Regulatory Investment Test for Distribution (RIT-D)

West End Zone Substation Limitation

Final Project Assessment Report

27 April 2022

energex
Part of Energy Queensland

EXECUTIVE SUMMARY

About Energex

Energex Limited (Energex) is a subsidiary of Energy Queensland Limited and manages the electricity distribution network in the growing region of South East Queensland which includes the major urban areas of Brisbane, Gold Coast, Sunshine Coast, Logan, Ipswich, Redlands and Moreton Bay. Our electricity distribution area runs from the NSW border north to Gympie and west to the base of the Great Dividing Range.

Our electricity network consists of approximately 54,200 kilometres of powerlines and 680,000 power poles, along with associated infrastructure such as major substations and power transformers.

Today, we provide distribution services to more than 1.4 million domestic and business connections, delivering electricity to a population base of around 3.4 million people.

Identified Need

West End Zone Substation (SSWED) is fed via two 110kV feeders 905 (from Rocklea SSH16) and 830 (From Charlottes Street SSCST). SSWED is equipped with two 60MVA 110/11kV single winding transformers and provides electricity supply to approximately 9,200 predominately residential customers in the surrounding areas.

The ongoing operation of the ageing circuit breakers and protection relays beyond 2024 presents a significant risk to safety and customer reliability. The Protection department has also identified the need to upgrade current protection schemes configured on the assets.

As per STNW3039, SSWED has been classified as a critical site. Based on this classification, the current security system is deemed inadequate and must be upgraded to monitor the critical site. Civil Condition Assessments have identified various works such as building a new boundary retaining wall as well as various conduit and transformer bunding.

Approach

The National Electricity Rules (NER) require that, subject to certain exclusion criteria, network business investments for meeting service standards for a distribution business are subject to a Regulatory Investment Test for Distribution (RIT-D). Energex has determined that network investment is essential in this case for it to continue to provide electricity to the consumers in the West End supply area in a reliable, safe and cost-effective manner. Accordingly, this investment is subject to a RIT-D.

One feasible option has been investigated:

- **Option 1:** Establish new 11kV Switchboard

West End Zone Substation Limitation
Final Project Assessment Report

This Final Project Assessment Report (FPAR), where Energex provides both technical and economic information about possible solutions, has been prepared in accordance with the requirements of clause 5.17.4(o) of the NER.

Energex's preferred solution to address the identified need is Option 1 – Establish new 11kV Switchboard.

CONTENTS

1. INTRODUCTION

This FPAR has been prepared by Energex in accordance with the requirements of clause 5.17.4(o) of the NER.

This report represents the final stage of the consultation process in relation to the application of the RIT-D on potential credible options to address the identified need for the West End network area.

In preparing this RIT-D, Energex is required to consider reasonable future scenarios. With respect to major customer loads and generation, Energex has, in good faith, included as much detail as possible while maintaining necessary customer confidentiality. Potential large future connections that Energex is aware of are in different stages of progress and are subject to change (including outcomes where none or all proceed). These and other customer activity can occur over the consultation period and may change the timing and/or scope of any proposed solutions.

1.1. Structure of the Report

This report:

- Provides background information on the network capability limitations of the distribution network supplying the West End area.
- Identifies the need which Energex is seeking to address, together with the assumptions used in identifying and quantifying that need.
- Describes the credible options that are considered in this RIT-D assessment.
- Quantifies costs and classes of material market benefits for each of the credible options.
- Describes the methods used in quantifying each class of market benefit.
- Provides details of classes of market benefits that are not considered material to this RIT-D assessment and provides explanations as to why these classes of market benefits are not considered material.
- Provides the results of Net Present Value (NPV) analysis of each credible option and accompanying explanatory statements regarding the results.
- Identifies the proposed preferred option, including detailed characteristics, estimated commissioning date, indicative costs, and noting that it satisfies the RIT-D.
- Provides contact details for queries on this RIT-D.

1.2. Dispute Resolution Process

In accordance with the provisions set out in clause 5.17.5(a) of the NER, Registered Participants or Interested Parties may, within 30 days after the publication of this report, dispute the conclusions made by Energex in this report with the Australian Energy Regulator. Accordingly, Registered Participants and Interested Parties who wish to dispute the conclusions outlined in this report based on a manifest error in the calculations or application of the RIT-D must do so within 30 days of the publication date of this report. Any parties raising a dispute are also required to notify Energex. Dispute notifications should be sent to demandmanagement@energex.com.au

If no formal dispute is raised, Energex will proceed with the preferred option.

1.3. Contact Details

For further information and inquiries please contact:

E: demandmanagement@energex.com.au
P: 13 74 66

2. BACKGROUND

2.1. Geographic Region

SSWED supplies the suburbs of South Brisbane, West End and Highgate Hill. SSWED provides electricity supply to approximately 9,200 predominately residential customers in the surrounding areas. The geographical location of Energex's sub-transmission network and substations in the area is shown in Figure 1.

Figure 1: Existing network arrangement (geographic view).

2.2. Existing Supply System

SSWED is fed via two 110kV feeders 905 from Rocklea Bulk Supply Point (SSH16) and 830 from Charlotte Street Zone Substation (SSCST). SSWED is equipped with two 60MVA 110/11kV single winding transformers and provides electricity supply to approximately 9,200 predominately residential customers in the surrounding areas.

SSWED has four 11kV buses with TR3 supplying BB13, BB16 and TR4 supplying BB14, BB15. There are ACO schemes for bus section CBs between BB13, BB14 and BB15, BB16. In addition, there is a bus tie between BB14 and BB15. BB14 supplies three remote direct-connect customer substations. SSWED has been identified as one of the critical substations supplying the Olympic 2032 games infrastructure.

A schematic view of the existing sub-transmission network arrangement is shown in Figure 2.

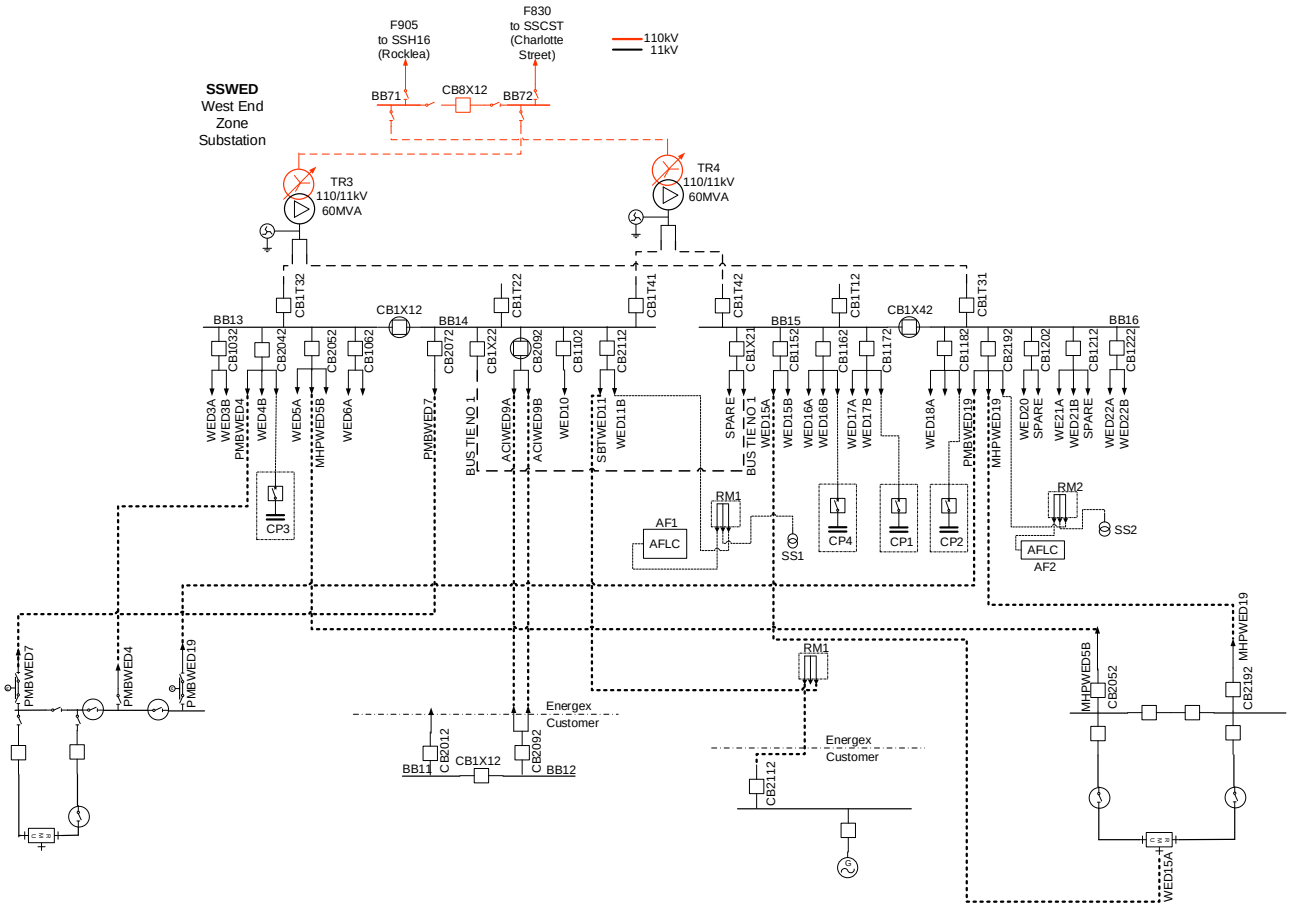


Figure 2: Existing network arrangement (schematic view)

2.3. Load Profiles / Forecasts

The load at SSWED comprises of largely residential customers. The load is summer peaking, and the annual peak loads are predominantly driven by residential power consumption.

2.3.1. Full Annual Load Profile

The full annual load profile for West End Substation over the 2020/21 financial year is shown in Figure 3. It can be noted that the peak load occurs during summer.

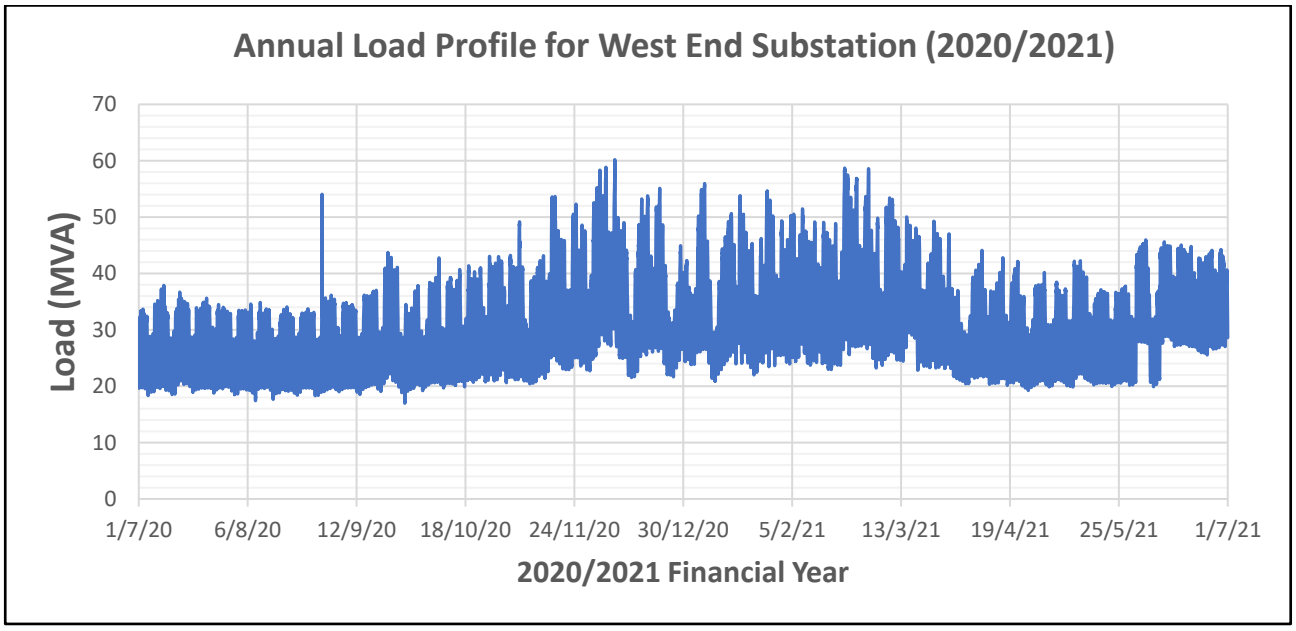


Figure 3: Substation actual annual load profile

2.3.2. Load Duration Curve

The load duration curve for West End Substation over the 2020/21 financial year is shown in Figure 4.

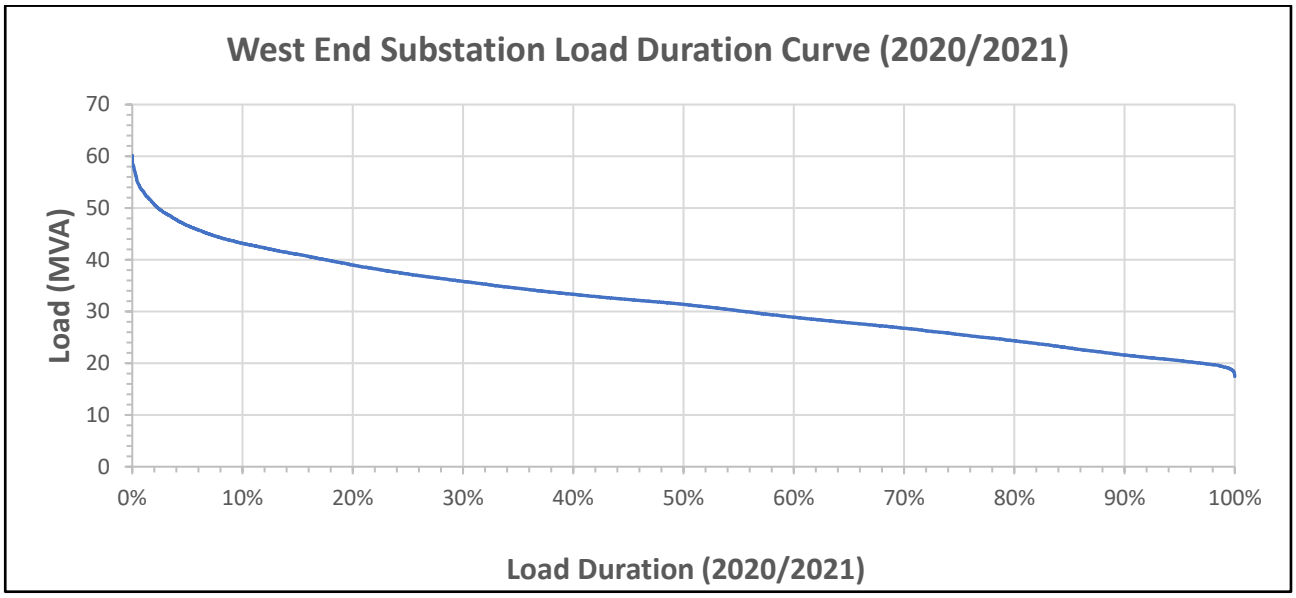


Figure 4: Substation load duration curve

2.3.3. Average Peak Weekday Load Profile (Summer)

The daily load profile for an average peak weekday during summer is illustrated below in Figure 6. It can be noted that the summer peak loads at West End Substation are historically experienced at midday and in the evenings.

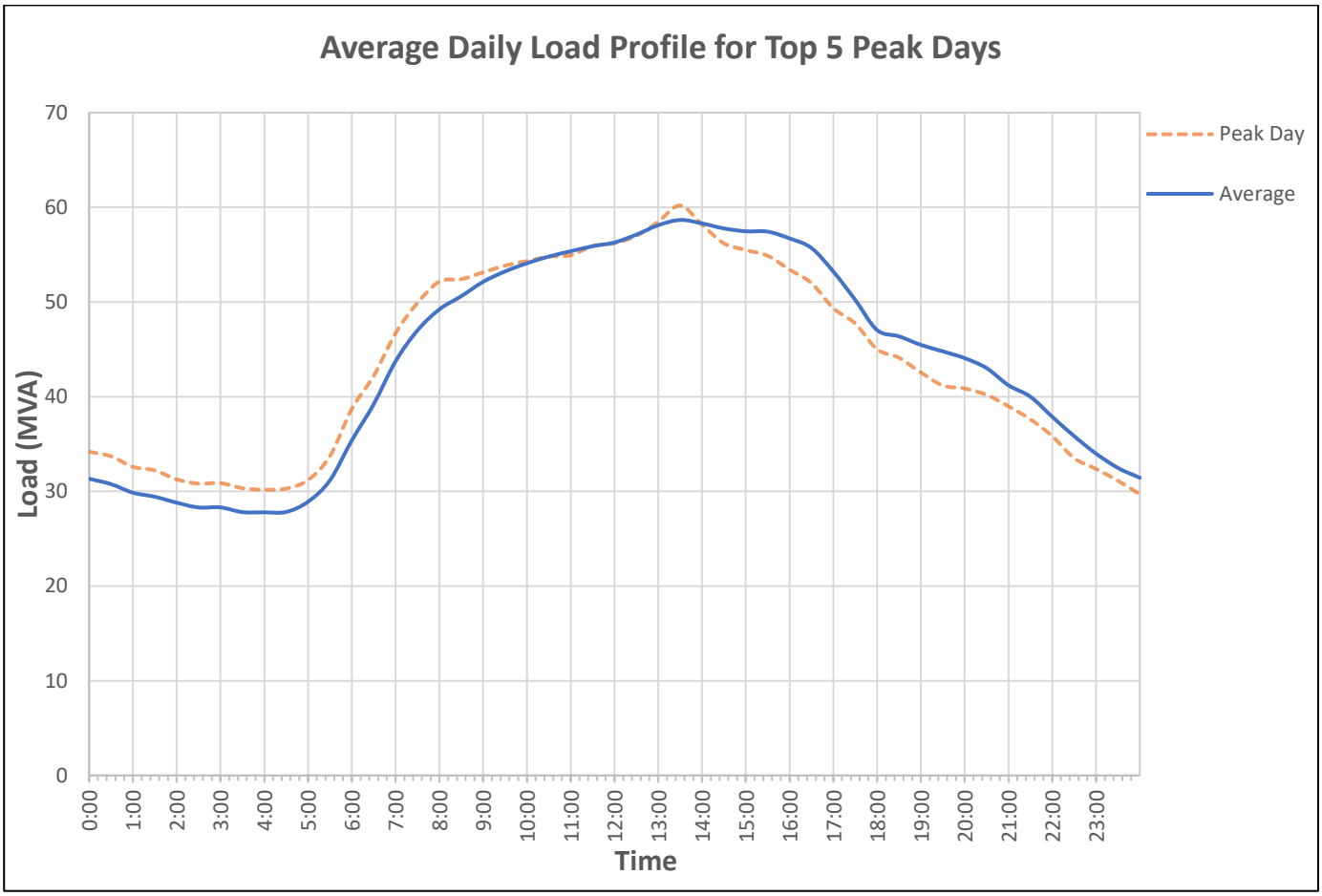


Figure 5: Substation average peak weekday load profile (summer)

2.3.4. Base Case Load Forecast

The 10 PoE and 50 PoE load forecasts for the base case load growth scenario are illustrated in Figure 6. The historical peak load for the past six years has also been included in the graph.

It can be noted that the historical annual peak loads have fluctuated slightly over the past five years. It can also be noted that the peak load is forecast to relatively steady over the next 10 years until experiencing a rapid increase in demand due to the upcoming Olympics under the base case scenario.

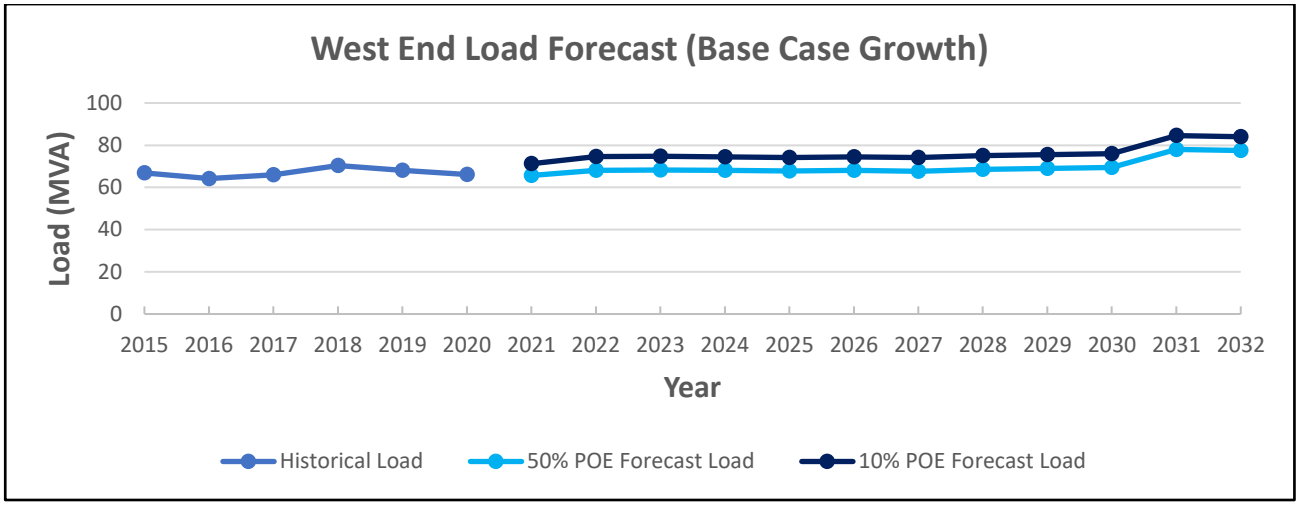


Figure 6: Substation base case load forecast

High Growth Load Forecast

The 10 PoE and 50 PoE load forecasts for the high load growth scenario are illustrated in Figure 7. With the high growth scenario, the peak load is forecast to relatively steady over the next 10 years until experiencing a rapid increase in demand due to the upcoming Olympics.

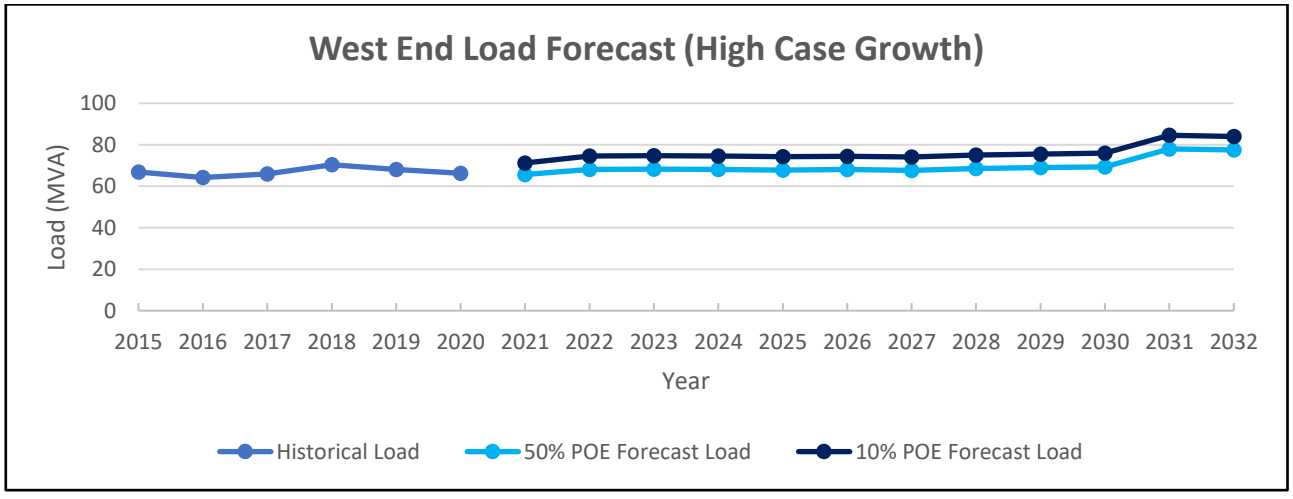


Figure 7: Substation high growth load forecast

2.3.5. Low Growth Load Forecast

The 10 PoE and 50 PoE load forecasts for the low load growth scenario are illustrated in Figure 8. With the low growth scenario, the peak load is forecast to remain relatively steady over the next 10 years until experiencing a rapid increase in demand due to the upcoming Olympics.

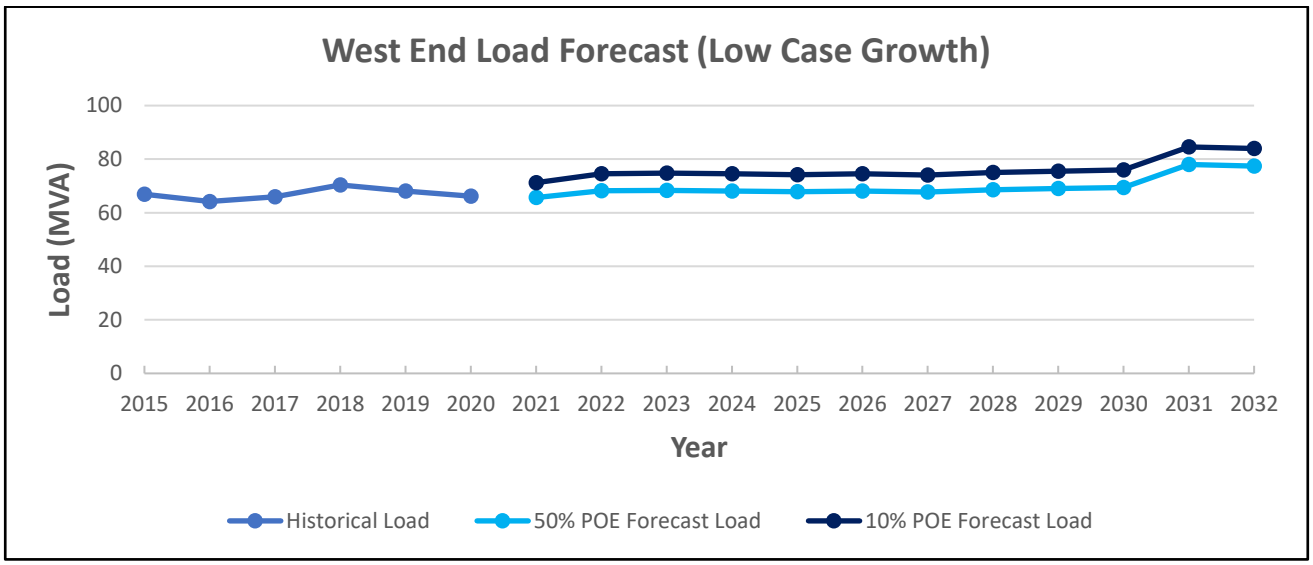


Figure 8: Substation low growth load forecast

3. IDENTIFIED NEED

3.1. Description of the Identified Need

3.1.1. Aged and Poor Condition Assets

A recent condition assessment has highlighted that a number of critical assets are at end of life and are in poor condition. The condition of these assets presents a considerable safety, environmental and reliability risk. These assets include:

- Six (6) 11kV Circuit Breakers
- Protection Relays on BB13 and 110kV bus

The deterioration of these primary and secondary system assets poses safety risks to staff working within the switchyard. It also poses a safety risk to the general public, through the increased likelihood of protection relay mal-operation. Without remediation, Energex views that the safety risk to the public and its staff to not be reduced to So Far As Is Reasonably Practicable.

The failure of both circuit breakers and protection relays significantly increases the likelihood of outages in addition to potential damage to existing infrastructure, resulting in a reduction in the level of reliability experienced by the customers supplied from West End Substation.

A recent condition assessment has highlighted that a number of critical assets are at end of life and are in poor condition. The condition of these assets presents a considerable safety, environmental and reliability risk.

3.1.2. Reliability

Currently the aged assets present a risk to the reliability of supply at West End. Figure 11 shows that the value of customer reliability by replacing the assets is over $800,000 after the first five years. The scenarios that have been considered are:

- 11kV feeder CB failure
- 11kV transformer CB failure
- Bus Section CB failure
- Protection Relay failure

For 11kV feeder and/or transformer CB failure it was assumed that up to half the load on the 11kV switchboard could potentially be lost; however, it was assumed that this load could be supplied by transfers within 3hrs. This provides a conservative estimate for the value of customer reliability (VCR). A bus fault would result in an outage to a quarter of 11kV customers, which affects over 2,300 customers and results in a load at risk of approximately 17.5MVA.

3.2. Quantification of the Identified Need

3.2.1. Aged and Poor Condition Assets

A recent condition assessment has highlighted that a number of critical assets are at end of life and are in poor condition. The condition of these assets presents a considerable safety, environmental and reliability risk.

Condition data indicates that the 11kV J18 oil circuit breakers and accompanying protection relays are reaching end of life.

The deterioration of these primary and secondary system assets poses safety risks to staff working within the switchyard. It also poses a safety risk to the general public, through the increased likelihood of protection relay mal-operation and failure of the circuit breakers. Additionally, the poor condition of these assets significantly increases the likelihood of outages, resulting in a reduction in the level of reliability experienced by the customers supplied from West End Substation.

Where Energex identifies an imminent asset safety risk, immediate temporary measures are put in place to ensure safety of staff and public until permanent remediation can be performed.

3.2.2. Reliability

Risk quantification analysis has been completed for Option 1 which includes the VCR and cost of emergency replacement (ERC). Figure 11 shows the benefits of Option 1 in comparison to the counter-factual, which in this case is continuing the use of the existing circuit breakers and maintenance and operation. The benefit of this option is greater than $1,000,000 by 2031 and increases to over $4,000,000 by 2059.

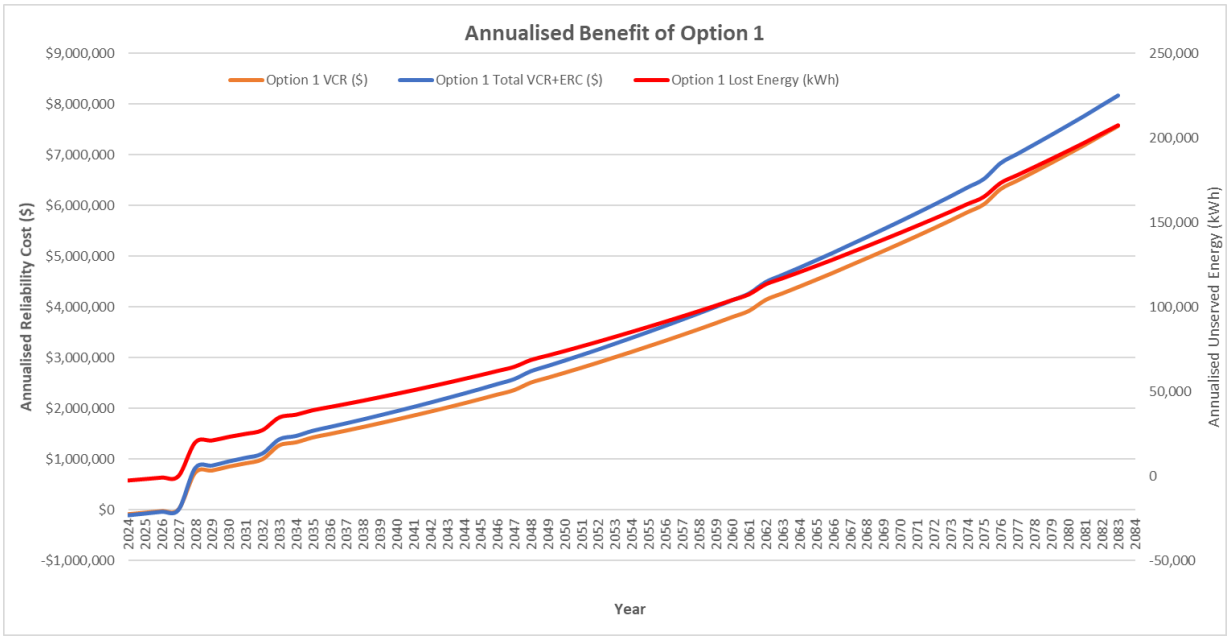


Figure 9: Annualised Benefits of Option 1 compared with Counter-factual

3.3. Assumptions in Relation to Identified Need

Below is a summary of key assumptions that have been made when the identified need has been analysed and quantified.

It is recognised that the below assumptions may prove to have various levels of correctness, and they merely represent a 'best endeavours' approach to predict the future identified need.

3.3.1. Forecast Maximum Demand

It has been assumed that forecast peak demand at West End Substation will be consistent with the base case forecast outlined in Section 2.3.4.

Factors that have been taken into account when the load forecast has been developed include the following:

- load history;
- known future developments (new major customers, network augmentation, etc.);
- temperature corrected start values (historical peak demands); and
- forecast growth rates for organic growth.

3.3.2. Load Profile

Characteristic average day load profiles shown in Section 2.3.3 are unlikely to change significantly from year to year and the shape of the load profile is assumed to remain virtually the same with increasing maximum demand.

4. CREDIBLE OPTIONS ASSESSED

4.1. Assessment of Network Solutions

Energex has identified one (1) credible network option that will address the identified need.

4.1.1. Option 1: Establish new 11kV Switchboard

This option involves the following works:

- Replace existing BB14 with new switchgear (6 x feeder CBs, 1 x transformer CB)
- Upgrade TR3 and TR4 protection to dual DIFF protection
- Upgrade 110kV BZ protection
- Replace identified EOL relays on BB13
- Improve backup protection reach on identified 11kV feeders on BB13
- Upgrade site security as per network asset classification
- Decommission the existing CO2 fire suppression system
- Replace 110kV surge arresters on TR3 and TR4
- Upgrade remote end protection (SSACI, SSSBT, SSPMB) to match SSWED end
- Provide FO communications (SSWED-SSACI, SSACI-SSPMB)
- Demolish existing boundary retaining wall and build new wall 3m high

A schematic diagram of the proposed network arrangement for Option 1 is shown in Figure 10.

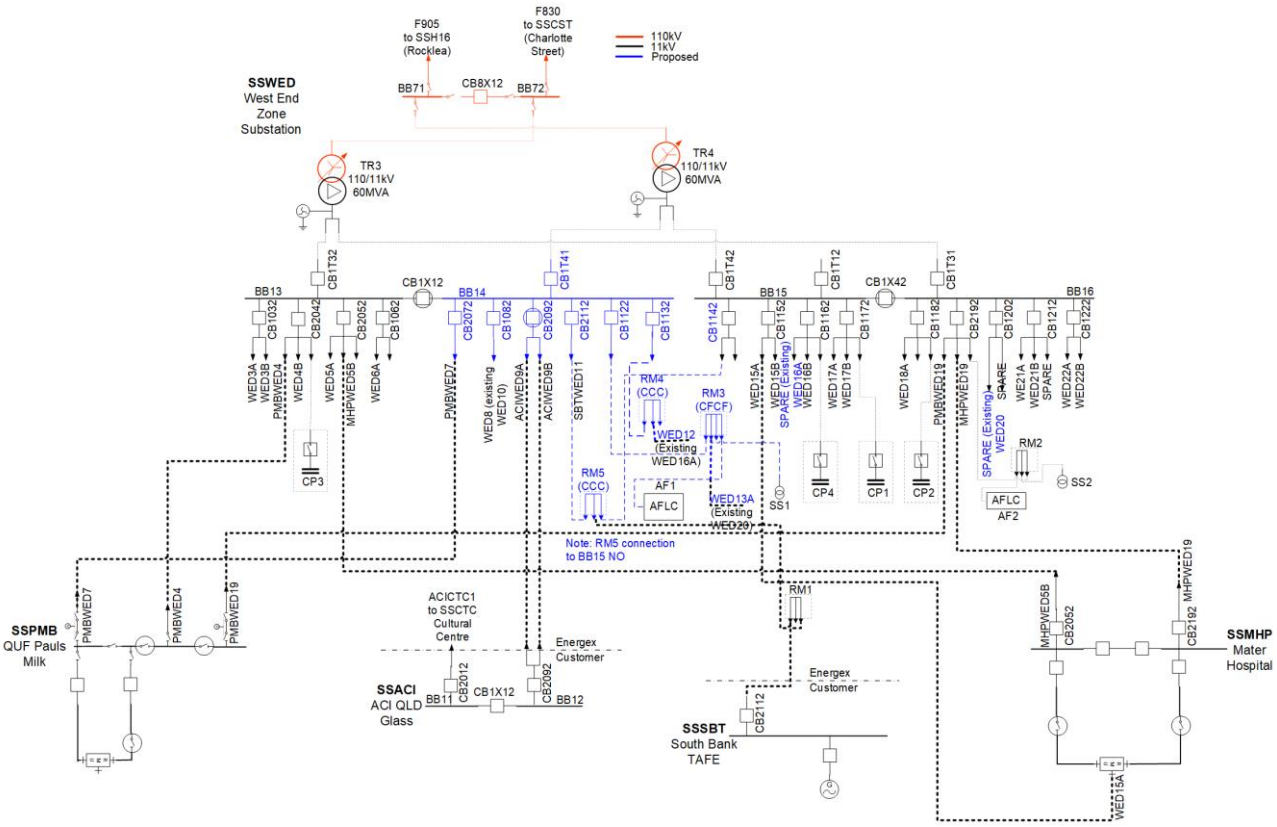


Figure 10: Option 1 proposed network arrangement (schematic view)

4.2. Assessment of Non-Network Solutions

Energex's Demand & Energy Management (DEM) team has assessed the potential non-network alternative (NNA) options required to defer the network option and determine if there is a viable demand management (DM) option to replace or reduce the need for the network options proposed.

Credible options must be technically and commercially viable and must be able to be implemented in sufficient time to satisfy the identified risk to the public and/or the network due to the identified constraints.

4.2.1. Demand Management (Demand Reduction)

A non-network investigation Energex normally undertakes is to assess the potential of Demand and Energy Management (DEM). However, for this project to be deferred, the 11kV load would need to be reduced to be zero (0) MVA, therefore demand reduction is not applicable.

4.2.1. Non-Network Solution Summary

Energex has not identified any viable non-network solutions internally that will provide a complete or a hybrid (combined network and non-network) solution to provide the magnitude of network support required in the West End area to address the identified need.

4.3. Preferred Network Option

Energex's preferred internal network option is Option 1, to Establish a new 11kV switchboard.

Upon completion of these works, the asset safety and reliability risks at West End Substation will be addressed. The preferred option will provide the greatest reliability benefit for customers, whilst also reducing expenditure on obsolete, non-compliant and high maintenance assets, while ensuring more efficient use of design and construction resources.

The estimated capital cost of this option inclusive of interest, risk, contingencies and overheads is $5.19 million. The change in annual operating and maintenance costs are anticipated to be immaterial. The estimated project delivery timeframe has design commencing towards the end of 2022 and construction completed by March 2024.

5. MARKET BENEFIT ASSESSMENT METHODOLOGY

The purpose of the RIT-D is to identify the 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, Energex has analysed the classes of market benefits required to be considered by the RIT-D.

5.1. Classes of Market Benefits Considered and Quantified

Value of Customer Reliability, or involuntary load shedding and avoidance of future emergency replacement of assets have been considered and quantified in this analysis. This can be seen in Section **Error! Reference source not found.** to have a material impact; and have therefore not been included in this RIT-D assessment. All Market benefits considered have been listed in section **Error! Reference source not found.** for completeness.

5.1.1. Changes in Involuntary Load Shedding

Involuntary load shedding is where a customer's load is interrupted from the network without their agreement or prior warning. As discussed in Section **Error! Reference source not found.** a number of scenarios exist where an in-service failure of substations assets would result in a network outage.

5.2. Classes of Market Benefits not Expected to be Material

The following classes of market benefits are not considered to be material for this RIT-D, and have not been included in this RIT-D assessment:

- Changes in voluntary load curtailment
- Changes in costs to other parties
- Changes in timing of expenditure
- Changes in load transfer capability
- Changes in network losses
- Option value

5.2.1. Changes in Voluntary Load Curtailment

Because none of the credible options include any voluntary load curtailment, and because there are no customers on voluntary load curtailment agreements in the West End area at present, any market benefits associated with changes in voluntary load curtailment have not been considered.

5.2.1. Changes in Costs to Other Parties

Energex does not anticipate that any of the credible options included in this RIT-D assessment will affect costs incurred by other parties.

5.2.1. Changes in Timing of Expenditure

None of the credible options included in this RIT-D assessment is expected to affect the timing of other distribution investments for unrelated identified needs.

5.2.1. Changes in Load Transfer Capability

None of the credible options included in this RIT-D assessment are expected to have an impact on the load transfer capability between the zone substations in the West End area.

5.2.1. Changes in Network Losses

Energex does not anticipate that any of the credible options included in the RIT-D assessment will lead to any significant change in network losses.

5.2.1. Option Value

The AER's view is that 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 the credible options considered by the RIT-D proponent are sufficiently flexible to respond to that change[1].

Energex does not consider that the identified need for the options included in this RIT-D would be affected by uncertain factors about which there may be more clarity in future.

[1] AER "Regulatory Investment Test for Distribution Application Guidelines", Section A6. Available at: http://www.aer.gov.au/networks-pipelines/guidelines-schemes-models-reviews/regulatory-investment-test-for-distribution-rit-d-and-application-guidelines

6. DETAILED ECONOMIC ASSESSMENT

6.1. Methodology

The RIT-D requires Energex to identify the credible option that maximises the present value of net economic benefit to all who produce, consume and transport electricity in the NEM.

Accordingly, a base case NPV comparison of the alternative development options has been undertaken. A sensitivity analysis was then conducted on this base case to establish the option that remained the lowest cost option in the scenarios considered.

Further to the scenarios considered, a Monte-Carlo analysis simulation was undertaken on the base case project timings to assess the projects' sensitivity to a change in the parameters of the NPV model.

6.2. Key Variables and Assumptions

The economic assessment contains anticipated costs of providing, operating and maintaining the options as well as expected costs of compliance and administration associated with each option.

The present value comparison summary includes all costs directly associated with constructing and providing the option. This includes the cost of land and easements currently owned or to be acquired for network augmentation.

Interest on borrowings is not included as a cost in the comparison of options as it represents a cost of project financing, and as such is accounted for in present value calculations through the discounting of the project cash flows at the regulated WACC. The interest on borrowings is included in the Total Project Cost for which approval is being sought as it represents a legitimate cost of network augmentation.

6.3. Net Present Value (NPV) Results

An overview of the initial capital cost and the base case NPV results are provided in **Error! Reference source not found.**.

Option	Option Name	Rank	Initial Capital Cost	Net Economic Benefit ($ real)	PV of Capex ($ real)	PV of Opex ($ real)	PV of Benefits ($ real)
1	Establish new 11kV Switchboard	1	$5,190,135	$77,731,886	-$7,500,000	$0	$85,231,886

Table 1: Base case NPV ranking table

Note: There is no material change in OPEX between the current network and Option 1, meaning the PV of OPEX is $0.

7. CONCLUSION

The FPAR represents the final stage of the consultation process in relation to the application of the RIT-D.

Energex intends to take steps to progress the proposed preferred option to ensure any statutory non-compliance is addressed and undertake appropriately justified network reliability improvements, as necessary.

7.1. Preferred Option

Energex's preferred option is Option 1, to establish a new 11kV Switchboard at West End Substation.

Upon completion of these works, the asset safety and reliability risks at West End Substation will be addressed. The preferred option will provide the greatest reliability benefit for customers, whilst also reducing expenditure on obsolete and non-compliant assets while ensuring more efficient use of design and construction resources.

The estimated capital cost of this option inclusive of interest, risk, contingencies and overheads is $5.19 million. The change in annual operating and maintenance costs are anticipated to be immaterial. The estimated project delivery timeframe has design commencing towards the end of 2022 and construction completed by March 2024.

7.2. Satisfaction of RIT-D

The proposed preferred option satisfies the RIT-D.

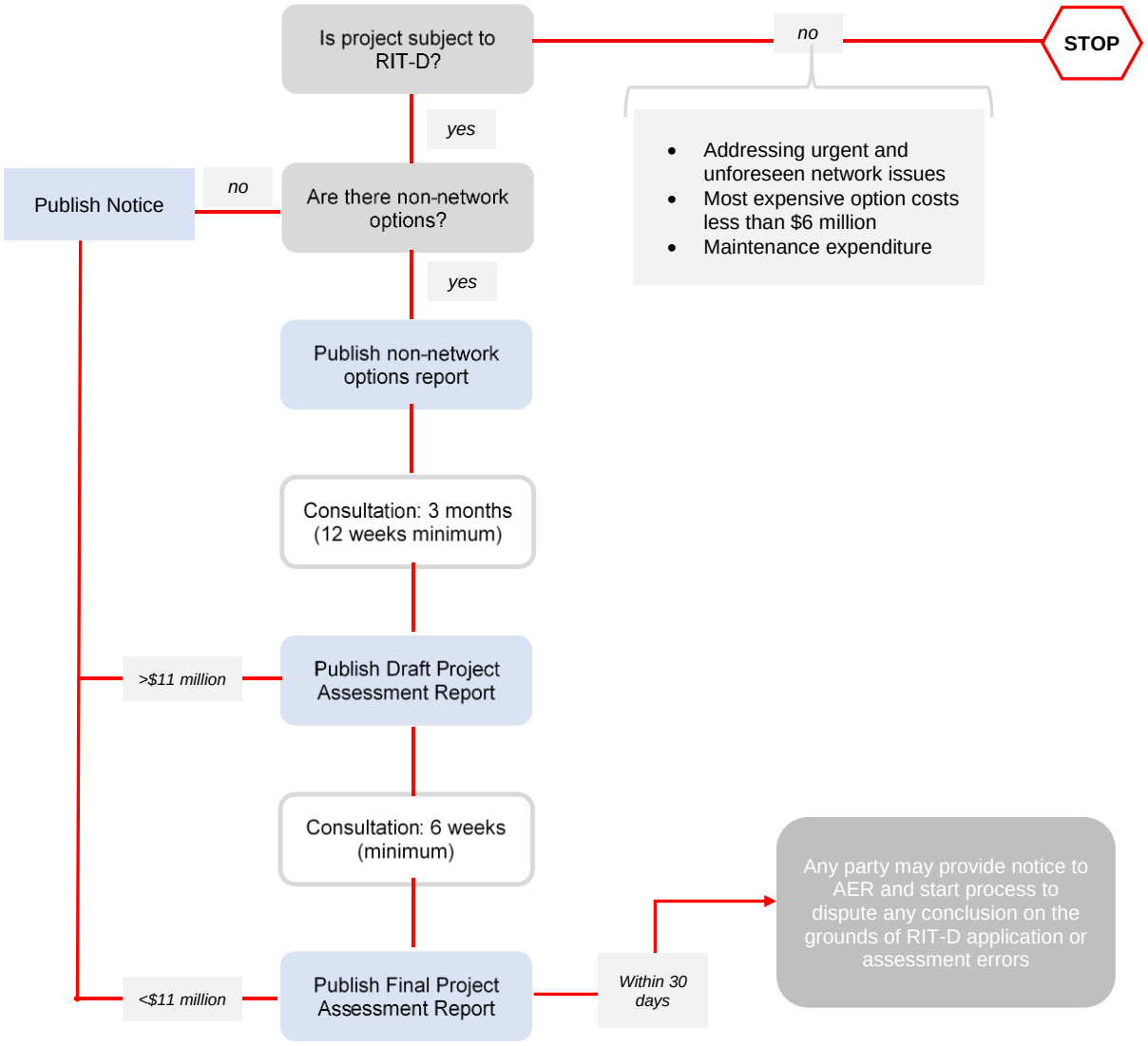
This statement is made on the basis of the detailed analysis set out in this report. The proposed preferred option is the credible option that has the highest net economic benefit under the most likely reasonable scenarios.

8. COMPLIANCE STATEMENT

This Final Project Assessment Report complies with the requirements of NER section 5.17.4(j) as demonstrated below:

Requirement	Report Section
(1) a description of the identified need for investment;	3
(2) the assumptions used in identifying the identified need (including, in the case of proposed reliability corrective action, why the RIT-D proponent considers reliability corrective action is necessary;	3.3
(3) if applicable, a summary of, and commentary on, the submissions received on the DPAR;	N/A
(4) a description of each credible option assessed	4
(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 of each credible option	5
(6) a quantification of each applicable cost for each credible option, including a breakdown of operating and capital expenditure	4
(7) a detailed description of the methodologies used in quantifying each class of costs or market benefit	5
(8) where relevant, the reasons why the RIT-D proponent has determined that a class or classes of market benefits or costs do not apply to a credible option	5.2
(9) the results of a NPV analysis of each credible option and accompanying explanatory statements regarding the results	6.3
(10) the identification of the proposed preferred option	7.1
(11) for the proposed preferred option, the RIT-D proponent must provide: (i) details of the technical characteristics; (ii) the estimated construction timetable and commissioning date (where relevant); (ii) the indicative capital and operating costs (where relevant); (iv) a statement and accompanying analysis that the proposed preferred option satisfied the RIT-D; and (v) if the proposed preferred option is for reliability corrective action and that option has a proponent, the name of the proponent	7.1 & 4.3
(12) contact details for a suitably qualified staff member of the RIT-D proponent to whom queries on the final report may be directed.	1.4

APPENDIX A – THE RIT-D PROCESS



Source: AEMC, *Rule determination: National Electricity Amendment (Replacement expenditure planning arrangements) Rule 2017*, July 2017, p. 64.