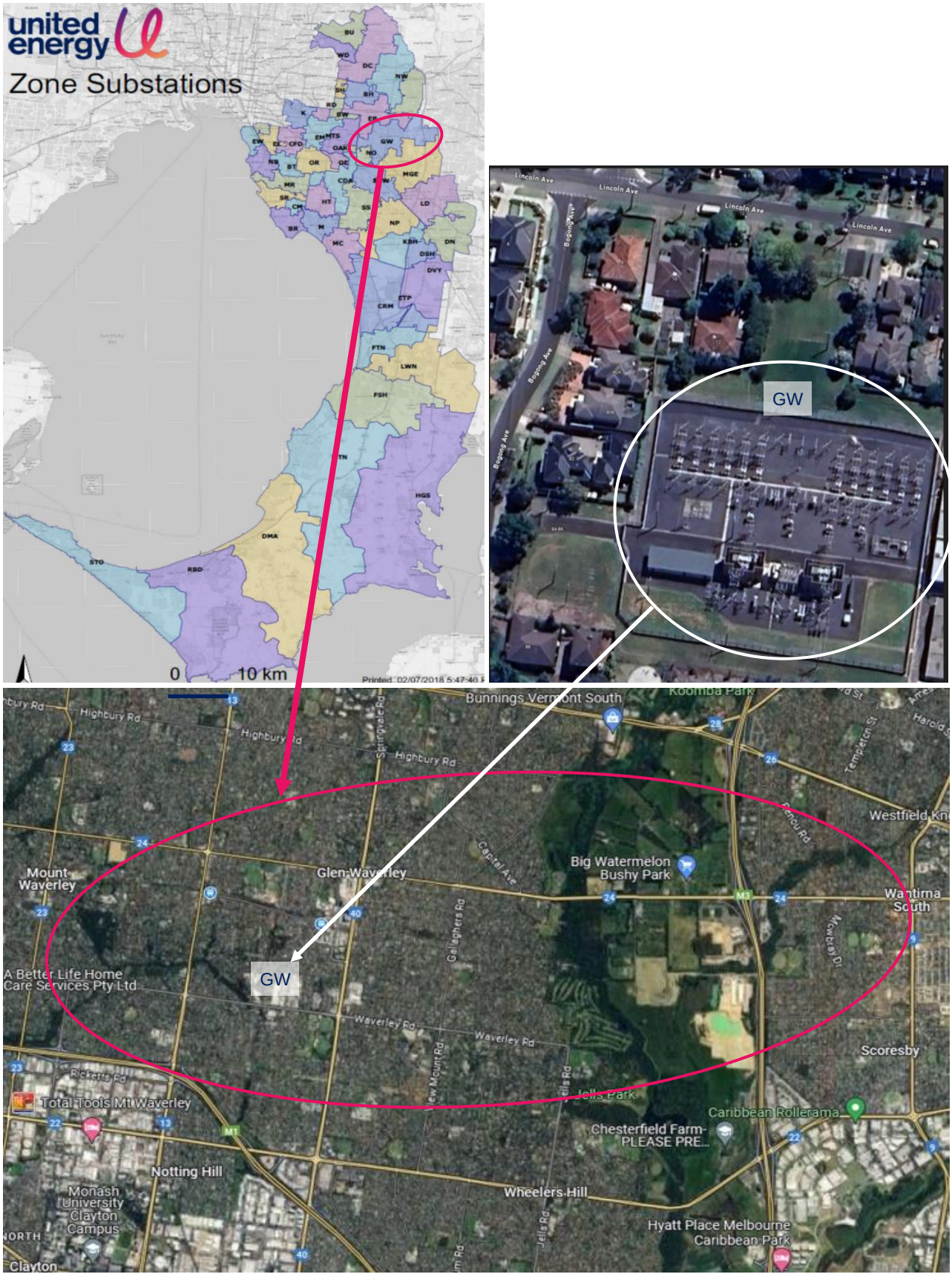

Figure 2: GW Supply Area

5.2 Description of the Identified Need

The identified need at GW is to protect power sector workers and members of the public from harm caused by asset failure (Safety), and to continue to maintain a reliable power supply to the residences and businesses that are dependent on the supply from this distribution network (Reliability).

The condition of the secondary assets, 22 kV switchgear and control building at GW, necessary for the provision of a safe and reliable power supply to customers within the GW supply area, are deteriorating. UE has assessed there is now an unacceptable risk of asset failure, with significant consequences for safety, and the reliability of electricity supply to UE's customers within the GW supply area.

The protection relays at GW are at end of life, have a history of failure, and are obsolete with limited spares and no manufacturer support.

UE's fleet of 354GC 22 kV outdoor circuit breaker switchgear is approaching end of life, with an increasing number of defects being found across the UE fleet. There are 18 of these circuit breakers installed at GW, with one currently not fit for service as the welds on the circuit breaker mechanism tank have started to crack and cannot be cost effectively repaired.

The original asbestos fibre cement clad control building at GW installed in the 1960s, has an increasing number of serious defects, which is putting at risk the safe and reliable operation of the secondary assets housed within it.

Solutions to the identified need shall manage and mitigate the increasing risk of secondary asset failure, switchgear failure, and control building defects, to maintain safety and reliability of electricity supply to UE's customers and workforce within the GW supply area.

The need for investment and the possible options for addressing the Glen Waverley Zone Substation Secondary Assets, Switchgear and Control Building Condition identified need, has been foreshadowed in UE's 2023 Distribution Annual Planning Report (DAPR)[9].

The assets whose condition is of key concern are identified below, including a description and photographic evidence of their condition, and historical performance.

5.2.1 Protection and Control Equipment Condition

Protection and control systems are critical to the safe and reliable operation of the network. These systems are designed to detect the presence of power system faults and/or other abnormal operating conditions, and to automatically isolate the faulted network by the opening of appropriate high-voltage circuit breakers. Failure to isolate power system faults will invariably result in severe damage to network assets, presenting a serious health and safety hazard to the public, and greatly increases the risk of fire starts. Most of the protection and control relays at GW are now technically obsolete, being no longer supported by vendors, and limited to no spare parts. All of these factors increase the likelihood of a power system fault not being detected and safely isolated, or a maloperation.

Some of the recent relay failure history at GW is listed in Table 11.

Table 11: GW Protection & Control Relay Failure History

Date	Identified Issue	Identified Cause and Rectification
2016	Relay Health Alarm	GW1 Feeder Relay Failure
2016	Relay Health Alarm	GW7 Feeder Relay Failure
2019	Output contact failure	GW11 Feeder Relay Output Contact Failure
2019	Relay Health Alarm	GW4 Feeder Relay Analogue Error (Power Supply Error)
2022	Relay Health Alarm	Station Master Earth Fault Relay Failure (Alarm)

[9] UE: Distribution Annual Planning Report. Available at: https://dapr.unitedenergy.com.au/ue_data/UE-PL-2209%20Distribution%20Annual%20Planning%20Report%20DAPR%20-%202023.pdf

5.2.2 Circuit Breaker Condition

The 22 kV Email/Westinghouse 345GC circuit breaker type failure history across the UE network. These are the same circuit breaker types used at GW. The circuit breaker type has a history of being prone to animal and bird faults. The most recent 22 kV Email/Westinghouse type 345GC circuit breaker defects at GW are listed in Table 12.

Table 12: GW Circuit Breaker Defects History

Date	Identified Issue	Identified Cause and Rectification
2020	Trip Coil	GW12 Feeder CB replace broken trip coil Pin
2020	Leaking	GW8 Feeder CB low oil
2021	Structural Damage	GW12 Feeder CB support structure rusted
2022	CB Earth Bond	GW #3 Capacitor Bank CB earthing bond performing poorly
2022	CB Earth Bond	Solenoid box bond performing poorly
2024	Structural Damage	GW12 cracked welds on contact support
2024	Bushing Defect	GW7 Feeder CB White Phase Bushing broken seal
2024	Bushing Defect	GW7 Feeder CB Blue Phase Bushing broken seal

5.2.3 Control Building Condition

The control building defect history at GW is extensive, indicative of the age of this building and its construction type. The most recent defects are listed in Table 13.

Table 13: GW Control Building Defects History

Date	Identified Issue	Identified Cause and Rectification
2012	Roof, Gutter Defect	Repaired hole in the ceiling.
2012	Lighting System Defective	Control room lights not working; wiring repaired.
2012	Window Issue	Re-painting control room window.
2013	Locks Defective	Control room security.
2014	Door, Defect	Door not closing, faulty latch.
2014	Roof, Gutter Defect	Repaired hole in the ceiling.
2014	Painting Deteriorated	Windows needed painting.
2015	LV Fuse/CB Problem	GPO in mess room requires replacement.
2015	Painting deteriorated	Painted control room doors.
2015	Roof, Gutter Defect	Repair ceiling panels coming away.
2015	Roof, Gutter Defect	Control room building roof corroded; repaired / replaced.
2016	Door, Gate Defect	Control room door latch broken / replaced.
2019	Air-Conditioning / Ventilation System Defect	Air conditioner broken, replaced.
2019	Plumbing Problems	Replace cracked toilet bowl.
2019	Door, Gate Defect	Broken control room steps.
2019	Lighting System Defective	No emergency exit lights; repaired.
2019	Lighting System Defective	Control room fluorescent tubes changed.
2019	Animal Other / Vermin problem	Control room damage by fox entering.
2019	Window Issue	Window painting.

Date	Identified Issue	Identified Cause and Rectification
2019	Plumbing Problems	Repair gutter and spoon drain.
2019	Painting deteriorated	Window painting.
2020	Toilet Defect	Toilet leaking water / repaired plumbing.
2021	Battery Room Fan	Battery room exhaust fan not working / replaced
2023	Animal Other / Vermin problem	Fox den under the control building.
2024	Lighting System Defective	Fluorescent lights not working /replaced.

5.3 Quantification of the Identified Need

Table 14 quantifies the forecast impact of the identified network need on customers. The table shows over the forecasting period, the risk costs and hence the potential market benefits considered, including:

1. Expected unserved energy (EUE) cost, which is the value of the energy at risk after taking into account the probability of asset failures or malfunctions at GW, representing the deterioration in supply reliability within the GW supply area.
2. Safety risk cost, which is the cost of harm to UE's staff and the general public located within the GW supply area, as a result of safety incidents caused by asset failures or malfunctions at GW.
3. Total risk cost which is the sum of the EUE cost and the safety risk cost.

Table 14: Base Case GW Reliability and Safety Risk Quantification ($'000, Real 2024)

Financial Year	EUE Cost	Safety Risk Cost[10]	Total Risk Cost
2024	348	459	807
2025	376	483	859
2026	407	507	914
2027	438	533	970
2028	468	558	1,027
2029	500	585	1,085
2030	534	612	1,146
2031	572	639	1,210
2032	611	666	1,277
2033	651	694	1,345
2034	686	722	1,408
2035	721	750	1,470
2036	756	777	1,533
2037 - 2050	792 pa	805 pa	1,597 pa

For the purposes of this RIT-D, economic evaluations are undertaken over a 25-year period, commensurate with the asset life of secondary assets.

Table 15 provides a summary of the base case option, using the risk costs presented above.

[10] For simplicity, no AFAP disproportionate factors have been applied to the Safety Risk Cost.

Table 15: Base Case

Option	Description
Do Nothing (status quo)	This base case option involves running the GW secondary systems, circuit breakers and control building to failure. That is, continue with existing maintenance of this equipment, coupled with replacement upon failure. Given this option does not address the identified need at all, the cost of unplanned asset failures is represented by the full value of both the EUE and the safety risk costs. The present value of all costs (EUE and safety risk) is $21.12 million (Real, 2024).

6. Key Assumptions on the Identified Need

6.1 Method for Quantifying the Identified Need

UE adopts its Asset Risk Quantification Guide (UE-GU-2011) in quantifying safety and reliability risks associated with asset condition failures and their consequences. This modelling is based on Weibull distribution parameters for each asset class.

UE calculates the impact of changes in safety and reliability (in the form of involuntary load shedding), by comparing the total value of the safety cost and value of EUE under the base case (where no action is undertaken by UE) with each of the credible options in place using the assumptions below.

6.1.1 Safety

The safety risk to UE employees and the general public, arising from potential failure or malfunction of network assets is quantified by UE using an annualised safety risk cost, based on the asset conditions. The safety risk cost provides a measure of the expected financial value of the safety risk event. The safety risk cost is defined as the probability weighted cost of consequences, with the likelihood of consequences being the moderating factor in quantifying the risk.

The Electricity Safety Act[11] requires UE 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 from managing those risks. As such, UE's approach to safety risk is based on the As Far As Practicable (AFAP) principle.

In implementing this principle for assessing safety risks from asset condition failures, UE uses a Value of Statistical Life (VSL) to estimate the benefits of reducing the risk of death, a value of Lost Time Injury (LTI) to estimate the benefits of reducing the risk of injury, and a disproportionality factor. UE notes that this approach, including the use of a disproportionality factor[12], is consistent with practice notes provided by the AER[13], and is the approach taken by other network service providers within the NEM.

The AFAP principle recommends safety risk reduction measures be implemented unless the cost, time or form of the risk reduction measure is grossly disproportionate to the benefit gained from the reduced risk. A "Do Nothing" (or run to failure) approach would result in the poor condition assets remaining in service, deteriorating further, and completely failing to address any safety concerns.

6.1.2 Reliability

UE's reliability planning standard for its zone substation assets is based on a probabilistic planning approach which quantifies annualised EUE (in MWh per annum) of energy not supplied, taking into account the network capacity, demand characteristics, unavailability of an asset due to a failure (or malfunction), and the restoration time. The value of EUE is expressed financially by multiplying the EUE with a locational Value of Customer Reliability (VCR) ($/MWh).

[11] Victorian State Government, Victorian Legislation and Parliamentary Documents, Electricity Safety Act 1998. Available at: https://www.legislation.vic.gov.au/in-force/acts/electricity-safety-act-1998/081.
[12] For simplicity, no AFAP disproportionate factors have been applied to the Safety Risk Cost.
[13] AER: "AER – Industry Practice Application Note – Asset Replacement Planning – January 2019". Available at: https://www.aer.gov.au/system/files/D19-2978%20-%20AER%20-Industry%20practice%20application%20note%20Asset%20replacement%20planning%20-%2025%20January%202019.pdf

6.2 Forecast Maximum Demand

Forecasts of the 10% PoE and 50% PoE summer maximum demand and power factor at GW are presented in Table 16 from UE's 2023 DAPR. These forecasts are based on an expected economic growth scenario.

Table 16: GW Maximum Demand Forecast (MVA)

Time Period	Power Factor	10% PoE	50% PoE
2024-25	1.00	62.1	57.4
2025-26	1.00	63.0	58.0
2026-27	1.00	64.3	58.7
2027-28	1.00	64.8	59.5
2028-29	1.00	65.5	60.1

6.3 Characteristic of Load Profile

UE has prepared load profiles that are characterised by the use of profiles from the most recent 50% PoE year. Based on this approach, the 2022/23 historical demand profile has been prepared and presented herein.

The coincident maximum demand of the customers within the GW supply area occurs during working weekday periods. The annual demand profile at GW expressed as a percentage of the 50% PoE maximum demand listed in Table 16, is illustrated in Figure 3.

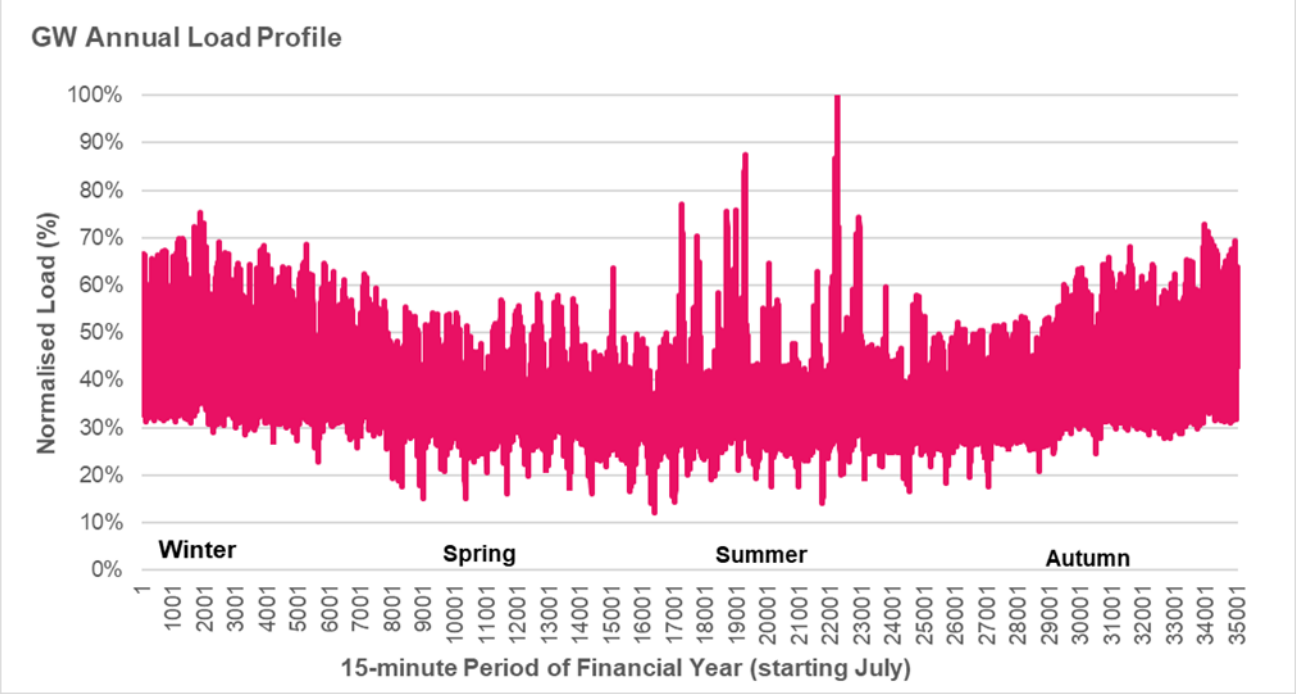

Figure 3: Annual Load Profile at GW

The load profile on the day of a 50% PoE summer maximum demand is illustrated in Figure 4. The prominence of air-conditioning load within the GW supply area, results in a maximum demand occurring during the early evening as the solar PV output subsides.

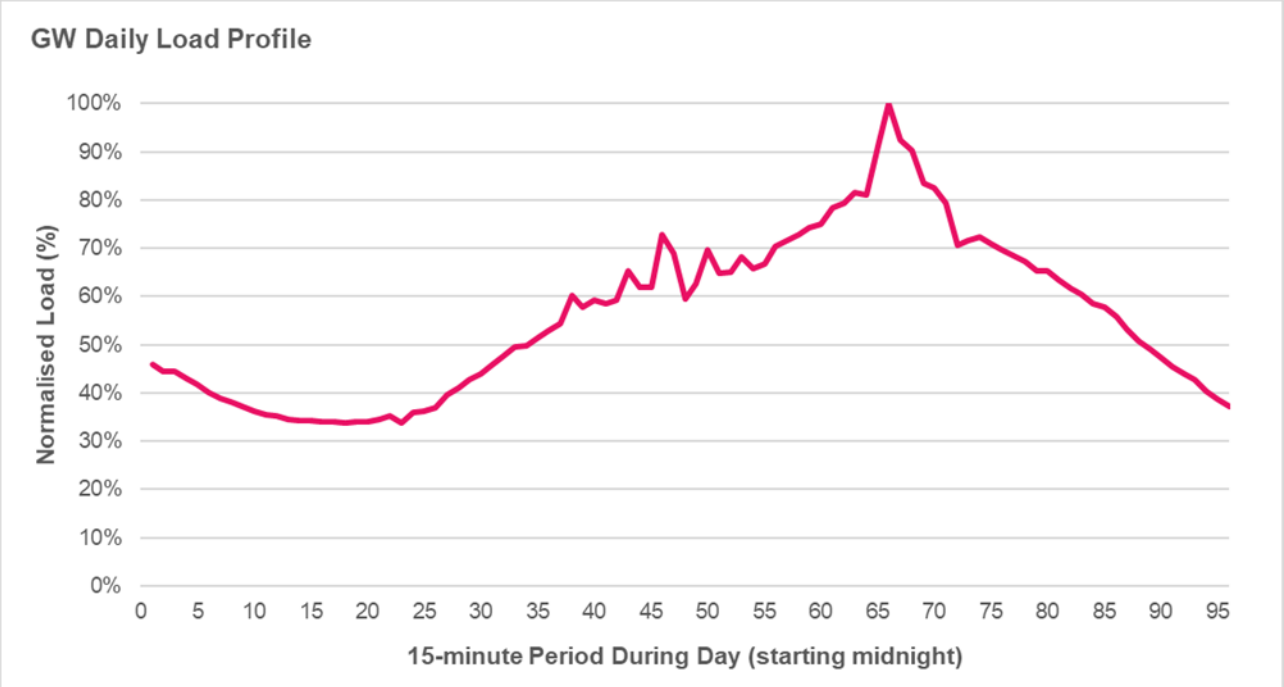

Figure 4: Load Profile on Day of Annual Maximum Demand at GW

Figure 5 shows the normalised annual load-duration curve at GW for a 50% PoE maximum demand year.

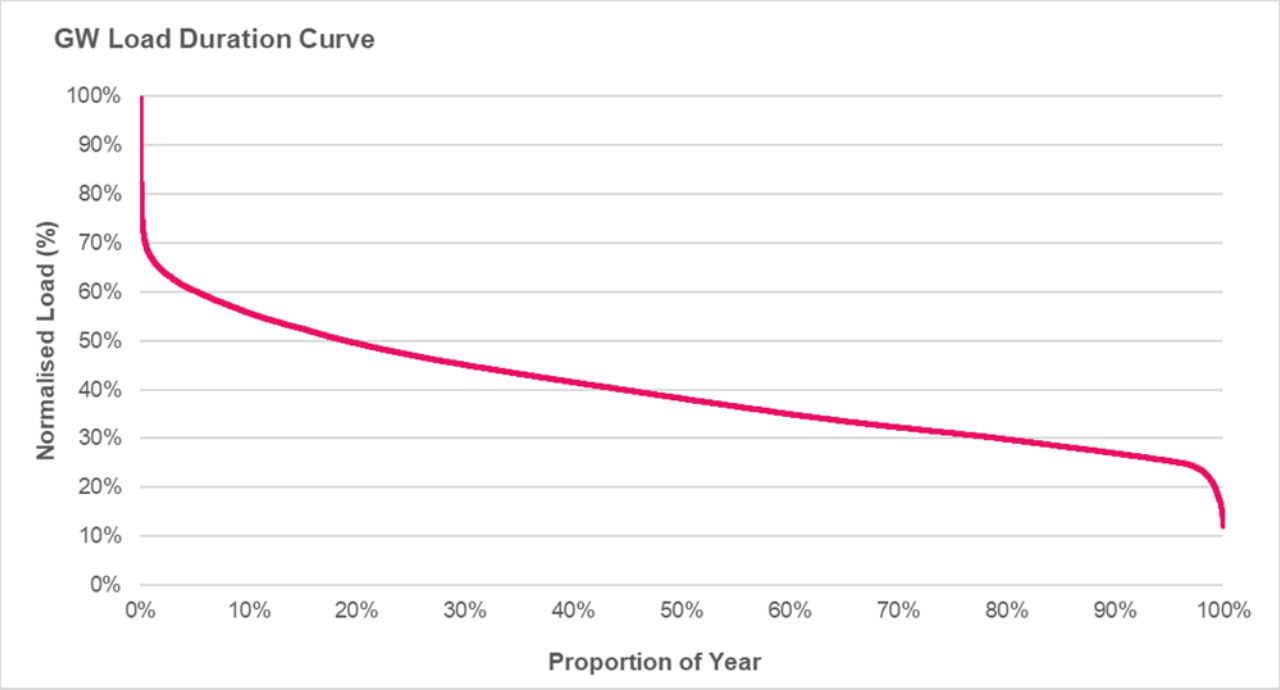

Figure 5: Annual Load-Duration Curve at GW

The load characteristics can vary marginally from year to year due to changes in weather, solar generation systems growth, and underlying changes in the customers' load usage. Figure 5 shows that load in excess of 80% of the maximum demand lasts for less than 1% of the year. This shows that GW has a higher penetration of air conditioning cooling which operates for a very small fraction of the year.

6.4 Load Transfer Capacity and Supply Restoration Times

The load transfer capability between GW and the neighbouring networks RWT, EB, MGE and NO (among others) is forecast to be 18.5 MVA for summer 2024/25.

Future load transfer capability levels between GW and the neighbouring network are assumed to remain relatively constant.

Customers' supply is normally restored within 60 minutes following the loss of a major plant item (i.e. a zone substation transformer, or distribution feeder).

6.5 Asset Ratings

The existing capabilities of GW zone substation for summer and winter are presented in Table 17 for all plant in service (N), and for one transformer out of service (N-1).

Table 17: Summary of GW Ratings (MVA)

Zone Substation	Summer Cyclic Rating at 40°C		Winter Cyclic Rating at 10°C	
	N	N-1	N	N-1
GW Import[14]	103.2	68.8	119.2	79.5
GW Export[15]	-84.0	-54.0	-84.0	-54.0

6.6 Value of Customer Reliability

Location-specific Value of Customer Reliability (VCR) is used to value reliability of supply. The locational VCR for the GW supply area was derived from the sector VCR estimates provided by the AER, weighted in accordance with the composition of the load, by sector, and escalated by CPI. This is summarised in Table 18.

Table 18: Summary of Location Specific VCR

Zone Substation	VCR ($ per MWh, Real 2024)
GW	42,020

6.7 Asset Failure Rates

The base (average) reliability and safety consequence data adopted in this assessment is presented in Table 19, Table 20 and Table 21 below. The data is based on observed UE asset failure rates.

Table 19: Summary of Asset Failure Rates and Hazard Function (Weibull Distribution Parameters)

Equipment	α parameter	β parameter
Electro-mechanical Relay (Failure to Operate)	6.0	75
Analogue Relay (Failure to Operate)	4.0	56
Digital / Numerical Relay (Failure to Operate)	3.0	36
Switchgear (Failure)	6.8	69

[14] Power flow towards customer load.
[15] Power flow towards the transmission network.

Table 20: Summary of Asset Reliability Consequence Probability

Equipment	Consequence	Probability
Electro-mechanical Relay (Reliability)	Bus Outage Feeder Outage	37% 16%
Analogue Relay (Reliability)	Bus Outage Feeder Outage	32% 16%
Digital / Numerical Relay (Reliability)	Bus Outage Feeder Outage	21% 9%

Table 21: Summary of Asset Safety Consequence Probability

Equipment	Consequence	Probability
All Protection Relays (Safety)	Injury Death – Public Death – Staff	0.0260% 0.0115% 0.1960%

6.8 Value of Safety Consequence

Values of safety consequence used in this RIT-D are derived from various sources including Safe Work Australia[16] for LTI, and the Department of Prime Minister and Cabinet, Best Practice Regulation Guidance Note[17] for VSL, (adjusted to Real 2024). These values of safety consequence are summarised in Table 22.

Table 22: Summary of Safety Consequence Values

Safety Consequence	Value of Safety Consequence ($'000, Real 2024)
Injury (LTI)	151
Death (VSL)	5,362

6.9 Discount Rates

To compare cash flows of options with different time profiles, it is necessary to use a discount rate to express future costs and benefits in present value terms. The choice of discount rate will impact on the estimated present value of net market benefits and may affect the ranking of alternative options. A real, pre-tax discount rate of 4.43 per cent is applied.

[16] 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

[17] Department of the Prime Minister and Cabinet, Australian Government, Best Practice Regulation Guidance Note: Value of statistical life. Available at: https://oia.pmc.gov.au/resources/guidance-assessing-impacts/value-statistical-life

7. Credible Options

UE presented eight options (network, non-network and standalone power system) in the Notice of Determination for the Glen Waverley Zone Substation Secondary Assets, Switchgear and Control Building Condition identified need. Only two network options were regarded as being credible for the reasons set out in that report and assessed in the DPAR. Details of those credible options assessed in this RIT-D against the base case are presented in Table 23.

Table 23: Credible Options Assessed in this RIT-D

Option	Description
1 - Proactive Relay, Control Building and Switchyard Replacement. (i.e. Indoor switchboard).	This option involves a renewal of secondary systems and the 22 kV switchyard in a new control and switchgear building. This option is the most economically viable option. It addresses network reliability and safety risks to AFAP. It realises synergies and economies of sale by combining secondary system and 22 kV switchyard replacement works and provides a reduction in commissioning risk. The total capital cost of this option is $14.80 million (Real, 2024). The present value of all costs (capital, O&M, EUE and safety risk) is $16.24 million (Real, 2024).
2 - Proactive Relay and Control Building Replacement. (i.e. Switchyard status-quo).	This option involves a renewal of the secondary systems only in a new control room. This option addresses secondary systems and control building risks only. The total capital cost of this option is $11.58 million (Real, 2024). The present value of all costs (capital, O&M, EUE and safety risk) is $16.84 million (Real, 2024).

The purpose of the RIT-D is to identify the preferred option, being the credible option that maximises the present value of net market benefit to all those who produce, consume and transport electricity in the National Electricity Market (NEM). In order to quantify the net market benefits of each credible option, the value of EUE and safety risk cost under the base case (where no action is taken by UE) is compared against the value of EUE and safety risk cost with each of the credible options in place.

8. Submissions to the DPAR

This section summarises the consultation to date and the submissions received on the DPAR.

A RIT-D Stage 1: Notice of Determination, published on UE's website on 26 June 2024, was prepared to present the potential options being considered and establish whether the proposed network solution to address the need, could be changed in scope or otherwise altered in response to a non-network or SAPS solution.

It was concluded that there would unlikely be any potential credible non-network or SAPS options (or any combination of those options, or with a network option) that could adequately and economically address the identified need within the GW supply area.

A RIT-D Stage 2: Draft Project Assessment Report, published on UE's website on 15 July 2024, was prepared for consultation and presented the economic evaluation of the credible options and identified the proposed preferred option.

Option 1 was identified as the proposed preferred option, comprising of the proactive relay, control building and switchyard replacement. (i.e. Indoor switchboard) at GW.

There were no submissions received by UE on the DPAR during the consultation period.

9. Market Modelling Methodology

The RIT-D requires market benefits identified to be material, to be calculated by comparing the state-of-the-world in the base case (where no action is undertaken by UE), against each of the credible options in place. The states-of-the-world are a range of reasonable and mutually consistent scenarios of credible supply and demand characteristics and conditions that may affect the calculation of the market benefits over the period of assessment. The selection of the preferred option is informed by a weighting of all the reasonable scenarios.

The RIT-D economic analysis has been undertaken over a 25-year period, commensurate with the long-lived nature of the investments considered in this RIT-D assessment. For simplicity, the risk modelling for calculation of market benefits is calculated across a forecast horizon up to 2037. The market benefits calculated in 2037 has been applied as the assumed annual market benefit that would continue to arise until the end of the 25-year period.

Furthermore, a set of sensitivity studies is undertaken on the preferred option by varying key input variables, to test the economic viability and rank of the preferred option against other options and the base case, for all credible changes in assumptions.

9.1 Classes of Market Benefits Considered Material

The purpose of the RIT-D is to identify the credible option that maximises the present value of net market benefits to all those who produce, consume and transport electricity in the National Electricity Market (NEM).

In order to measure the increase in net market benefit, UE has analysed the classes of market benefits required to be considered by the RIT-D.[18] The classes of market benefits that are considered material and have been quantified in this RIT-D assessment are:

- Changes in safety risk costs[19]; and
- Changes in involuntary load shedding.

9.1.1 Changes in Safety Risk Cost

Reducing the likelihood of asset failure by addressing poor condition assets provides a better safety outcome for the supply area, by reducing potential safety incidents and the consequential risk of harm to UE's personnel and the wider community. At GW, the safety risk cost is considered to be material. The method used by UE in quantifying changes in safety risk cost is described in Section 6.1.1.

9.1.2 Changes in Involuntary Load Shedding

Reducing the likelihood of asset failure by addressing poor condition assets provides a greater reliability for the supply area, by reducing potential supply interruptions and the consequential risk of involuntary load shedding. At GW, the reliability risk cost (expressed as the value of EUE) is considered to be material. The method used by UE in quantifying changes in involuntary load shedding is described in Section 6.1.2.

9.2 Classes of Market Benefits Not Expected to be Material

UE considers that the following classes of market benefit are not likely to be material for this RIT-D assessment:

- Changes in load transfer capacity and the capacity of embedded generating units to take up load;
- Changes in electrical energy losses;
- Changes in voluntary load curtailment;
- Changes in costs to other parties;
- Difference in timing of expenditure; and
- Additional option value.

[18] NER: clause 5.17.1(c) paragraph 4.

[19] UE notes that use of a safety risk cost as a class of market benefit is consistent with practice notes provided by the AER, and is the approach taken by other network service providers within the NEM. Refer to: "AER – Industry Practice Application Note – Asset Replacement Planning – January 2019". Available at: https://www.aer.gov.au/system/files/D19-2978%20-%20AER%20-Industry%20practice%20application%20note%20Asset%20replacement%20planning%20-%2025%20January%202019.pdf

9.2.1 Changes in Load Transfer Capacity and the Capacity of Embedded Generating Units

The modelling undertaken in Section 9.1.2 considers load transfer that may be expected to occur with each of the credible options in place. Changes in load transfer capability is not expected to be materially different between any of the credible options considered, or with the base case. Furthermore, changes in the capacity of embedded generating units to take up load is not expected to be materially different between any of the credible options considered, or with the base case.

9.2.2 Changes in Electrical Energy Losses

The differences in electrical energy losses between credible options and with the base case is considered to be negligible.

9.2.3 Changes in Voluntary Load Curtailment

Voluntary load curtailment is where customers agree to voluntarily curtail their electricity under certain circumstances, such as during a network asset outage event. The customer will typically receive an agreed payment for making load available for curtailment, and for actually having it curtailed during a network event. A credible demand-side reduction option leads to a change in the amount of voluntary load curtailment.

In its Notice of Determination, UE assessed the potential for voluntary load curtailment within the GW supply area. It was identified from that report that the potential for voluntary load curtailment was immaterial to address the identified need. Therefore, this market benefit is not quantified for this RIT-D, as it was considered to be not material to differentiate between credible options, or with the base case.

9.2.4 Changes in Costs to Other Parties

There are no material market benefits (or costs) associated with changes in costs to other parties in this instance.

9.2.5 Difference in Timing of Expenditure

UE has determined that the timing of other unrelated expenditure is not impacted by the options considered in this assessment. Therefore, this market benefit is not quantified, as it was not considered to be relevant to differentiate between options that address the need within the GW supply area.

9.2.6 Additional Option Value

Additional option value is likely to arise where there is uncertainty regarding future outcomes, the information that is available in the future is likely to change, and if the credible options considered by UE are sufficiently flexible to respond to that change.

In the context of the GW supply area, it is noted that a key identified need relates to safety. As there is virtually no uncertainty in the condition of the assets further deteriorating over time, and that the current condition of the assets is not tenable under the AFAP principle, there is little value in retaining flexibility.

UE considers that the estimation of any option value benefits captured via the scenario analysis and comparison of the credible option under those scenarios would be adequate to meet the NER requirements to consider option value as a class of market benefit.

UE therefore does not propose to estimate any additional option value market benefit for this RIT-D assessment.

9.3 Costs of Credible Options

UE has estimated the capital costs of the credible options, based on actual costs from previous projects of a similar nature. They have been developed in-house by project estimators. UE estimates that the actual cost is within +/- 20 per cent of the capital cost used within this RIT-D. The capital and operating cost assumptions for each credible option considered in this RIT-D assessment are summarised in Table 24.

Table 24: Capital and Operating Costs of Credible Options ($'000, Real 2024)

Option	Capital Cost	Operational Cost (pa)
Base Case - Do Nothing	0	0
Option 1 - Proactive Relay, Control Building and Switchyard Replacement (i.e. Indoor switchboard).	14,797	(4)
Option 2 - Proactive Relay and Control Building Replacement (i.e. Switchyard status-quo).	11,579	(3)

The 25-year present value of capital, operating and risk costs for each credible option considered in this RIT-D assessment are summarised in Table 25.

Table 25: Present Value of Costs of Credible Options ($'000, Real 2024)

Option	Capital Cost	Operational Cost	Investment Cost (Net)	Risk Cost	Total Cost
Base Case - Do Nothing	0	0	0	21,124	21,124
Option 1 - Proactive Relay, Control Building and Switchyard Replacement (i.e. Indoor switchboard).	13,900	(52)	13,848	2,393	16,241
Option 2 - Proactive Relay and Control Building Replacement (i.e. Switchyard status-quo).	11,198	(44)	11,153	5,687	16,840

9.4 Scenarios

Clause 5.17.1 paragraph (c)(1) of the NER requires the RIT-D to be based on a cost-benefit analysis that considers a number of reasonable state-of-the-world scenarios of future supply and demand.

The development of additional reasonable scenarios applied by UE for this RIT-D involved a process of applying a credible sensitivity on key input variables around a Central Scenario, to identify a credible Low Scenario and a credible High Scenario. A weighting is then assigned to each of the three scenarios, representing the likelihood of each of these state-of-the-world scenarios materialising. The Weighted Scenario is then used to identify the preferred option, as it inherently takes into account the uncertainty associated with different future states-of-the-world.

For the identified need in this RIT-D assessment, the major input variables that impact future reliability and safety outcomes within the GW supply area, are changes in the demand for electricity, and changes in the asset failure rates. Table 26 lists the variables and ranges adopted for the purpose of defining scenarios.

Table 26: Scenario Variables and Weightings

Scenario Definition	Low Scenario	Central Scenario	High Scenario
Weighting	25%	50%	25%
Maximum demand	90%	100%	105%
Asset failure rate	85%	100%	115%

9.5 Sensitivities

In order to test the robustness of the RIT-D preferred option to changes in assumptions, a set of sensitivities to key input variables to the analysis has been applied. Table 27 lists the variables and ranges adopted for the purpose of informing sensitivity analysis.

Table 27: Sensitivity Analysis Variables

Sensitivity Testing	Lower Bound	Base Value	Upper Bound
Maximum demand	90%	100% - Refer Section 6.2.	105%
Capital and operational costs	80%	100% - Refer Section 9.3.	120%
Value of customer reliability	80%	100% - Refer Section 6.6.	120%
Discount rate	2.22%	4.43% - Refer Section 6.9.	6.65%
Asset failure rates	85%	100% - Refer Section 6.7.	115%

10. Results of Analysis

The results of the Net Present Value (NPV) cost-benefit analysis for each of the credible options considered in this RIT-D assessment, for each scenario are detailed below.

10.1 Gross Market Benefits

The gross market benefit is the sum of each of the individual categories of material market benefit, as quantified on the basis of the approach set out in Section 9.1, expressed in present value terms over the 25-year analysis period.

Table 28 and Table 29 summarises the present value of gross market benefits of Option 1 and Option 2 respectively.

Table 28: Gross Market Benefits Option 1 - Proactive Relay, Control Building and Switchyard Replacement.

Option 1 Scenario	Present Value ('000, Real 2024)		
	Avoided EUE Risk	Avoided Safety Risk	Gross Market Benefit
Weighted	8,874	9,796	18,670
Central	8,935	9,796	18,731
Low	6,836	8,327	15,162
High	10,790	11,265	22,055

Table 29: Gross Market Benefits Option 2 - Proactive Relay and Control Building Replacement.

Option 2 Scenario	Present Value ('000, Real 2024)		
	Avoided EUE Risk	Avoided Safety Risk	Gross Market Benefit
Weighted	7,766	7,617	15,384
Central	7,820	7,617	15,438
Low	5,982	6,475	12,457
High	9,443	8,760	18,203

The gross market benefits of Option 2 are lower than Option 1, hence Option 1 is preferred. Refer Section 10.4 for more information on the timing of each option.

Figure 6 shows the breakdown of gross market benefits for Option 1 and Option 2 for each year up to 2040 under the Central Scenario, assuming an implementation completion date from 2026/27 and 2025/26 respectively.

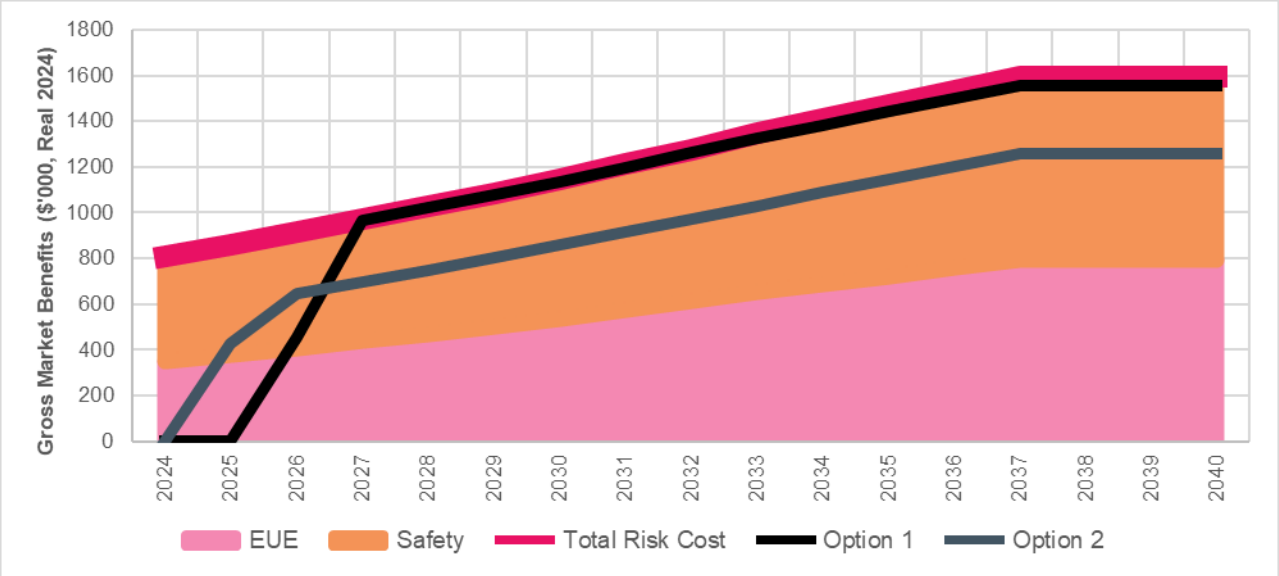

Figure 6: Gross Market Benefits: Central Scenario ($'000, Real 2024)

10.2 Net Market Benefits

Table 30 summarises the net market benefit in present value terms for each credible option over a 25-year analysis period, relative to the base case (Do Nothing). The net market benefit for Option 1 and Option 2 is the present value of gross market benefits, under the Weighted Scenario (as set out in Table 28 and Table 29 respectively), minus the present value of total investment costs of each option (as set out in Table 25).

The table also shows the corresponding ranking of each option under the RIT-D, with options ranked in the order of descending net market benefit.

Table 30: Net Market Benefits of Credible Options for the Weighted Scenario

Options	Present Value ('000, Real 2024)			
	Investment Cost	Gross Market Benefits	Net Market Benefits	Ranking Under RIT-D
Do Nothing	0	0	0	3
Option 1	13,848	18,670	4,822	1
Option 2	11,153	15,384	4,230	2

This RIT-D assessment demonstrates that Option 1 has the highest net market benefit under the Weighted Scenario.

10.3 Sensitivity Assessment

UE has tested the robustness of the RIT-D assessment to the inclusion of a number of sensitivity tests around the input assumptions adopted. These sensitivities were presented in Table 27. Table 31 shows the results of these sensitivity studies.

Table 31: Present Net Market Benefits of Credible Options - Sensitivities ($'000, Real 2024)

Sensitivity for Central Scenario	Option 1	Option 2
All Variables: Base value	4,883	4,284
Maximum demand: Lower bound	3,990	3,502
Maximum demand: Upper bound	5,330	4,675
Capital and operational costs: Lower bound	7,663	6,524
Capital and operational costs: Upper bound	2,103	2,044
Value of customer reliability: Lower bound	3,096	2,720
Value of customer reliability: Upper bound	6,670	5,848
Discount rate: Lower bound	10,822	9,224
Discount rate: Upper bound	1,752	941
Asset failure rates: Lower bound	2,073	1,968
Asset failure rates: Upper bound	7,693	6,600

Option 1 has a present value of net market benefit that remains positive under all credible sensitivities, and when compared with Option 2, clearly maintains its status as the preferred option under all credible sensitivities.

Table 32 presents the net market benefits in NPV terms for each option across all reasonable scenarios considered.

Table 32: Present Value of Net Market Benefits of Credible Options - Scenarios ($'000, Real 2024)

Scenario	Do Nothing		Option 1		Option 2	
	Net Market Benefit	Ranking	Net Market Benefit	Ranking	Net Market Benefit	Ranking
Weighted	0	3	4,822	1	4,230	2
Central	0	3	4,883	1	4,284	2
Low	0	3	1,314	1	1,304	2
High	0	3	8,207	1	7,049	2

For all reasonable scenarios considered, Option 1 maximises the present value of net market benefits for all scenarios, including under the Weighted Scenario (i.e. a weighting of the Central, Low and High Scenarios).

Under the RIT-D, the preferred option should maximise the present value of the net market benefits to all those who produce, consume and transport electricity in the NEM when compared to other credible options and the base case. This RIT-D assessment, based on the sensitivity results in Table 31 and the scenario results in Table 32, demonstrates that Option 1 maximises the present value of net market benefits under all reasonable sensitivities and scenarios considered.

The preferred option for investment for the GW supply area is therefore Option 1 Proactive Relay, Control Building and Switchyard Replacement. This option satisfies the requirements of the RIT-D.

10.4 Economic Timing

The previous Sections 10.2 and 10.3 demonstrate Option 1 to be the preferred option to address the identified need. Although the choice of the preferred option is clear, the optimum timing of this investment is not, given a number of reasonable scenarios are investigated. The economic timing of the preferred option is when the annualised value of EUE and safety risk cost (i.e. the annualised cost of the total risk) exceeds the annualised cost of the preferred option (i.e. the annualised investment cost). Table 33 shows the expected timing of the preferred option under each reasonable scenario.

Table 33: Expected Timing of the Preferred Option

Scenario	Annualised cost of total risk minus investment costs ('000, Real 2024)				Optimum Timing Before Summer[20]
Weighted	202	256	312	368	2024/25
Central	203	258	314	371	2024/25
Low	2	43	85	128	2024/25
High	398	466	535	604	2024/25

Although the optimum timing is identified as 2024/25, it is not practical to complete the works by this time. Therefore, considering the lead time, under the Weighted Scenario, the optimum timing of Option 1 is prior to summer 2026/27 (i.e. November 2026).

11. Preferred Option

Section 10 has presented the results of the NPV analysis conducted for this RIT-D assessment. This RIT-D assessment has demonstrated that Option 1 maximises the present value of net market benefits under all reasonable sensitivities and scenarios considered.

The preferred option for investment is therefore Option 1. This option involves a renewal of GW's secondary systems and the 22 kV switchyard in a new control and switchgear building, built to UE's latest design standards. This option addresses both the safety need and reliability need and maximises the present value of the net economic benefit to all those who produce, consume and transport electricity in the NEM, considering a set of reasonable state-of-the-world scenarios and their weightings.

The preferred option was tested under a range of sensitivities. In each case, Option 1 was confirmed to provide positive economic benefits in all sensitivities and is the highest-ranked option in all sensitivities.

The optimum timing for commissioning of the preferred option is no later than November 2026.

The preferred option has a capital cost of $14.8 million (Real, 2024).

12. Next Steps

This FPAR represents the final stage of the RIT-D process.

In accordance with the provisions set out in clause 5.17.5, paragraph (c) of the NER, Registered Participants or interested parties may, within 30 days after the publication of this report, dispute the conclusions made by UE in this report with the Australian Energy Regulator (AER).

Accordingly, Registered Participants and interested parties who wish to dispute the recommendation outlined in this report must do so by 10th October 2024. Any parties raising such a dispute are also required to notify UE at planning@ue.com.au. If no formal dispute is raised, UE will commence with the investment activities necessary to proceed with the implementation of the preferred option.

[20]The economic analysis concludes the optimum timing is 2024/25 however the preferred option cannot be constructed within this timeframe. Instead it can be constructed before the 2026/27 summer.

13. Checklist of Compliance with NER Clauses

This Section 13 sets out a compliance checklist which demonstrates the compliance of this FPAR with the requirements of clause 5.17.4, paragraph (r)(1) of the NER in Table 34.

Table 34: NER Requirements Checklist

NER Clause	Summary of Requirements	Relevant Section DPAR
5.17.4(j)(1)	A description of the identified need for investment	Section 5.2
5.17.4(j)(2)	The assumptions used in identifying the need (including, in the case of proposed reliability corrective action, why the RIT-D proponent considers reliability corrective action is necessary)	Section 6
5.17.4(j)(3)	A summary of, and commentary on, the submissions on the options screening report	Not Applicable
5.17.4(j)(4)	A description of each credible option assessed	Section 7
5.17.4(j)(5)	Where a Distribution Network Service Provider has quantified market benefits in accordance with clause 5.17.1(d), a quantification of each applicable market benefit for each credible option	Section 10.1
5.17.4(j)(6)	A quantification of each applicable cost for each credible option, including breakdown of operating and capital expenditure	Section 9.3
5.17.4(j)(7)	A detailed description of methodologies used in quantifying each class of cost and market benefit	Section 9.1
5.17.4(j)(8)	Where relevant, the reasons why UE has determined that a class or classes of market benefits do not apply to a credible option	Section 9.2
5.17.4(j)(9)	The results of a net present value analysis for each option and accompanying explanatory statements regarding the results	Section 10.2 Section 10.3
5.17.4(j)(10)	The identification of the preferred option	Section 11
5.17.4(j)(11)	Details of the preferred option including technical characteristics, construction timetable and commissioning date, the indicative capital and operating cost (where relevant), a statement and accompanying detailed analysis that the proposed preferred option satisfies the RIT-D, if the proposed preferred option is for reliability corrective action and that option has a proponent and the name of the proponent.	Section 11
5.17.4(j)(12)	Contact details for a suitably qualified staff member of the RIT-D proponent to whom queries on the final report may be directed.	Section 12
5.17.4(r)(1)(ii)	Summary of, and commentary on, the submissions on the Draft Project Assessment Report	Section 8

14. Appendix A GW Asset Photos

A significant proportion of the secondary systems, 22 kV outdoor circuit breakers and the control building within GW are in a poor condition. UE has assessed there is now an unacceptable risk of asset failure, with significant consequences for safety, and for the reliability of electricity supply to UE's customers within the GW supply area.



Figure 7: In-Service Secondary Systems, 22 kV Circuit Breakers & Control Building at GW