# Regulatory Investment Test for Distribution (RIT-D)

# Addressing Reliability Requirements in the Gladstone South Network Area

## Notice of No Non-Network Options

20 March 2023

Part of Energy Queensland

# EXECUTIVE SUMMARY

## About Ergon Energy

Ergon Energy Corporation Limited (Ergon Energy) is part of Energy Queensland and manages an electricity distribution network which supplies electricity to more than 765,000 customers. Our vast operating area covers over one million square kilometres (around 97% of the state of Queensland) from the expanding coastal and rural population centres to the remote communities of outback Queensland and the Torres Strait.

Our electricity network consists of approximately 160,000 kilometres of powerlines and one million power poles, along with associated infrastructure such as major substations and power transformers.

We also own and operate 33 stand-alone power stations that provide supply to isolated communities across Queensland which are not connected to the main electricity grid.

## Identified Need

Gladstone South 132/66/11kV Substation T019 (GLSO) is a bulk supply substation jointly owned by Powerlink and Ergon Energy and is immediately adjacent to Gladstone South 132kV Switching Station T152 (GLSU) owned by Powerlink. GLSO is located to the south of Gladstone city and a major network node that supplies approximately 24,820 customers via the 66kV and 11kV networks in Central Queensland. At GLSO, there are two 132/66kV 100MVA transformers owned by Powerlink, two 66/11kV 20MVA transformers, seven 66kV bays owned by Ergon Energy including four feeder bays, two transformer bays and one Audio Frequency Load Control (AFLC) bay as well as seven 11kV feeders and one spare 11kV feeder bay. One 66kV feeder bay is a spare and the other three 66kV feeders respectively supply Gladstone Friend Street (GLFS), Boyne Residential (BORE), Awoonga (AWOO), Calliope (CALL), Wooderson Pumps (WOPU), Bocoolima Pumps (BOPU), Littlemore (LITT) and Miriam Vale (MIVA) Substations. In addition to these connected substations there are several major customers that are supplied via this network. In 2022, the 66kV load peaked at 50.9MVA and the 11kV load peaked at 25.3MVA.

It has been determined that one 66kV Current Transformer (CT) set is forecast to reach its retirement age in the next five years, one 66kV feeder does not have its dedicated Voltage Transformer (VT) set, fourteen protection relays have already reached their retirement age, fifteen 66kV isolators do not have sufficient fault ratings, there are inadequate Direct Current (DC) supply systems and two Surge Diverter (SD) sets pose safety risks to staff working within the switchyard. In addition, a total of nineteen protection relays for the 66kV bays (inclusive of the fourteen mentioned above) are currently installed inside the masonry control building in poor structural condition owned by Powerlink and these need to be relocated to the prefabricated control building owned by Ergon Energy due to Powerlink's planned decommissioning of the masonry building.

The ongoing operation of these assets beyond their estimated retirement date presents a significant risk to safety and customer reliability. The purpose of this project is to remove the asset

condition limitations at GLSO in order to maintain continuity of supply to its customers and to reduce the safety risks SFAIRP (So Far As Is Reasonably Practicable).

## 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). Ergon Energy has determined that network investment is essential in this case for it to continue to provide electricity to the consumers in the Gladstone South supply area in a reliable, safe and cost-effective manner. Accordingly, this investment is subject to a RIT-D. An internal assessment has been conducted and it has been determined that there is not a non-network option that is potentially credible, or that forms a significant part of a potential credible option that will meet the identified need or form a significant part of the solution. This Notice has hence been prepared by Ergon Energy in accordance with the requirements of clause 5.17.4(d) of the NER.

# CONTENTS

# 1. BACKGROUND

## 1.1. Geographic Region

GLSO supplies the southern parts of Gladstone city at 11kV. It supplies GLFS via the Gladstone 66kV meshed network and also the regional substations of BORE, CALL, AWOO, WOPU, BOPU, MIVA and LITT via the 66kV network as shown geographically in Figure 1.

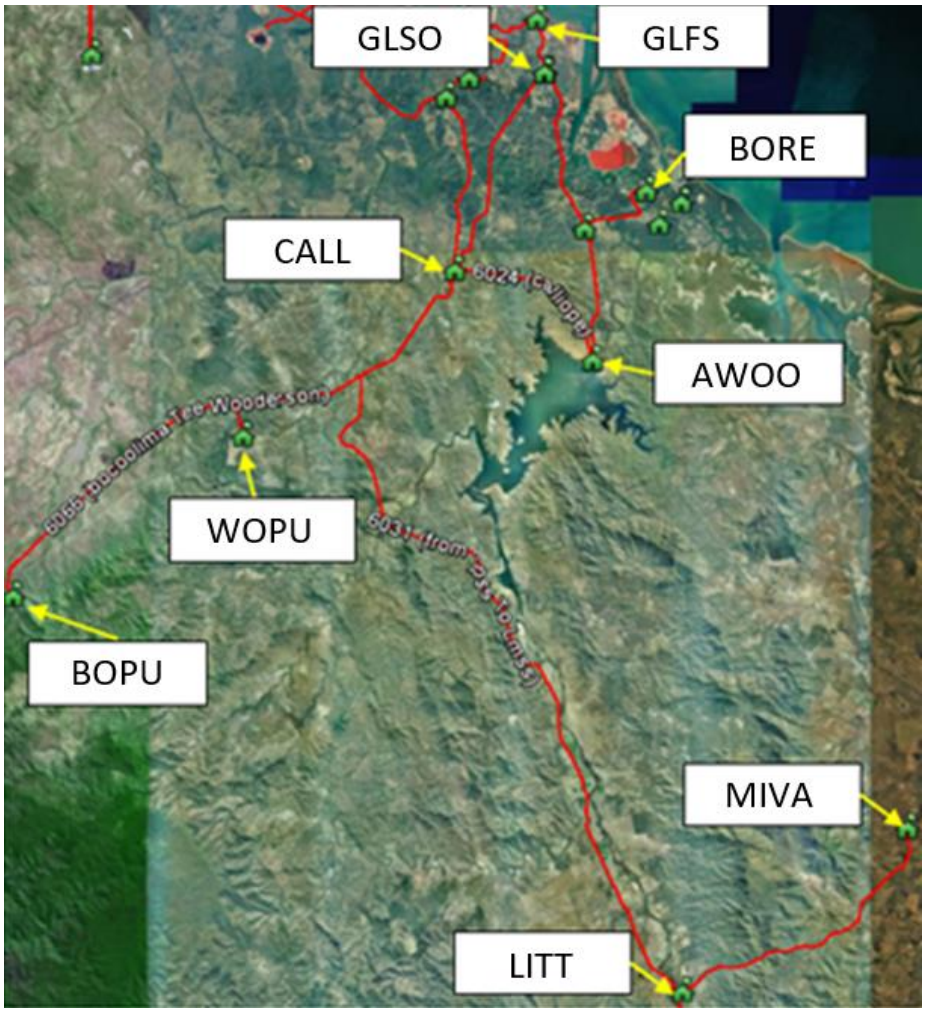



**Figure 1: Existing 66kV network arrangement (geographic view)**

## 1.2. Existing Supply System

GLSO is a bulk supply substation jointly owned by Powerlink and Ergon Energy and is immediately adjacent to GLSU owned by Powerlink. GLSO is located to the south of Gladstone city and a major network node that supplies approximately 24,820 customers via the 66kV and 11kV networks in Central Queensland. At GLSO, there are two 132/66kV 100MVA transformers owned by Powerlink, two 66/11kV 20MVA transformers, seven 66kV bays owned by Ergon Energy including four feeder bays, two transformer bays and one AFLC bay as well as seven 11kV feeders and one spare 11kV

feeder bay. One 66kV feeder bay is a spare and there are three 66kV feeders: Boyne Res, Friend St and Calliope. In 2022, the 66kV load peaked at 50.9MVA and the 11kV load peaked at 25.3MVA.

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

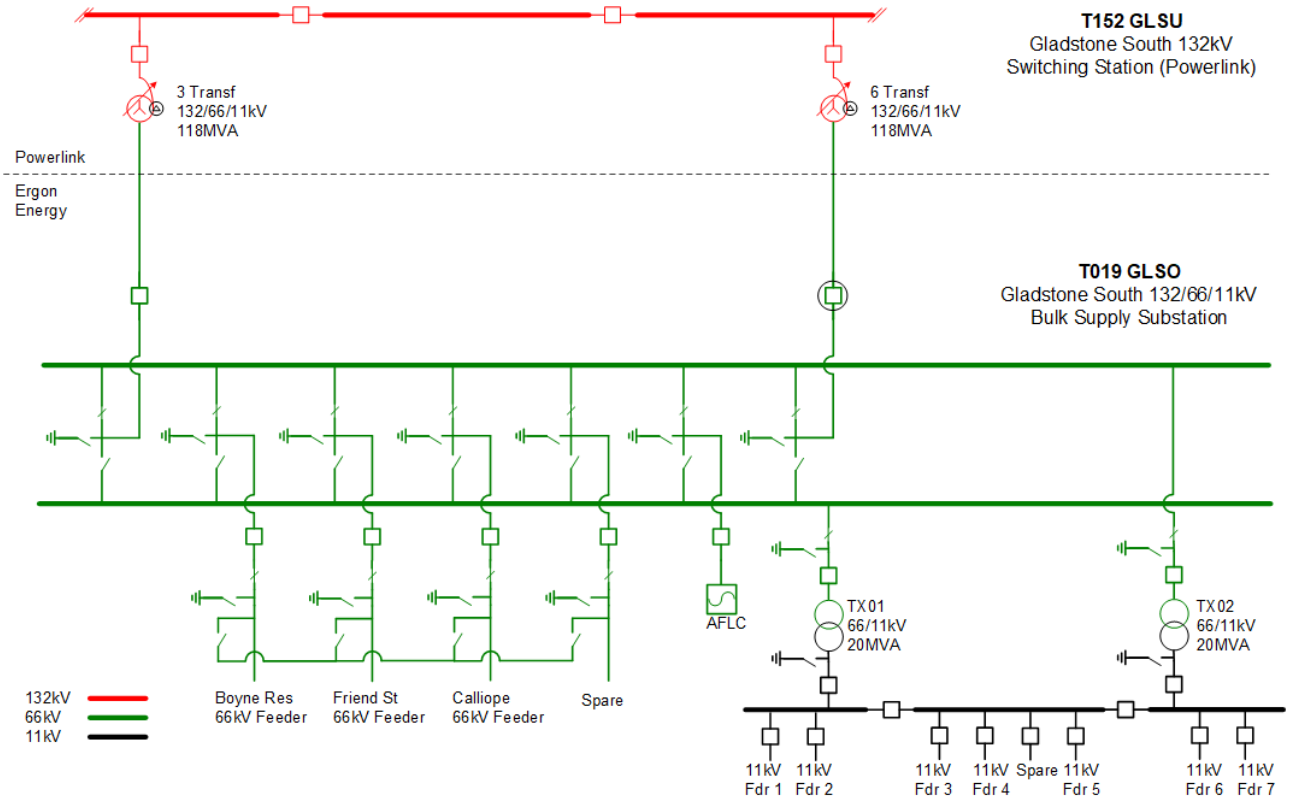



**Figure 2: Existing network arrangement (schematic view)**

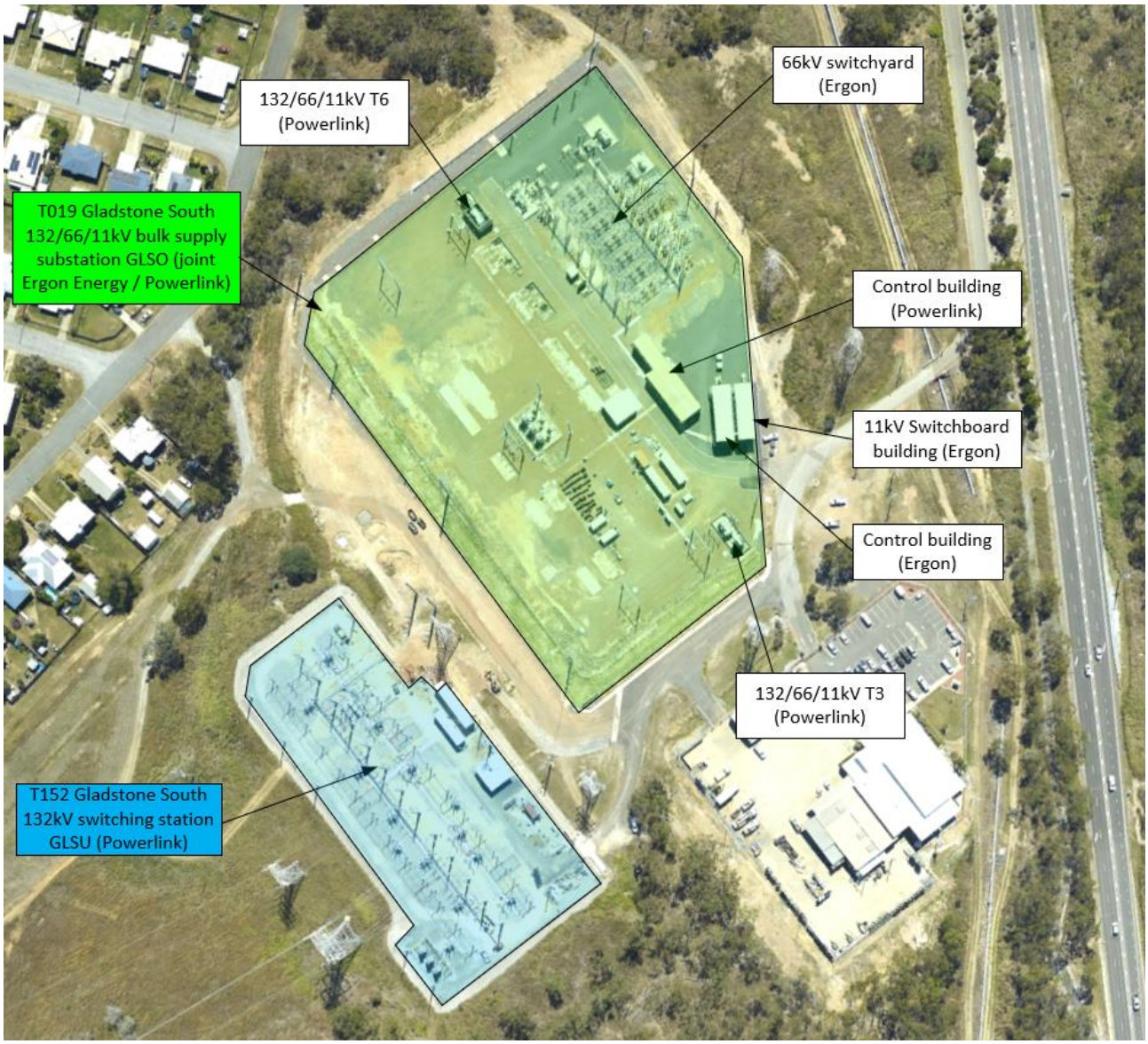



**Figure 3: GLSO and GLSU geographic view**

## 1.3. Load Profiles / Forecasts

The GLSO load is summer peaking. The average load at GLSO comprises a mix of residential (57%), commercial (21%), industrial (22%) which includes significant water pumping load from AWOO, WOPU and BOPU.

### 1.3.1. Full Annual Load Profile

The GLSO full annual load profile for 2022 is shown in Figure 4. It can be noted that the peak load occurs during summer.

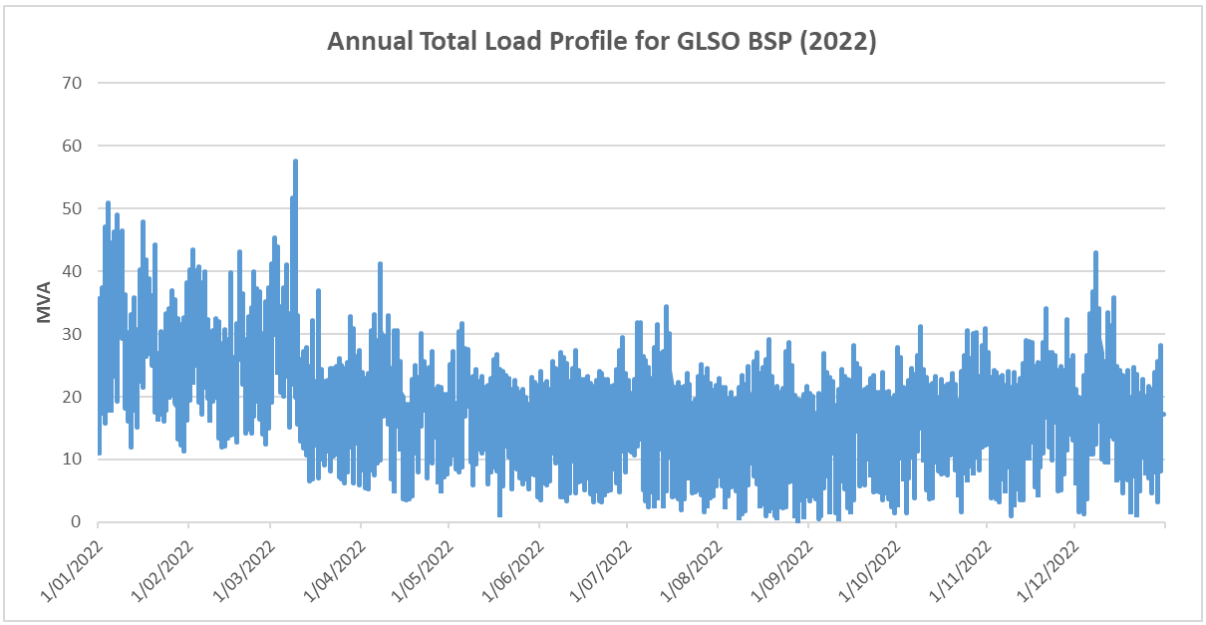



**Figure 4: GLSO annual load profile**

### 1.3.2. Load Duration Curve

The GLSO load duration curve for 2022 year is shown in Figure 5.

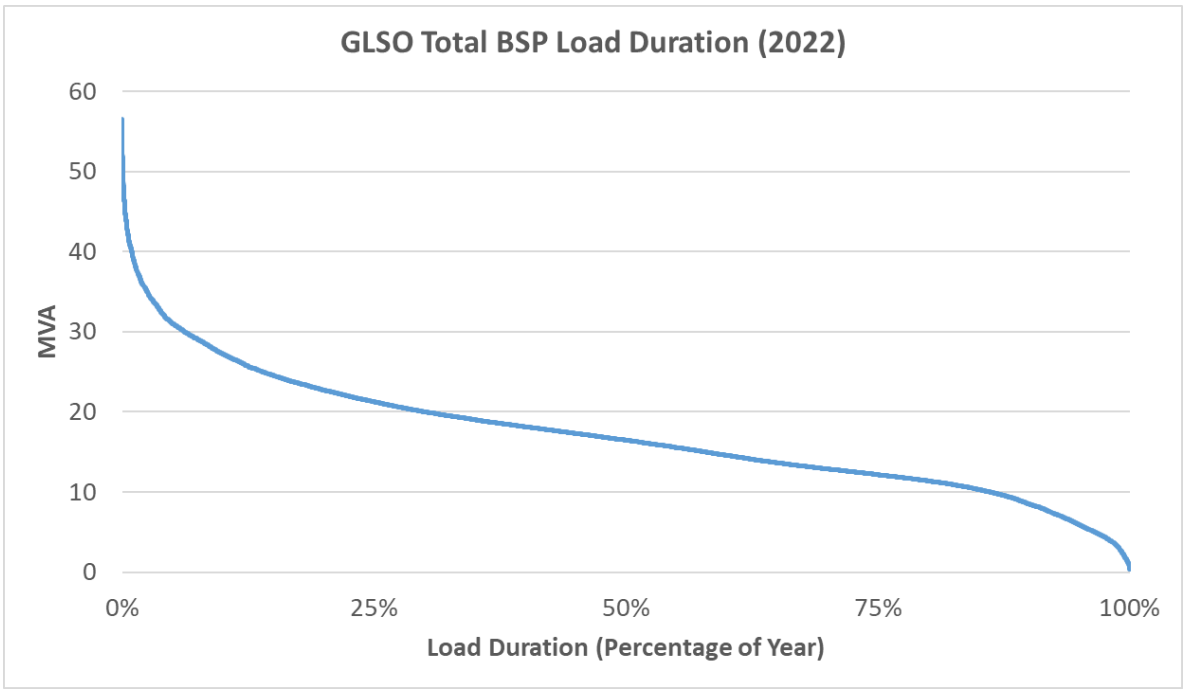



**Figure 5: Substation load duration curve**

### 1.3.3. 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 GLSO are historically experienced in the late afternoon and evening however the 2022 peak occurred at 1:30pm. This is attributed to additional load transferred to GLSO via the Gladstone 66kV ring during this time.

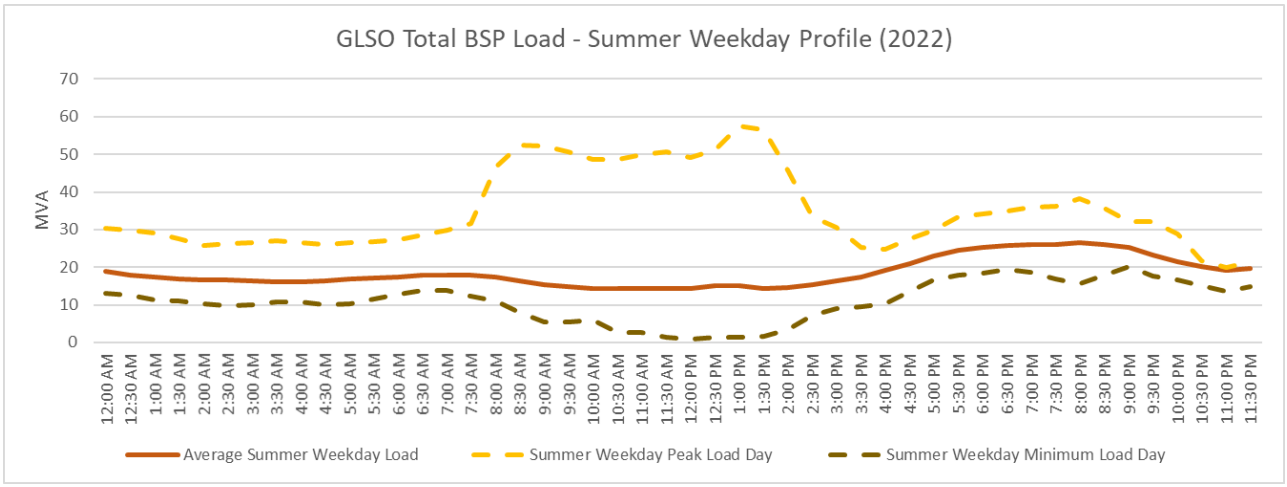



**Figure 6: Substation average and peak weekday load profile (summer)**

### 1.3.4. 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 five years has also been included in the graph. It can be noted that the peak load is forecast to increase over the next 10 years under the base case scenario.

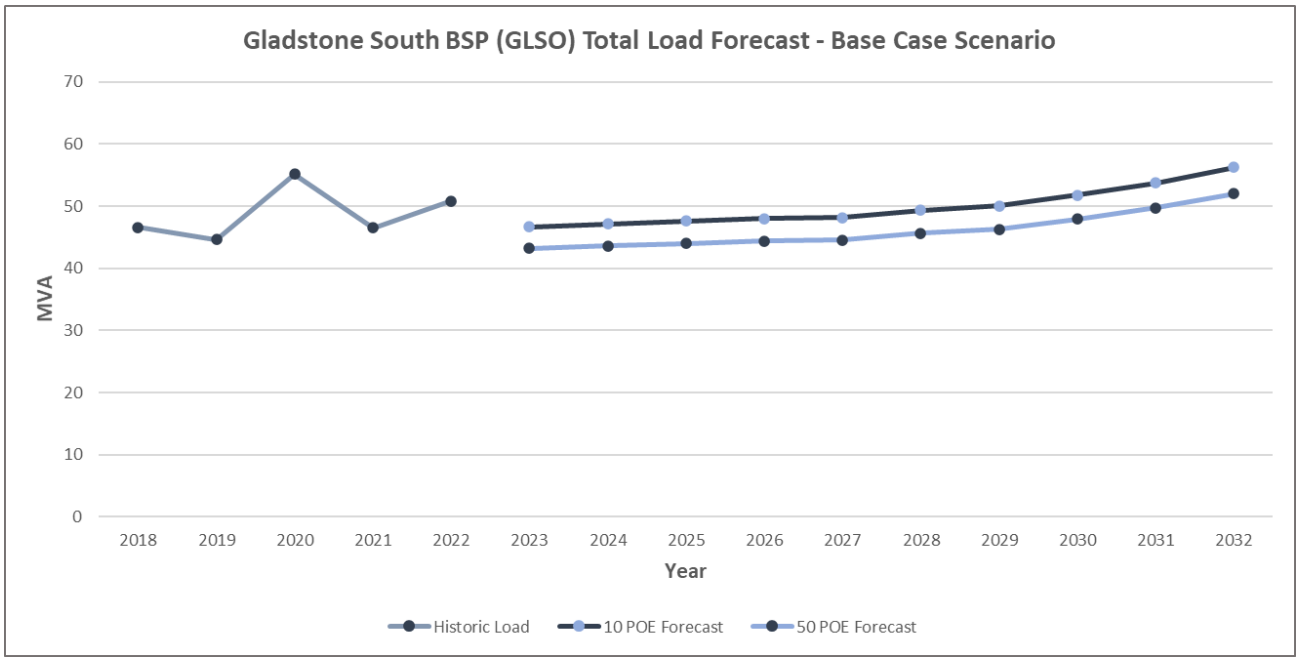



**Figure 7: Substation base case load forecast**

### 1.3.5. 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 significantly over the next 10 years.

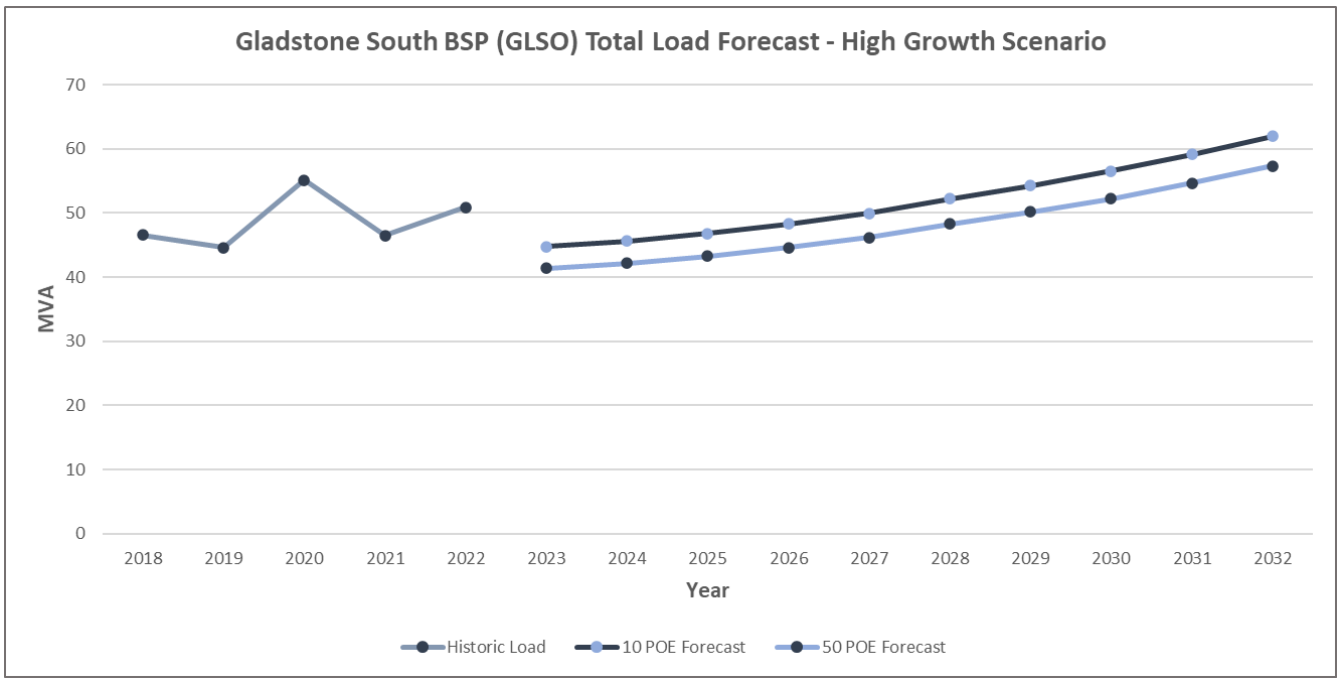



**Figure 8: Substation high growth load forecast**

### 1.3.6. 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.

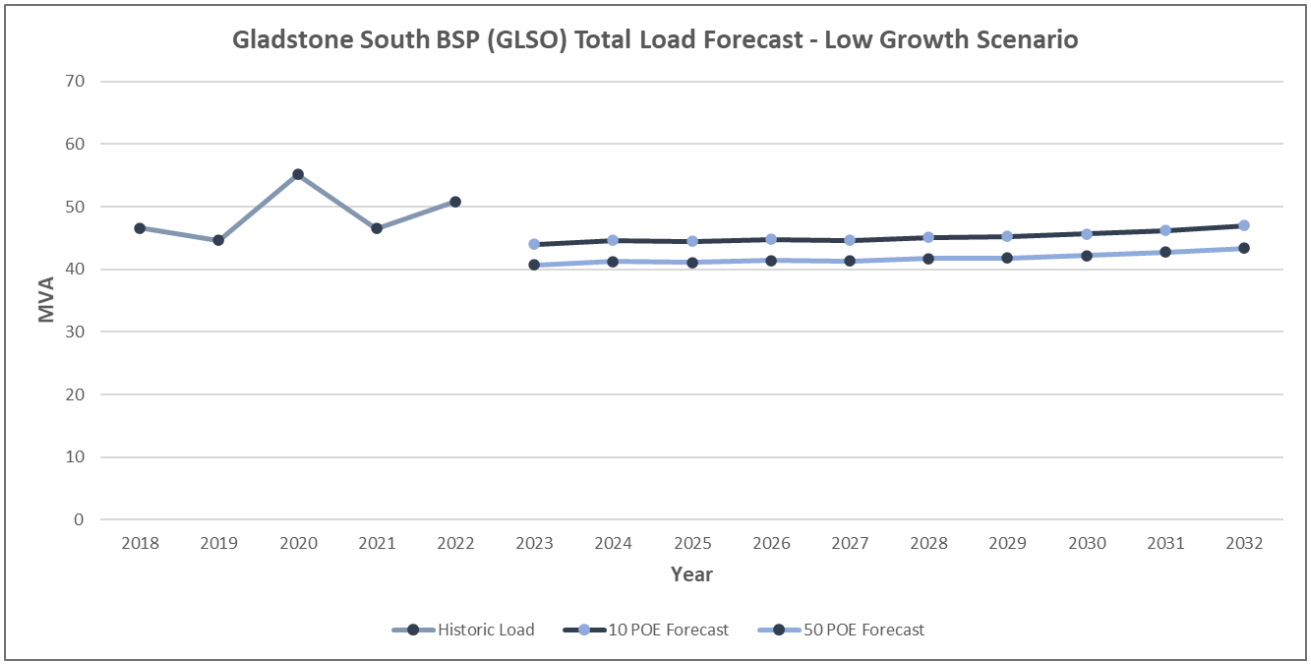



**Figure 9: Substation low growth load forecast**

# 2. IDENTIFIED NEED

## 2.1. Description of the Identified Need

### 2.1.1. 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. Condition data indicates that one 66kV CT set and fourteen protection relays are reaching end of life. Two 66kV porcelain Surge Diverter (SD) sets have been identified as presenting a safety risk.

In addition, a total of nineteen protection relays for the 66kV bays (inclusive of the fourteen mentioned above) are currently installed inside the masonry control building in poor structural condition owned by Powerlink and these need to be relocated to the prefabricated control building owned by Ergon Energy due to Powerlink's planned decommissioning of the masonry building.

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, though the increased likelihood of protection relay mal-operation and catastrophic failure of the surge diverters. 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 GLSO.

Where Ergon Energy 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.

### 2.1.2. Assets with Insufficient Fault Rating

A total of fifteen 66kV manual isolators have been identified with fault rating lower than the prospective maximum fault levels at GLSO (given in Table 1). In order to manage equipment rating risks, the 66kV Circuit Breaker (CB) of one of the Powerlink owned 132/66kV transformers is normally operated open, however this reduces the reliability of all customers supplied from GLSO. For example, when operating with one of the CBs normally open, a protection trip of the in-service transformer CB reduces the capacity available on the Gladstone 66kV meshed network and depending on network loading at the time, would lead to customer load shedding to avoid exceeding plant rating.

**Table 1: Substation prospective maximum fault level**

| Substation | Voltage (kV) | Three Phase | | Phase to Ground | |
|---|---|---|---|---|---|
| | | (MVA) | (kA) | (MVA) | (kA) |
| GLSO | 66 | 1601 | 14.0 | 611 | 16.0 |

# 3. INTERNAL OPTIONS CONSIDERED

## 3.1. Non-Network Options Identified

Ergon Energy 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 GLSO supply area to address the identified need.

## 3.2. Network Options Identified

Ergon Energy has identified one credible network option that would address the identified need.

### 3.2.1. Option 1: Replace individual assets

This option involves replacing the individual assets identified as having reached end of life and addressing the secondary systems limitations in order to address the identified need.

The scope of works include:

- Replace 2 x 66kV bus isolators in the transformer T6 bay.
- Replace 2 x 66kV bus isolators and 1 x 66kV feeder isolator in the Awoonga feeder bay.
- Replace 2 x 66kV bus isolators, 1 x 66kV feeder isolator and 1 x 66kV SD set as well as install 1 x 66kV VT set in the Friend Street feeder bay.
- Replace 2 x 66kV bus isolators and 1 x 66kV CT set in the Calliope feeder bay.
- Replace 2 x 66kV bus isolators as well as decommission 1 x 66kV feeder isolator, 1x 66kV VT set and 1 x 66kV SD set in the Spare feeder bay.
- Replace 2 x 66kV bus isolators in the AFLC bay.
- Install 1 x current standard bus protection scheme for the 66kV bus, 2 x current standard line differential and 1 x current standard distance protection schemes for the 66kV feeders, 1 x current standard protection scheme for the AFLC bay as well as communications equipment and second DC system in the modular control building.
- Decommission and remove all Ergon Energy owned equipment in the existing Powerlink owned control building.
- Perform the following remote end work:
    - Replace 2 x protection relays with the current standard line differential protection scheme for the 66kV Gladstone South feeder and communications equipment at CALL.

- Replace 1 x protection relay for the 66kV Gladstone South feeder and communications equipment at GLFS.
- Upgrade fibreoptic cable configurations at Gladstone Depot Communications Site (GLDECS).
- Replace communications equipment at Clinton Industrial substation (CLIN).

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

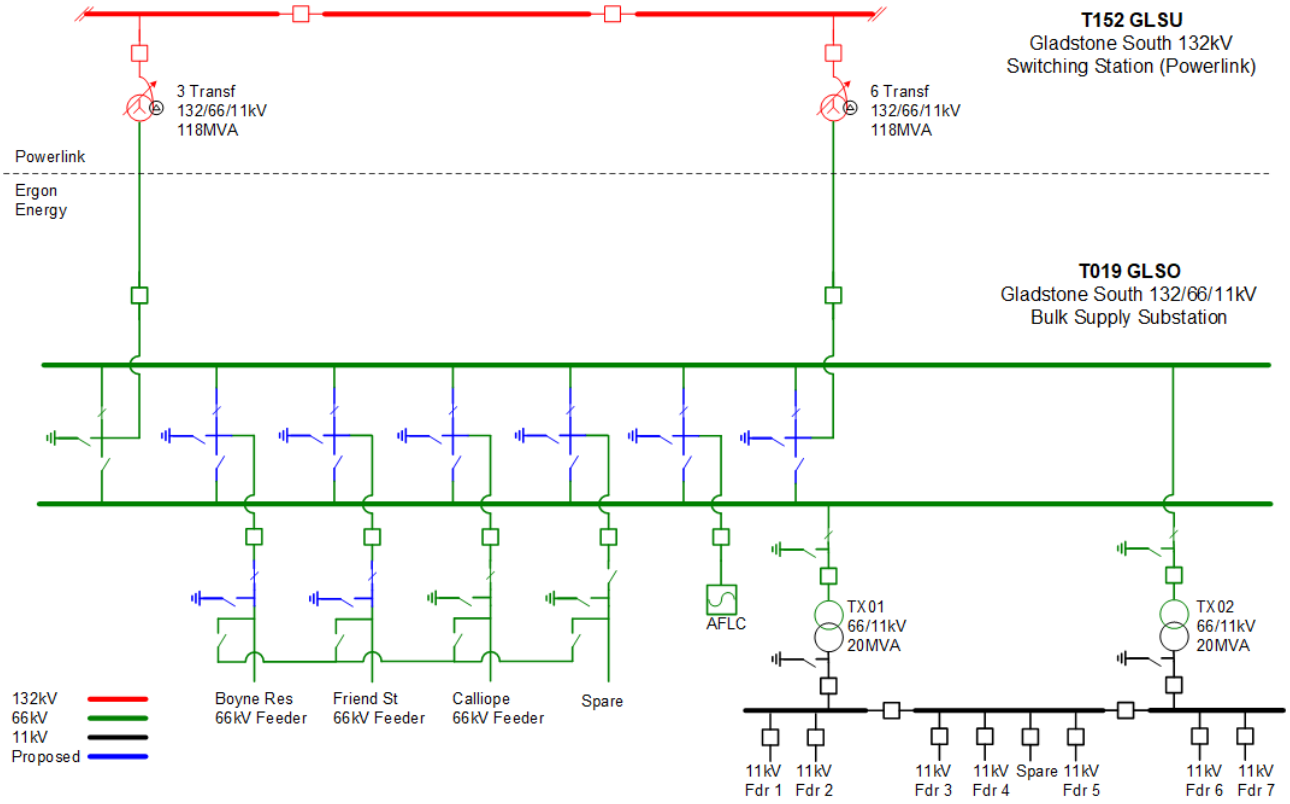



**Figure 10: Option 1 proposed network arrangement (schematic view)**

## 3.3. Preferred Network Option

Ergon Energy's preferred internal network option is Option 1, replacing the individual assets identified as having reached end of life and addressing the secondary systems limitations

Upon completion of these works, the asset safety and reliability risks at GLSO 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 $6.73 million. Annual operating and maintenance costs are anticipated to be 1.5% of the capital cost. The estimated project delivery timeframe has design commencing in mid-2023 and construction completed by August 2025.

# 4. ASSSESSMENT OF NON-NETWORK SOLUTIONS

Ergon Energy'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.

## 4.1. Demand Management (Demand Reduction)

The DEM team has completed a review of the GLSO customer base and considered a number of demand management technologies. Asset safety and performance risks are the key project drivers (i.e. the need) at GLSO. It has been determined that most demand management options will not be viable propositions and have been explored in the following sections.

### 4.1.1. Network Load Control

The residential, commercial and industrial customer loads appear to drive the daily peak demand which generally occurs between 6:00pm and 10:00pm.

There are 9595 customers on tariff T31 and T33 hot water load control (LC). An estimated demand reduction value of 5,757kVA[1] is available.

GLSO LC signals are controlled from the AFLC transmitter connected to the 66kV bus at GLSO. The Tariff 33 and 31 hot water LC channels are dynamic (that is, it responds to exceedance settings not on a timetable) and the current control strategy only calls LC when the load at GLSO exceeds 35MW. Tariff 33 air-conditioning channels are under manual control of the operational control centre and are used as required. This existing strategy works to reduce peak demand at GLSO, however network load control does not sufficiently address the identified need.

[1] Hot water diversified demand saving estimated at 0.6kVA per system

## 4.2. Demand Response

Four methods utilising demand response technology for deferring network investment are: Call Off Load (COL), Customer Embedded Generation (CEG), Large Scale Customer Generation (LSG) and customer solar power systems.

### 4.2.1. Customer Call Off Load (COL)

COL is an effective technique for deferring network investment where the need is for a short time period. However, in this instance, the need is required on a long-term permanent basis. There are a small number of large customers in the catchment area but the $/kVA funding available for demand reduction is low therefore customer call off load has been assessed as not a viable proposition as it will not address the identified need, nor benefit the community.

### 4.2.2. Customer Embedded Generation (CEG)

CEG is an effective technique for deferring network investment where the need is for a short time period. The primary driver for investment in this instance is asset safety and performance. A short-term deferral of network investment by using CEG is not a technically or financially feasible option (due to the number of contracts required to be negotiated and managed).

This option has been assessed as technically not viable as it will not address the identified network requirement.

### 4.2.3. Large-Scale Customer Generation (LSG)

LSG sites such as renewable energy generation, solar or wind farms of multiple MW's capacity constitute an opportunity to support substation investment by reducing demand on, and potentially providing reactive power support for substation assets.

This option could potentially address the identified need, however, has been assessed as technically not viable as there is no known existing or proposed LSG demand response available.

### 4.2.4. Customer Solar Power Systems

A total of 8,279 customers have solar photo voltaic (PV) systems for a connected inverter capacity of 43,967kVA.

The residential, commercial and industrial customer loads appear to drive the daily peak demand which generally occurs between 6:00pm and 10:00pm. As such customer solar generation does not coincide with the peak load period.

Business customers with large solar arrays are deemed to present a significant opportunity for targeted load control or load curtailment if coupled with a Battery Energy Storage System (BESS). Contracting such customers is attractive as they represent a larger load across fewer customers and therefore are cheaper and easier to engage and contract.

However, only a small percentage of customers in this supply area have solar PV systems and possibly none have a BESS. PV systems with BESS present a future portfolio opportunity for potential demand response but currently this supply area has a very limited solar/BESS. Solar

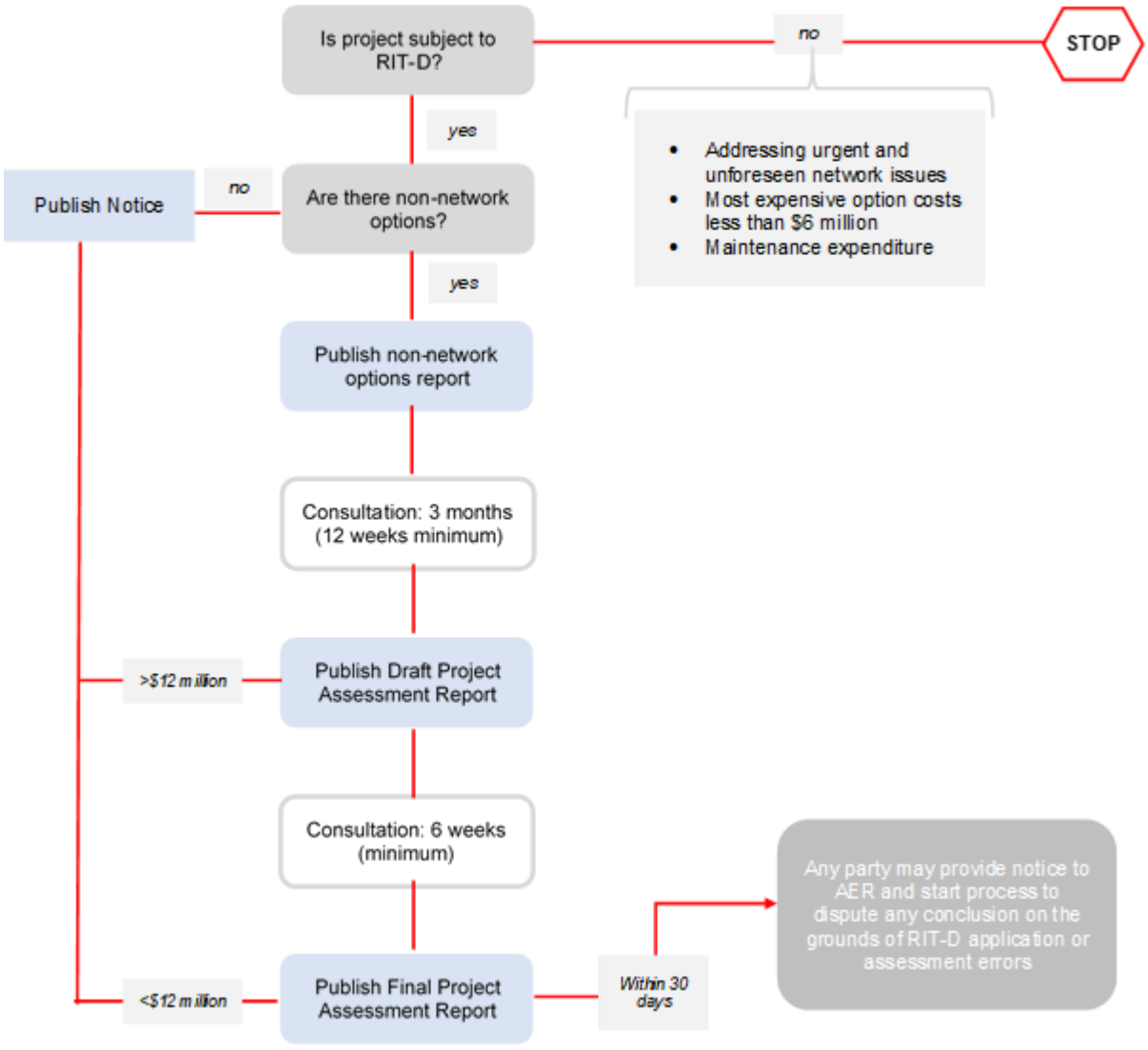
customers without a BESS will not meet the technical needs of the demand reduction as their solar contribution may not be available when the network un-met need is required.

## 5. CONCLUSION AND NEXT STEPS

The internal investigations undertaken on the feasibility of the non-network solutions revealed that it is unlikely to find a complete non-network solution or a hybrid (combined network and non-network) solution to provide the magnitude of network support required in the GLSO supply area to address the identified need.

The preferred network option is Option 1: Replace individual assets. This Notice of No Non-Network Options is therefore published in accordance with rule 5.17.4(d) of the National Electricity Rules. As the next step in the RIT-D process, Ergon Energy will now proceed to publish a Final Project Assessment Report.

# APPENDIX A – THE RIT-D PROCESS




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