Regulatory Investment Test for Distribution (RIT-D)

Addressing Reliability Requirements in the Caboolture Network Area

Final Project Assessment Report

21 February 2023

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

Caboolture bulk supply substation (SST11) has six 33kV feeders supplying eight zone substations such as Caboolture West substation (SSCBW), Morayfield substation (SSMFD), Morayfield North substation (SSMFN), Wamuran substation (SSWMR), Caboolture substation (SSCBT), Ningi substation (SSNGI), Toorbul Point substation (SSTPT) and Bribie Island substation (SSBIS). SST11 provides electricity supply to predominantly domestic customers in the Caboolture, Campbells Pocket, Upper Caboolture, Elimbah, Meldale and Bribie Island areas.

According to Energex condition-based assessment (CBRM) report, it has been identified that four 110kV circuit breakers, six 33kV circuit breakers and protection relays are reaching end of life and require replacement.

The deterioration of these primary and secondary system assets poses safety risks to staff working within the switchyard, and reliability risk to the customers supplied from Caboolture Substation.

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 Caboolture supply area in a reliable, safe and cost-effective manner. Accordingly, this investment is subject to a RIT-D.

Energex published a Draft Project Assessment Report for the above-described network constraint on 6 January 2023. No submissions were received by the closing date of 20 February 2023.

One potentially feasible option has been investigated:

- **Option 1:** Replace four 110kV circuit breakers and six 33kV circuit breakers

Addressing Reliability Requirements in the Caboolture Network Area 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 – Replace four 110kV circuit breakers and six33kV circuit breakers.

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1. INTRODUCTION

This Final Project Assessment Report 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 Caboolture 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. Response to the DPAR

Energex published a Draft Project Assessment Report for the identified need in the Caboolture network area on the 6 January 2023. No submissions were received by the closing date of the 20 February 2023.

1.2. Structure of the Report

This report:

- Provides background information on the network capability limitations of the distribution network supplying the Caboolture 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.

1.3. 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 to replace four 110kV circuit breakers and six 33kV circuit breakers.

1.4. Contact Details

For further information and inquiries please contact:

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

2. BACKGROUND

2.1. Geographic Region

Caboolture bulk supply substation (SST11) provides electricity supply to predominantly domestic customers in the Caboolture, Campbells Pocket, Upper Caboolture, Elimbah, Meldale and Bribie Island areas, of which 57% are residential and 43% are commercial.

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

Caboolture bulk supply substation is supplied by two 110kV feeders 745/3 and 746/3 that are double circuit constructed on a single tower. Feeders 745/3 and 746/3 are teed into the existing double circuit transmission lines which are approximately 73km between Powerlink's South Pine substation (SSH2) and Palmwoods substation (SSH9).

There are six 33kV feeders from SST11 supplying eight zone substations such as Caboolture West substation (SSCBW), Morayfield substation (SSMFD), Morayfield North substation (SSMFN), Wamuran substation (SSWMR), Caboolture substation (SSCBT), Ningi substation (SSNGI), Toorbul Point substation (SSTPT) and Bribie Island substation (SSBIS).

There is a normally opened 33kV feeder 3251 between SSMFD and Burpengary (SSBGY) zone substation, which could enable Hays Inlet (SSHIL) bulk supply substation to provide remote transfer supply to around half of SSMFD.

SST11 has three 80MVA 110/33kV transformers, two 33kV bus section breakers, six 33kV feeder breakers, two 110kV bus section breakers and four 110kV feeder breakers.

A schematic view of the existing sub-transmission network arrangement is shown in Figure 2 and the geographic view of Caboolture Substation is illustrated in Figure 3.

Figure 3

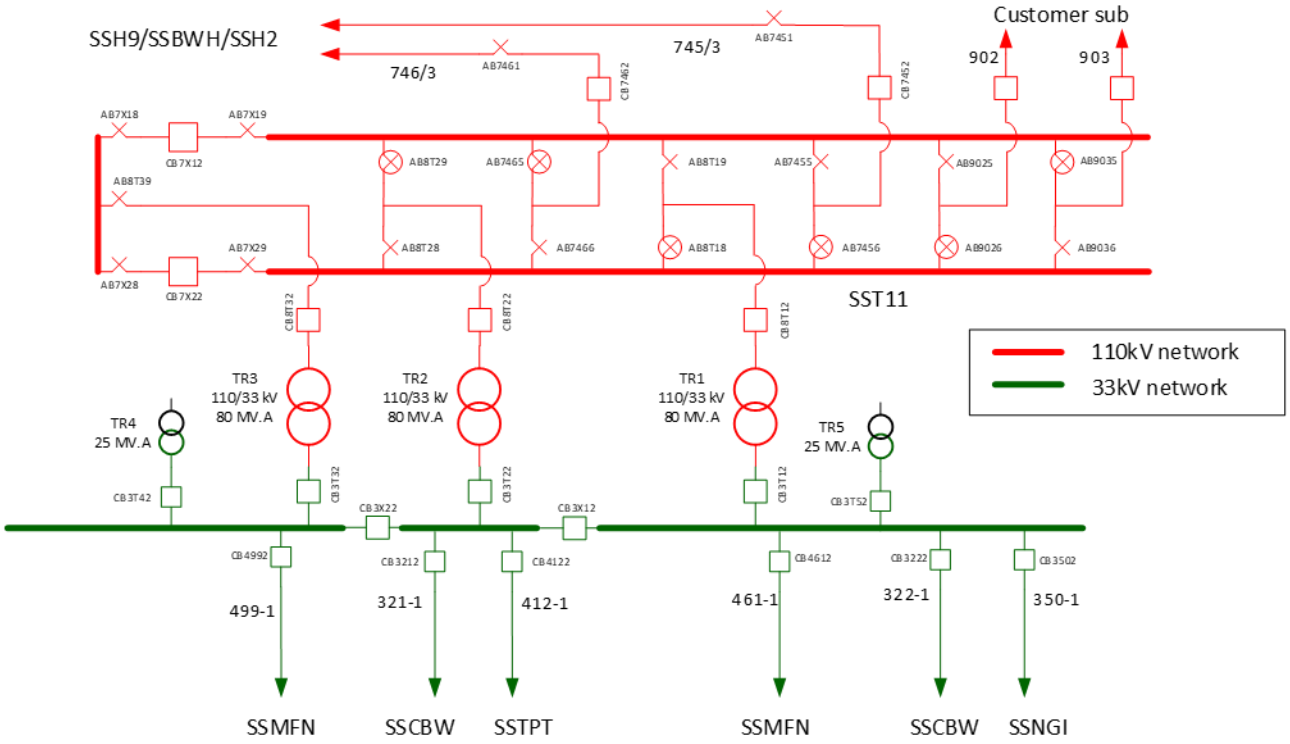


Figure 2: Existing network arrangement (schematic view)

Figure 3: Caboolture Substation (geographic view)

2.3. Load Profiles / Forecasts

The load at Caboolture Substation comprises a mix of residential and commercial/industrial customers. The load is summer peaking, and the annual peak loads are predominantly driven by residential customers.

2.3.1. Full Annual Load Profile

The full annual load profile for Caboolture Substation over the 2021/22 financial year is shown in Figure 4. It can be noted that the peak load occurs during summer; however it does not exceed the N-1 capacity of 180.4MVA.

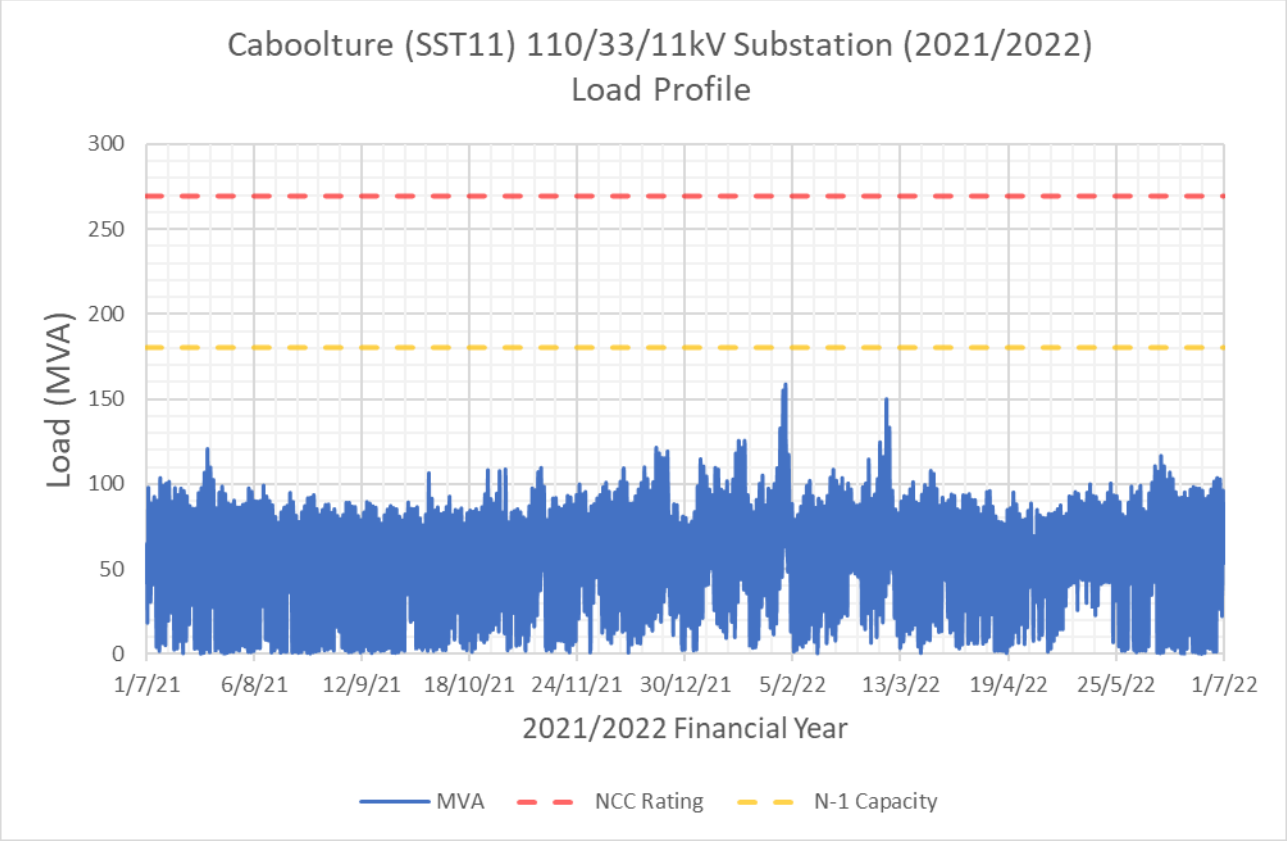


Figure 4: Substation actual annual load profile

2.3.2. Load Duration Curve

The load duration curve for Caboolture Substation over the 2021/22 financial year is shown in Figure 5.

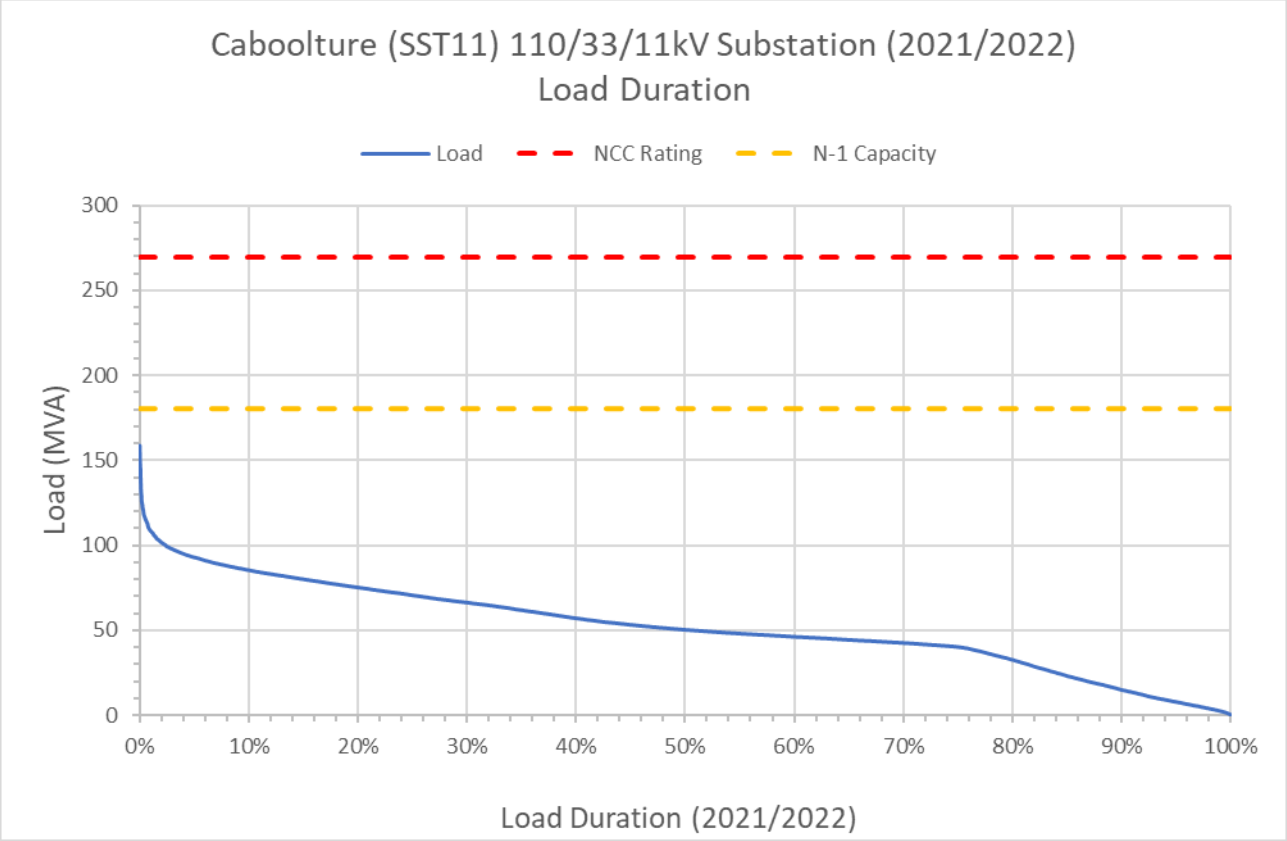


Figure 5: Substation load duration curve

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 Caboolture Substation are historically experienced in the late afternoon and evening.

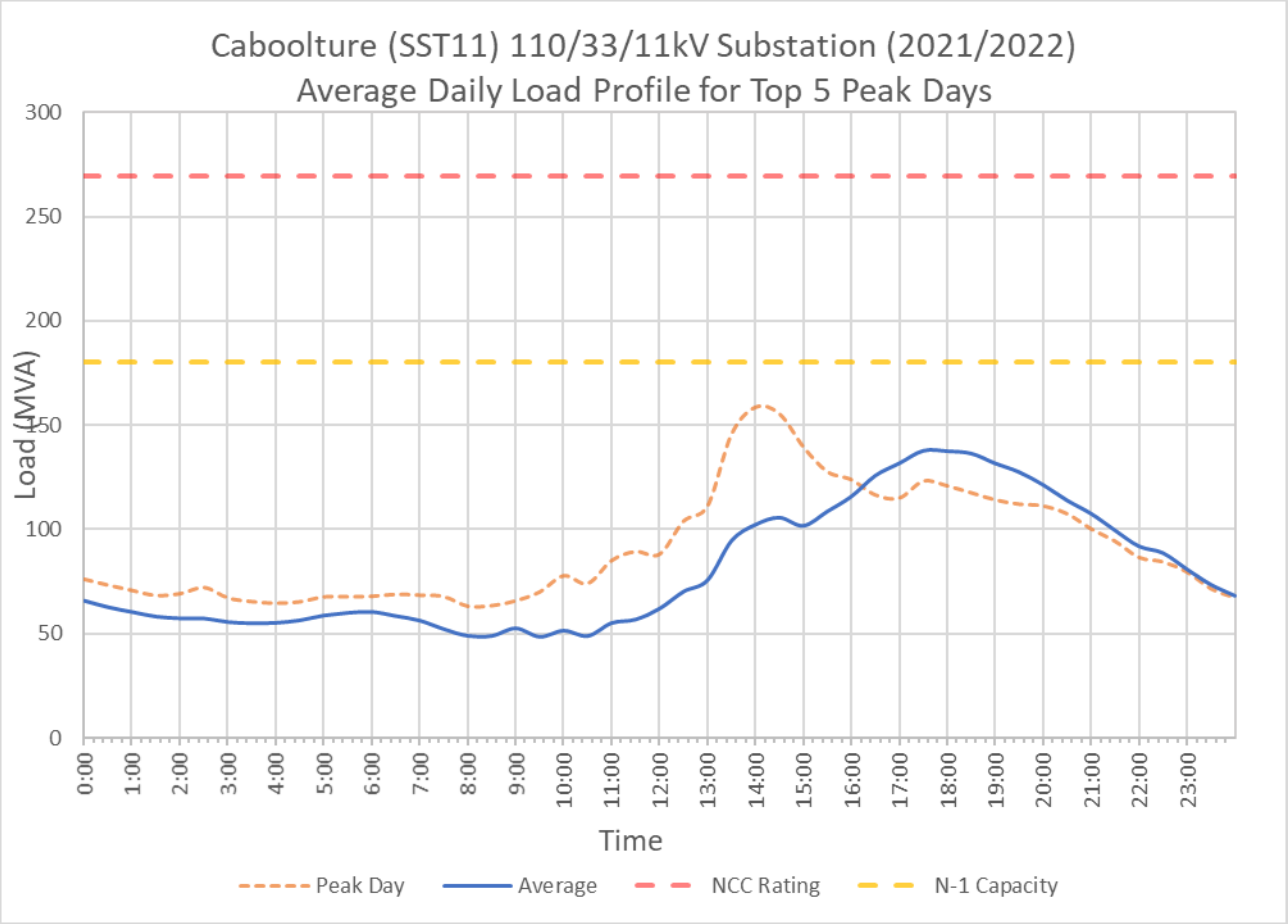


Figure 6: Substation average peak weekday load profile (summer)

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 7. The historical peak load for the past six years has also been included in the graph. It can be seen that the 50% POE forecast load growth in the base case scenario does not exceed the N-1 rating and the 10% POE forecast load growth in the base case scenario does not exceed the NCC rating. It can also be noted that the peak load is forecast to increase over the next 10 years under the base case scenario.

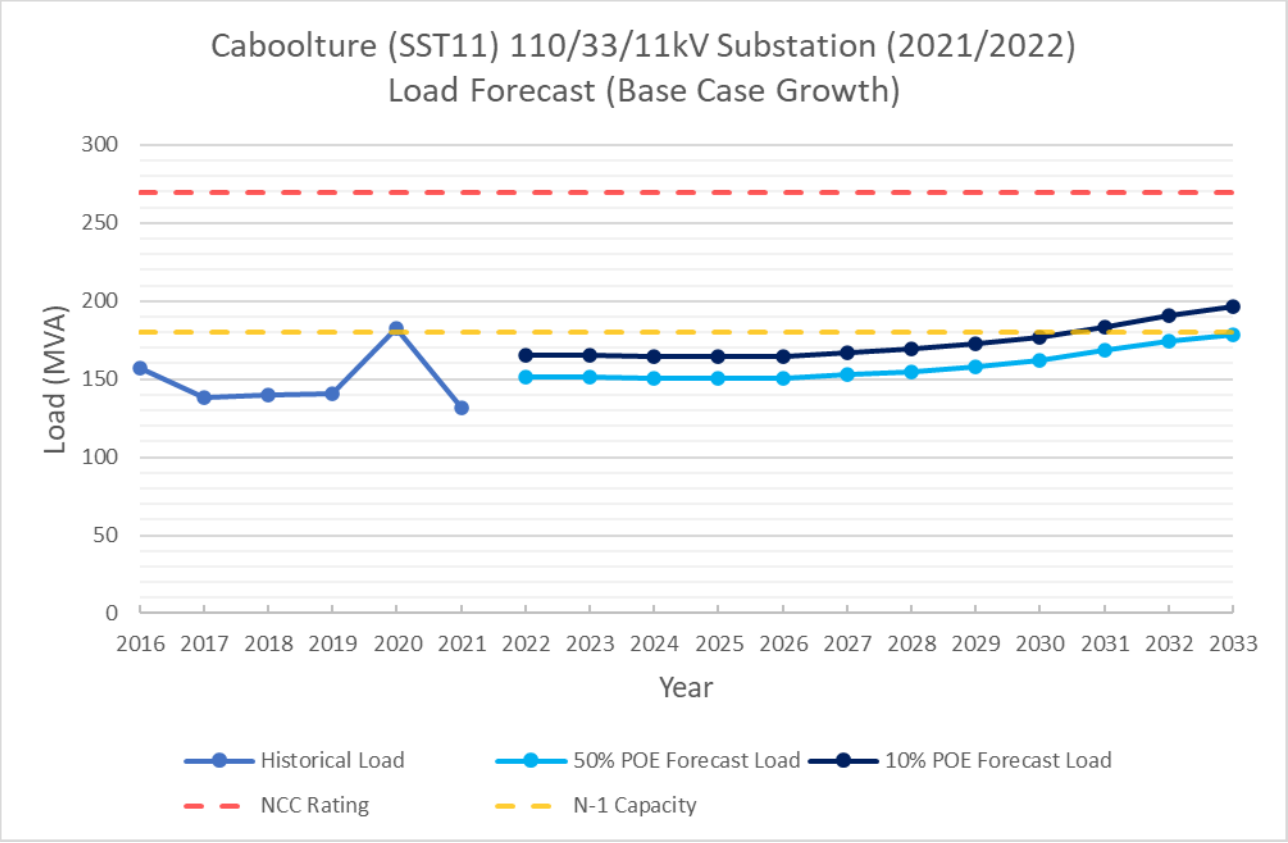


Figure 7: Substation base case load forecast

2.3.5. High Growth Load Forecast

The 10 PoE and 50 PoE load forecasts for the high load growth scenario are illustrated in Figure 8. With the high growth scenario, the peak load is forecast to increase over the next 10 years.

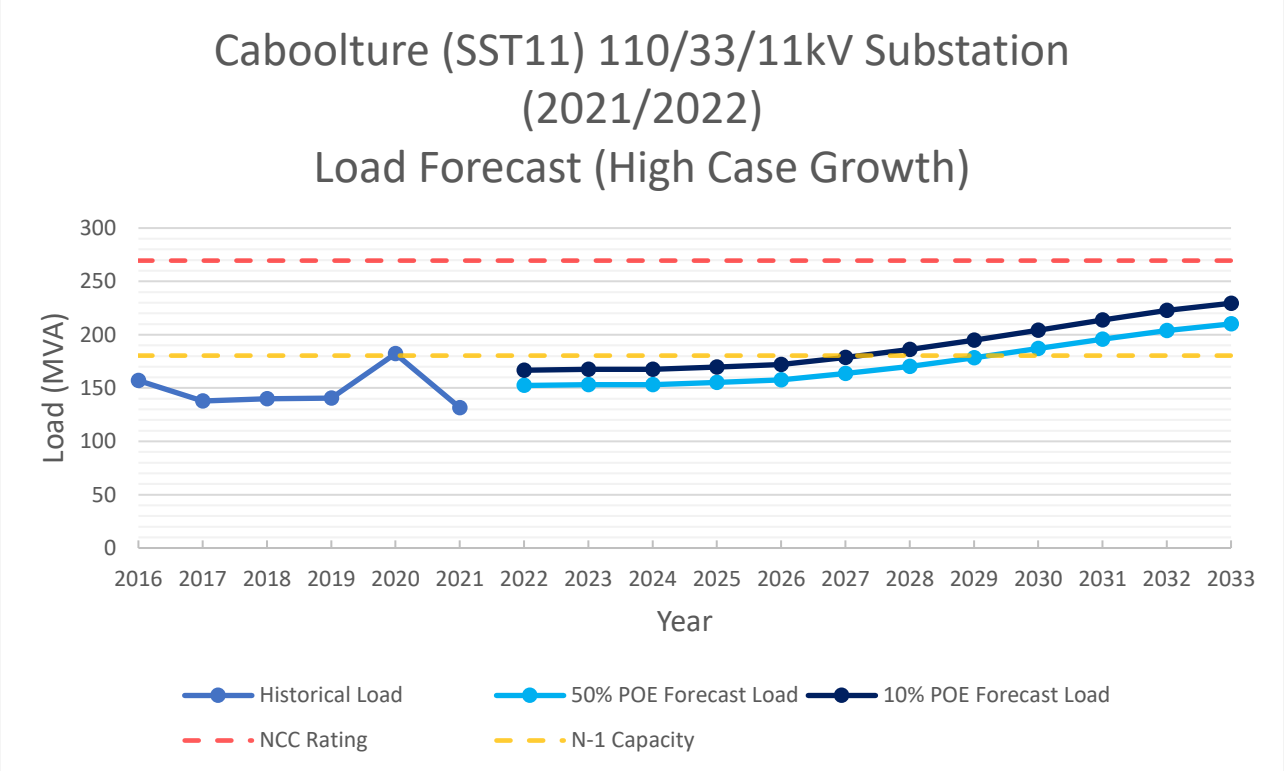


Figure 8: Substation high growth load forecast

2.3.6. Low Growth Load Forecast

The 10 PoE and 50 PoE load forecasts for the low load growth scenario are illustrated in Figure 9. With the low growth scenario, the peak load is forecast to remain relatively steady over the next 10 years.

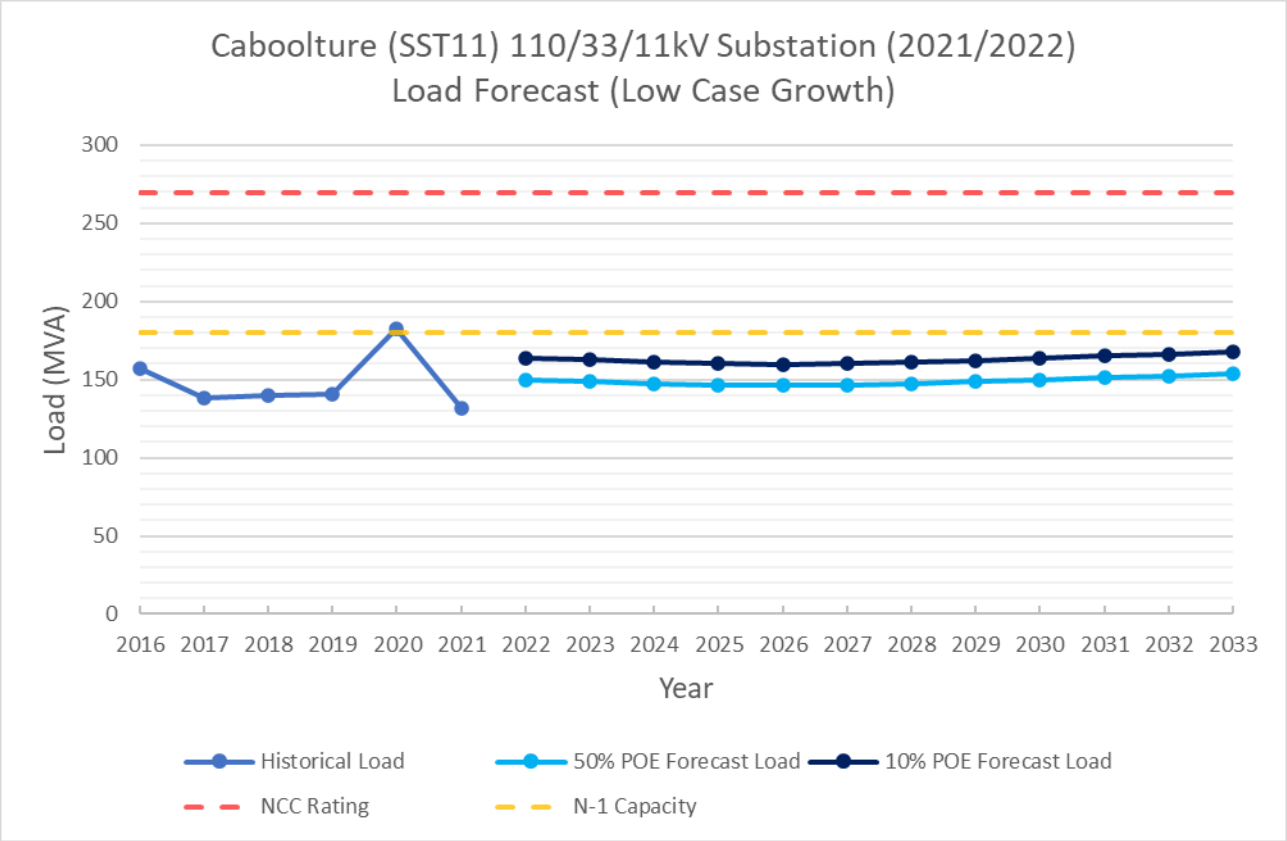


Figure 9: Substation low growth load forecast

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 and reliability risk. These assets include:

- Four 110kV circuit breakers
- Six 33kV circuit breakers
- Twenty-nine protection relays

The deterioration of these primary and secondary system assets poses safety risks to staff working within the switchyard. It also poses a safety risk the general public, through the increased likelihood of protection relay mal operation and failure of circuit breakers. 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.

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 Caboolture Substation.

3.1.2. Reliability

Currently the aged assets present a risk to the reliability of supply at Caboolture. Figure 10 shows that the value of customer reliability by replacing the assets is $380,000 after the first seven years. The scenarios that have been considered are:

- 33kV bus section circuit breaker (CB3X12) failure - It will result in the loss of two 33kV bus which is equivalent to a load loss of 84.5% of SST11 total load; however, it was assumed that around 20MVA of load could be remotely transferred to the neighbouring bulk supply substation.
- 33kV transformer and feeder circuit breaker (CB4122, CB3T22, CB3502, CB3T12 and CB3222) failure – It will result in the loss of SSNGI, SSTPT and SSBIS substations.
- 110kV feeder circuit breaker (CB7452 and CB7462) failure – It will result in an outage of one 110kV feeder and a customer feeder as well as a loss of a 110/33kV transformer; however, it was assumed that around 20MVA of load could be remotely transferred to the neighbouring bulk supply substation.

3.2. Quantification of the Identified Need

3.2.1. Risk Quantification Benefit Summary

Risk quantification analysis has been completed for option 1 which includes the value of customer reliability (VCR) and cost of emergency replacement (ERC). Figure 10 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 2042 and increases to over 3,400,000 by 2059.

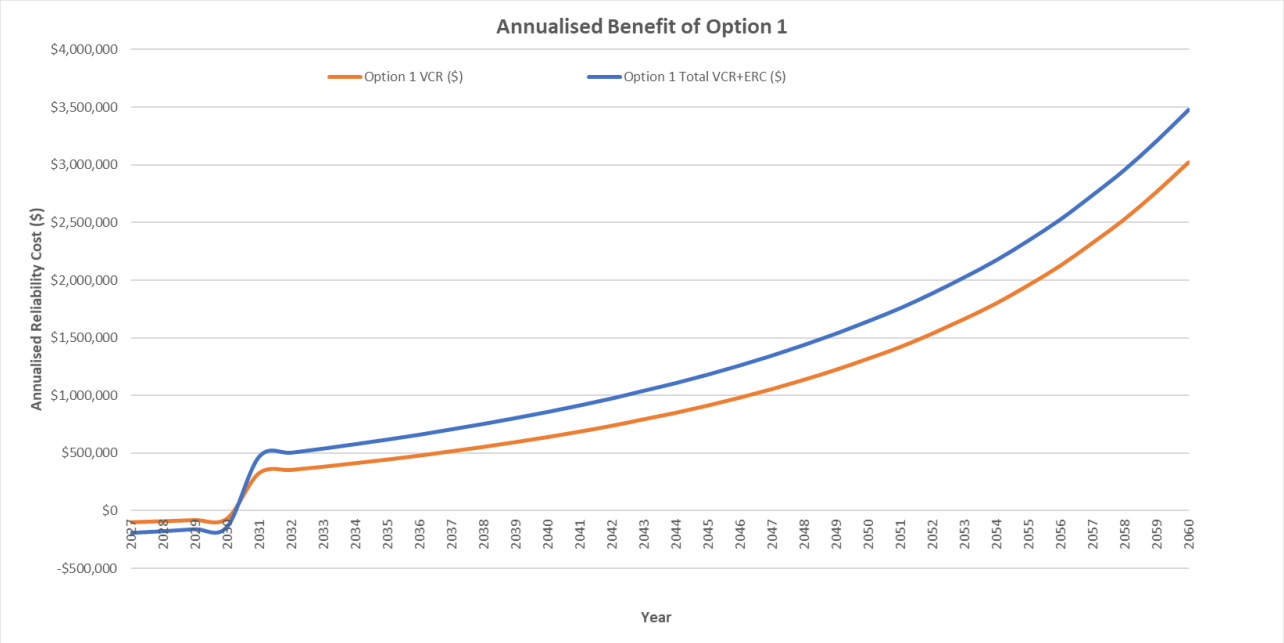


Figure 10: Annualised Benefits of Option 1 compared with Counter-factual

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 Caboolture 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 peak 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 credible network options that will address the identified need.

4.1.1. Option 1: Replace four 110kV circuit breakers and six 33kV circuit breakers

This option involves the following works:

Caboolture Substation (SST11)

- Replace existing 110kV outdoor circuit breakers (2 x feeder CBs and 2 x transformer CBs).
- Replace existing 33kV outdoor circuit breakers (2 x transformer CBs, 1 x bus section CB and 3 x feeder CBs).
- Recover existing TR1, TR2 and TR3 protection relays, and scrap the existing protection panels.
- Install new protection panels for TR1, TR2 and TR3 containing IPAC relays to establish new dual transformer differential protection schemes.
- Recover existing 33kV bus zone protection relays and scrap the existing protection panels.
- Establish new protection panels for dual 33kV bus zone protection for BB31, BB32 and BB33.
- Recover and scrap F350 existing protection relays and install a new F350 protection panel containing IPAC relays to establish standard protection on F350.
- Recover and scrap F499 existing protection relays and install a new F499 protection panel containing IPAC relays to establish standard protection on F499.
- Recover and scrap F412 existing protection relay and install a new F412 protection panel containing IPAC relays to establish standard protection on F412.
- Recover and scrap CP31 protection relays and replace them like for like in the existing protection panel.
- Recover CP11 protection relays and replace them like for like in the existing panel.
- Recover existing TR4 and TR5 protection relays and install new protection panels for TR4 and TR5 to establish new dual transformer differential protection schemes.
- Recover existing 11kV NX4 protection relay and replace with a relay as per current standard.

Ningi Substation (SSNGI)

- Recover and scrap F350 existing protection relay and replace with a relay as per current standard.

Morayfield North Substation (SSMFN)

- Recover and scrap F499 existing protection relay and replace with a relay as per current standard.

Toorbul Point Substation (SSTPT)

- Recover F412 existing protection relay SEL351-6 and replace with a relay as per current standard.

A schematic diagram of the proposed network arrangement for Option 1 is shown in Figure 11.

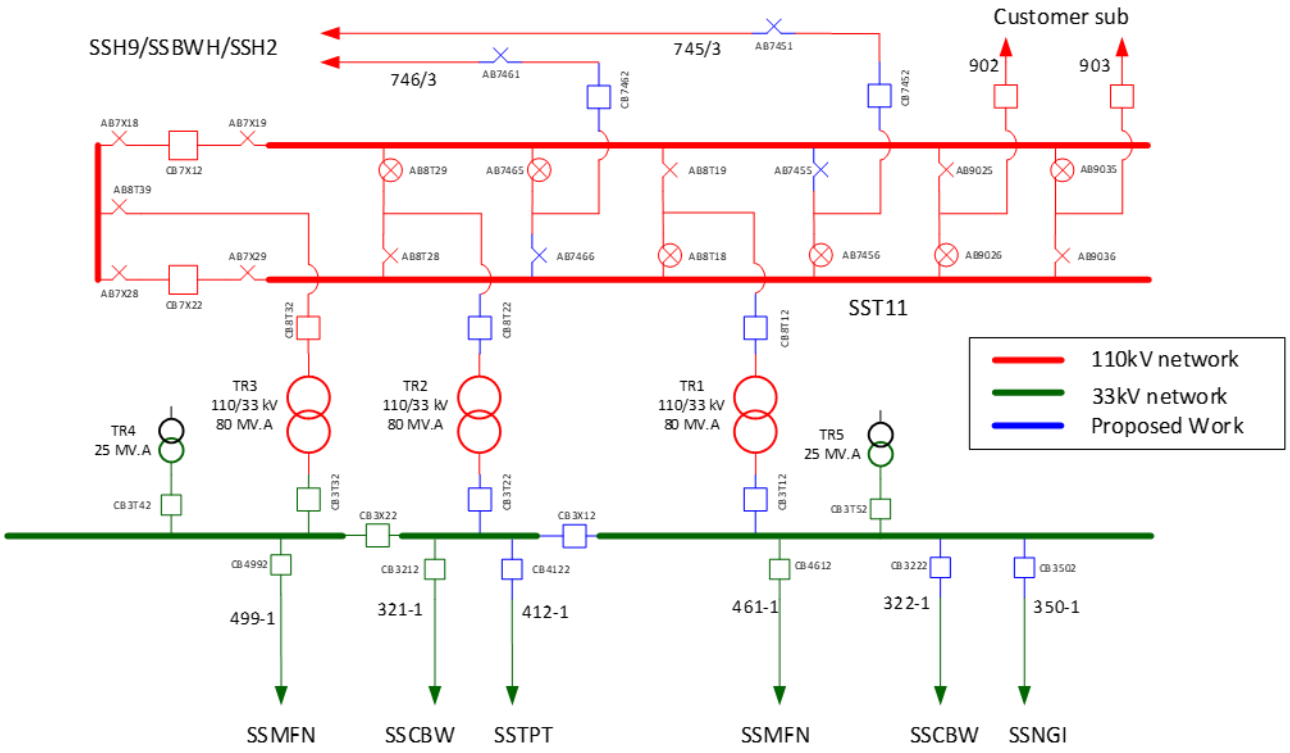


Figure 11: Option 1 proposed network arrangement (schematic view)

4.2. Assessment of Non-Network Solutions

A Notice of no non-network options was published as Energex did not identify any credible non-network solutions.

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 33kV 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 Caboolture area to address the identified need.

4.3. Preferred Network Option

Energex's preferred internal network option is Option 1, to replace four 110kV circuit breakers and six 33kV circuit breakers.

Upon completion of these works, the asset safety and reliability risks at Caboolture 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 $11.77 million. Annual operating and maintenance costs are anticipated to be the same as the existing network as a result of this option. The estimated project delivery timeframe has design commencing in June 2023 and construction completed by June 2027.

5. SUMMARY OF SUBMISSIONS RECEIVED IN RESPONSE TO DRAFT PROJECT ASSESSMENT REPORT

On 6th January 2023, Energex published the Draft Project Assessment Report providing details on the identified need on the Caboolture substation asset end of life replacement. This report provided both technical and economic information about possible solutions and sought information from interested parties about possible alternate solutions to address the need for investment.

In response to the Draft Project Assessment Report, Energex received no submissions by 20 February 2023, which was the closing date for submissions to the Draft Project Assessment Report.

6. 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.

6.1. 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 3.2.1. to have a material impact; and have therefore been included in this RIT-D assessment. The following classes of market benefits are considered material, and have been included in this RIT-D assessment:

- Changes in involuntary load shedding

6.1.1. 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 3.1.2., a number of scenarios exist where an in-service failure of a circuit breaker could cause a network outage.

6.2. 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

6.2.1. 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 Caboolture area at present, any market benefits associated with changes in voluntary load curtailment have not been considered.

6.2.1. 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.

6.2.1. 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.

6.2.1. 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 Caboolture area.

6.2.1. 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.

6.2.1. 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

7. DETAILED ECONOMIC ASSESSMENT

7.1. Methodology

The Regulatory Investment Test for Distribution 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 National Electricity Market.

Accordingly, a base case Net Present Value (NPV) comparison of the alternative development options has been undertaken.

7.2. 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.

7.3. Net Present Value (NPV) Results

An overview of the initial capital cost and the base case NPV results are provided in Table 1.

Option	Option Name	Rank	Initial Capital Cost (Total Project Cost)	Net Economic Benefit ($ real)	PV of Capex ($ real)	PV of Opex ($ real)	PV of Benefits ($ real)
1	Replace 4 x 110kV circuit breakers and 6 x 33kV circuit breakers	1	$11,770,728	$ 64,111,000	-$10,034,000	-$53,000	$74,197,000

Table 1: Base case NPV ranking table

8. CONCLUSION

The Final Project Assessment Report (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.

8.1. Preferred Option

Energex's preferred option is Option 1, to replace four 110kV circuit breakers and six 33kV circuit breakers.

Upon completion of these works, the asset safety and reliability risks at Caboolture 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 $11.77 million. Annual operating and maintenance costs are anticipated to be the same as the existing network as a result of this option. The estimated project delivery timeframe has design commencing in June 2023 and construction completed by June 2027.

8.2. 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.

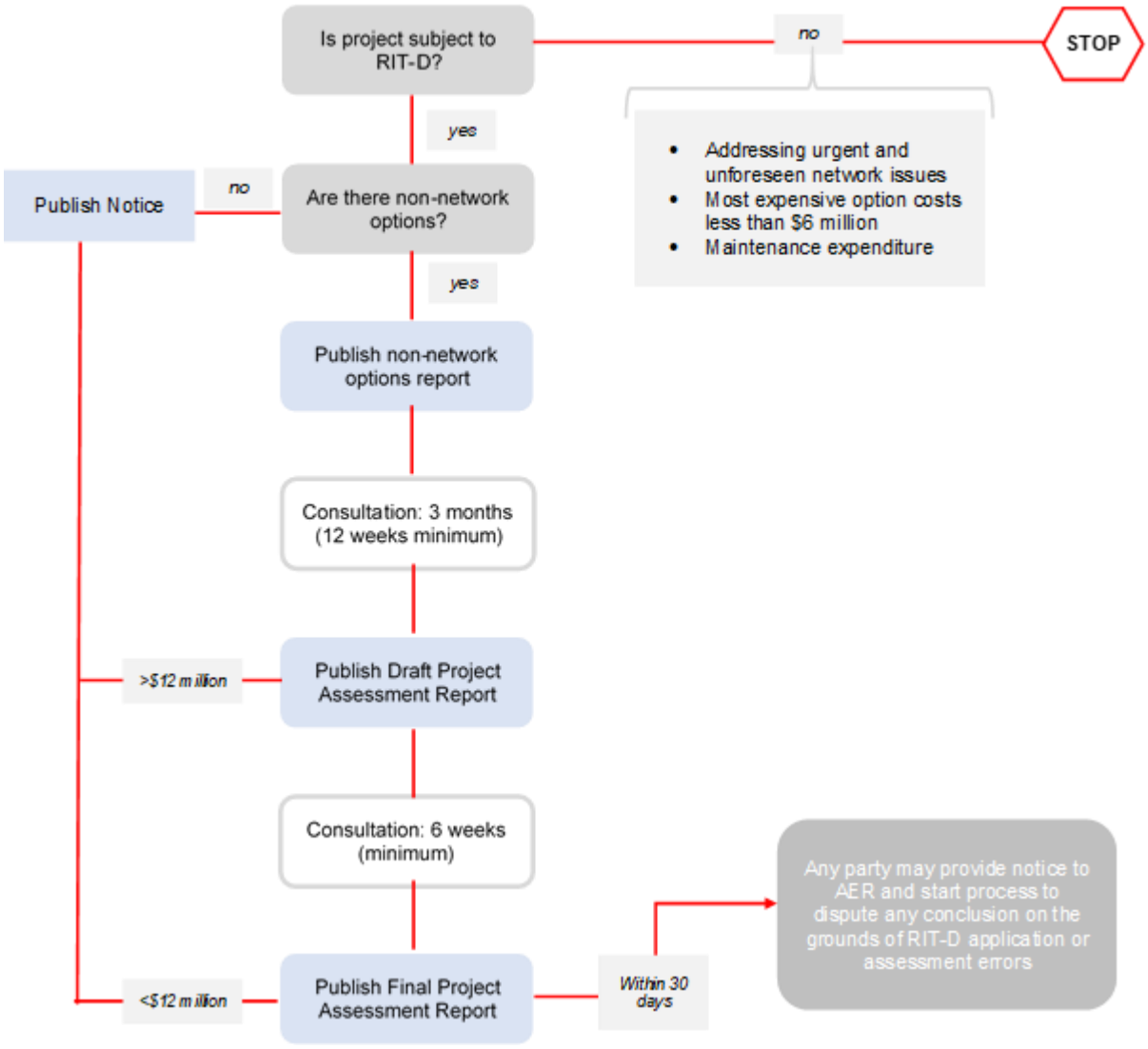
9. COMPLIANCE STATEMENT

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;	5
(4) a description of each credible option assessed	4 & 5

(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	6
(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	6
(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	6.2
(9) the results of a NPV analysis of each credible option and accompanying explanatory statements regarding the results	7.3
(10) the identification of the proposed preferred option	8.1
(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	8.1 & 8.2
(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.