Addressing reliability requirements in the Ku-ring-gai load area

NOTICE ON SCREENING FOR SAPS AND NON-NETWORK OPTIONS

30 August 2024

Ausgrid

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Addressing increased customer demand in the Ku-ring-gai load area

Notice on screening for SAPS and non-network options – August 2024

Title of Contents

1 Introduction

This Options Screening Notice has been prepared in accordance with the application of the Regulatory Investment Test for Distribution (RIT-D) process under clause 5.17.4(d) of the NER, and in line with the Final Project Assessment Report (FPAR) publication to options for ensuring reliable electricity supply to the Ku-ring-gai load area of Ausgrid's network.

The 132kV electricity subtransmission cables ('feeders') 9E1 and 9E2 are part of Ausgrid's Upper North Shore network, connecting TransGrid's Sydney East BSP and Kuringai STS via Belrose TP. Kuringai STS supplies four zone substations via 33kV feeders (Pymble, Lindfield, Turramurra and St Ives), providing electricity service to approximately 48,500 customers in this network area.

Feeders 9E1 and 9E2 consist of underground cables sections (0.91km and 1.05km long respectively) laid in separate trenches from Sydney East BSP to Belrose TP, and overhead sections via a 5.5km long double circuit tower line from the Belrose TP to Kuringai STS.

The underground feeder sections are of the self-contained fluid filled (SCFF) type, which are considered an obsolete and outdated technology. They were commissioned in 1980 and are now reaching the end of their service life. They are becoming less reliable and approaching the point at which their replacement maximises the net benefit for the community. Ausgrid's planning studies indicate that there will be substantial Expected Unserved Energy (EUE) to loads in this area of our network if these cables fail, as well as reactive maintenance costs associated with having to repair and restore service, and environmental risks from oil leaking from the cables. If action is not taken, it is expected that Ausgrid's electricity distribution license reliability and performance standards will be breached.

Ausgrid is therefore undertaking a RIT-D to assess options for addressing the risk associated with the ageing underground SCFF sections of feeders 9E1 and 9E2, to ensure we continue to satisfy our reliability and performance standards.

No exemptions listed in the NER clause 5.17.3(a) apply and therefore Ausgrid is required to apply the RIT-D to this project. This notice has been prepared under cl. 5.17.4(d) of the NER and summarises Ausgrid's determination that no SAPS and non-network option forms all or a significant part of any potential credible option for this RIT-D. It sets out the reasons for Ausgrid's determination, including the methodologies and assumptions used. A full discussion of asset conditions and the identified need can be found in the Final Project Assessment Report (FPAR) for ensuring reliable electricity supply to the Ku-ring-gai load area.

2 Description of the identified need

2.1 Overview of the existing supply arrangements

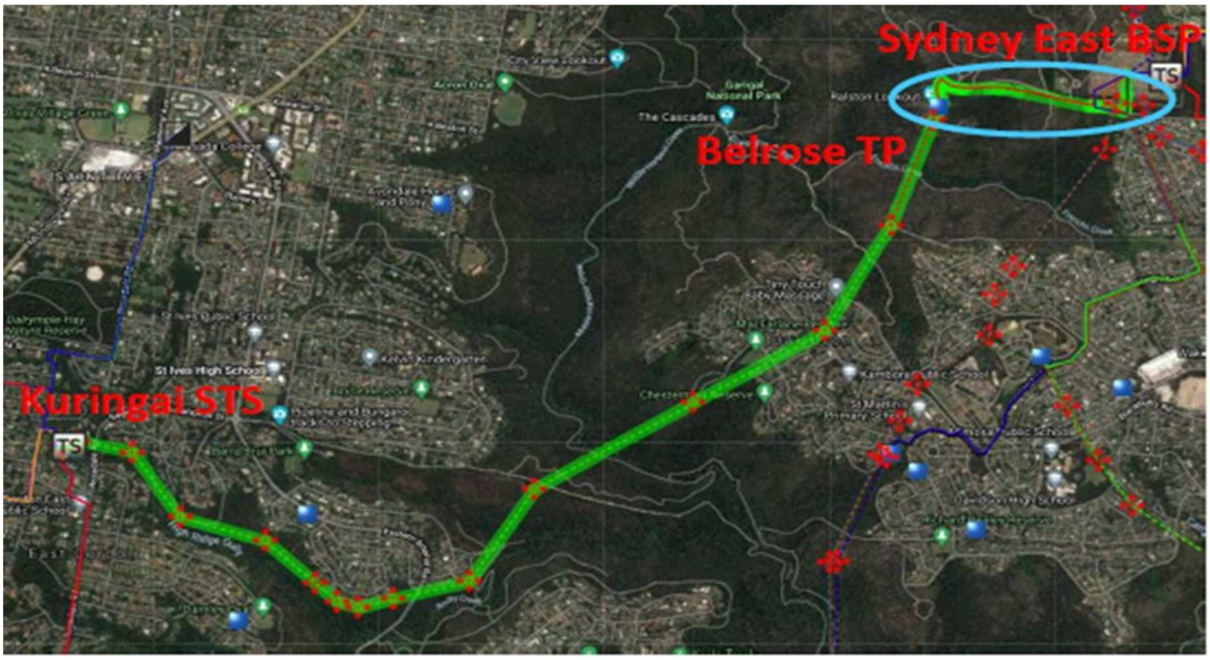
Ausgrid's Upper North Shore network extends from St Ives in the north, west to Turramurra, through Pymble and south to Lindfield. The Pacific Highway and the "North Shore" and "Western" railway lines run through the area. The Upper North Shore is a predominantly urban area that includes residential and commercial load, including standby supplies to Railcorp.

The network in the Upper North Shore area is supplied via 132kV feeders 9E1 and 9E2 from TransGrid's transmission system at Sydney East BSP to Kuringai STS. Feeders 9E1 and 9E2 form an important part of this network, suppling approximately 48,500 customers via a radial 33kV underground network. These feeders are the single source of supply to the Upper North Shore network.

Feeders 9E1 and 9E2 were commissioned in 1980 and consist of underground cable sections (0.91km and 1.05km long respectively) laid in separate trenches from Sydney East BSP to Belrose TP, and overhead sections via a 5.5km long double circuit tower line from the Belrose TP to Kuringai STS (Figure 1).

Figure 1 below shows the routes of feeders 9E1 and 9E2 with respect to the Sydney East BSP and Kuringai STS, where the blue ring specifies the location of the underground sections of the feeders that are in need of replacement.

Figure 1: Schematic view of the 132kV network including Feeders 9E1 and 9E2



The feeders' availability is critical to supplying Kuringai STS. Ausgrid's predictive failure models for the underground sections of feeders 9E1 and 9E2, which are informed by condition assessments, indicate that large quantities of unserved energy are expected to arise if action is not taken.

While the current network arrangement ensures a level of redundancy, any concurrent outage of these two feeders would result in the loss of supply to Kuringai STS since the feeders are its only source of supply. This could lead to the loss of supply to the zone substations: St Ives, Turramurra, Pymble, and Lindfield. Given that the area has limited interconnections to adjoining network areas, there is a low, but increasing, probability that some of the customers will experience a very long outage.

The underground sections of feeders 9E1 and 9E2 have experienced leaks in the past and have previously failed. They are also situated near national parkland, increasing the environmental risk costs associated with oil fluid leaks. To minimise the environmental risk of fluid leaks in SCFF feeders, Ausgrid has made a commitment to the NSW Environment Protection Authority (EPA) to replace or retire all SCFF cables with known leaks by 2034.

2.2 Summary of the 'identified need'

Ausgrid is obliged to comply with reliability and performance standards as part of its distribution license granted by the Minister for Industry, Resources and Energy under the *Electricity Supply Act 1995 (NSW)*. Under the license, reliability and performance standards are expressed in two measures:

- SAIDI[1] – which means the average derived from the sum of the durations of each sustained customer interruption (measured in minutes), divided by the total number of customers (averaged over the financial year); and
- SAIFI[2] – which means the average derived from the total number of sustained customer interruptions divided by the total number of customers (averaged over the financial year).

These two reliability measures capture two key sources of inconvenience to electricity customers from supply disruptions, i.e., how long their electricity supply is off for as well as how often their electricity supply is off. Customers experience less inconvenience (i.e., a better level of supply reliability), the lower each of these measures are. Reliability standards applied to distribution networks typically set maximums in relation to each of these two measures.

The main concern relates to increasing customer supply, maintenance and environmental risks derived from the fact the these SCFF feeders have failed in the past and experienced fluid leaks.

A concurrent outage of these feeders, would result in the loss of supply to Kuringai STS, leading to loss of supply to the zone substations: St Ives, Turramurra, Pymble, and Lindfield.

SCFF cables also impose environmental risks associated with oil leakages that increase as they age. Ausgrid has developed a SCFF cable management strategy which has been reviewed by the EPA and which we continue to follow. A supporting investment strategy has been implemented to replace or retire all SCFF feeders with known leaks by 2034. This strategy prioritises investments considering the expected decline in network reliability as well as environmental risks.

2.3 Key assumptions underpinning the identified need

This section summarises the key assumption underpinning the identified need for this RIT-D. Appendix D of the FPAR provides additional detail on assumptions used, and methodologies applied, to estimate the costs and market benefits as part of this RIT-D.

2.3.1 Ageing SCFF 132kV feeders 9E1 and 9E2 are expected to increase the risk of involuntary load shedding

A key assumption underpinning the identified need is the increasing probability of significant and sustained unserved energy at the Kuringai STS in the event of concurrent feeder outages. Probabilistic failure modelling, which is informed by condition assessment, indicates an increasing risk of significant involuntary load shedding on these feeders.

Feeders 9E1 and 9E2 are reaching the end of their technical and serviceable lives. The outage duration for SCFF cable leaks can be lengthy, with repairs taking much longer than for other assets in Ausgrid's network. Leaking cables must be removed from service to determine the source of the leak, requiring extensive excavation of heavily trafficked streets. Repair of these cables also requires specialist skills given the technology has been obsolete for over 30 years and manufacturers no longer produce the cables, nor the accessories required for their repair.

EUE forecasts for feeders 9E1 and 9E2 (Figure 2) are based on cable failure frequency and failure duration and are combined with a model of the electricity network, including the forecast pattern of demand. The cable failures are assumed to occur at a frequency determined by the cable failure model, but their impact depends on the load level at that time.

[1] System Average Interruption Duration Index.

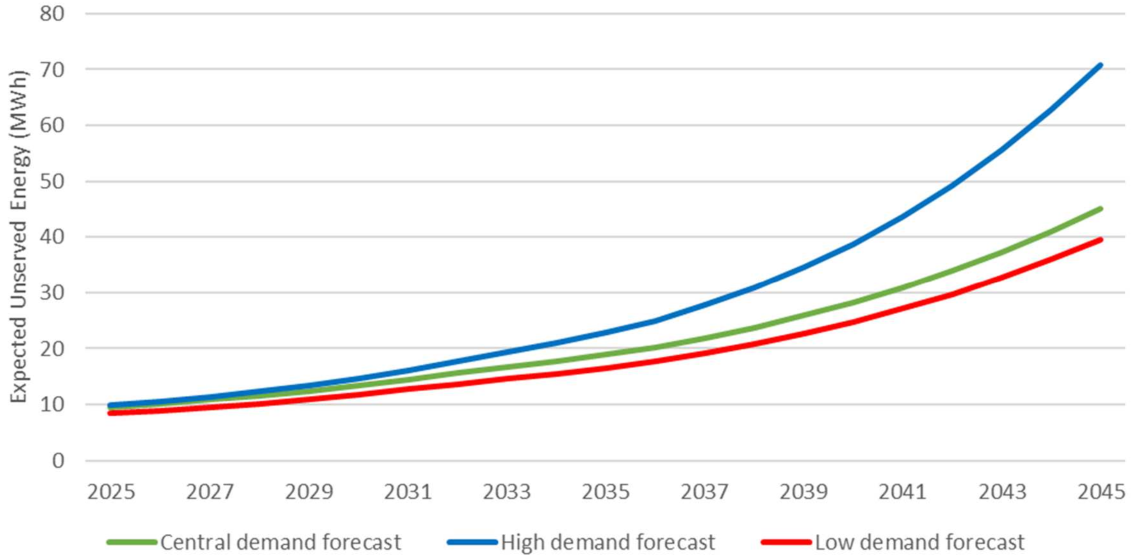
[2] System Average Interruption Frequency Index.

2.3.2 EUE Forecast

Ausgrid has developed a model to quantify the failure parameters (probabilistic distribution of outage frequency and duration) of each cable, relative to its observable condition. Supply or network risk is assigned for each cable based on the network configuration, available capacity under defined contingency conditions, demand forecasts and historical asset management records. A key component to this assessment is the cable failure model that forecasts the frequency of future cable failures. This model is developed from historical failure records, and then modified by cable condition indicators including Insulation Resistance tests. The failure model is applied to a probabilistic model of the network and the demand it is supplying, to estimate the long-term average amount of annual energy that is beyond the technical capability of the depleted network and therefore cannot be supplied.

Figure 2 shows the modelled levels of expected unserved energy (EUE), under each of the three underlying demand forecasts investigated, over the next twenty years. For clarity, this figure illustrates the MWh of EUE assumed under each load forecast if no credible option is commissioned (i.e. under the 'do nothing' base case for that load forecast).

Figure 2: Expected Unserved Energy Forecast for feeders 9E1 and 9E2



2.3.3 Feeder redundancy exists but capacity to undertake load transfers is limited

The level of impact on customers expected from any involuntary load shedding is dependent on the level of redundancy in backup 132kV feeders and the capacity to transfer load to other zone substations in the event of 132kV cable failures.

As noted above, a concurrent outage of these feeders would result in the loss of supply to Kuringai STS, leading to loss of supply to the zone substations: St Ives, Turramurra, Pymble, and Lindfield.

Cable failure modelling indicates that expected involuntary supply interruptions related to predicted failures of feeders 9E1 and 9E2 is approximately 9.6MWh in 2024/25 under the central scenario, increasing to 34MWh per year by 2041/42 if no corrective action is taken.

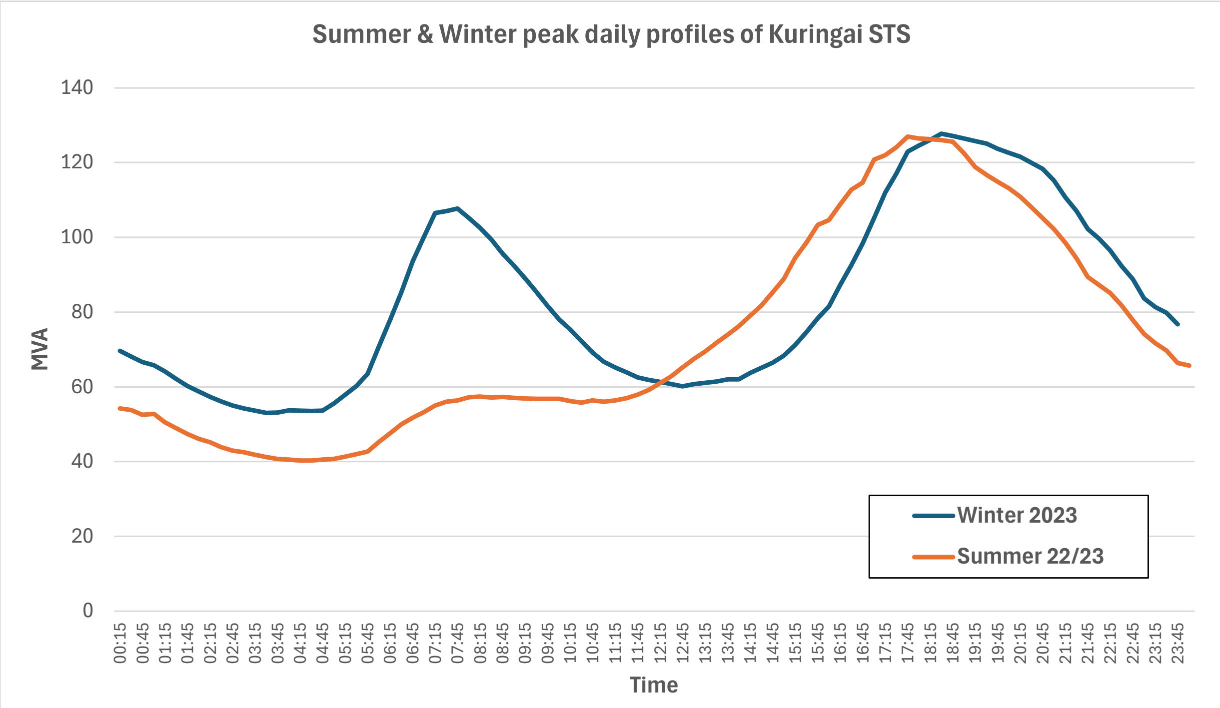
Both the degree of redundancy and the ability to transfer load elsewhere have been considered by Ausgrid in forecasting EUE. This EUE is then valued using the value of customer reliability (VCR) using values published by the Australian Energy Regulator (AER). Ausgrid has applied a central VCR estimate of $52.024/kWh reflecting the NSW state-wide VCR estimated by the AER in its December 2019 VCR Final Report, adjusted by the Consumer Price

Index (CPI) to be in 2023/24 dollars.[3] We have also tested the VCR as a sensitivity with values that are 30% lower and 30% higher than the central rate, consistent with the AER's specified +/- 30% confidence interval.[4]

2.3.4 Pattern of use

As described in Section 2.1, Ku-ring-gai load area consists of four zone substations: Pymble, Lindfield, St Ives and Turramurra. Based on the financial year (FY2023), there are 93.8% residential customers using 68.1% of energy, 6.2% non-residential customers using 31.9% of energy. The peak time occurred in early evening both in winter and summer. Figure 3 below shows the peak day profile of Kuringai STS.

Figure 3: Peak daily load profiles of Kuringai STS



2.3.5 Customer characteristics

Kuringai STS supplies four zone substations via 33kV feeders; Pymble, Lindfield, St Ives and Turramurra. These zone substations serve a mixture of residential and non-residential customers. A breakdown of the customer characteristic for the 2022/23 period is shown in Table 1 as follows.

Table 1: customer characteristics of combined four zones

Item	Residential	Small Non-Residential	Large Non-Residential	Total
Number of Customers	43,468	2,693	177	46,338
% of Customers	93.8%	5.8%	0.4%	
Annual Consumption (MWh)	332,057	52,286	103,525	487,868

[3] AER, Values of Customer Reliability – Final report on VCR values, December 2019, pp 71 and 87-88. The NSW state-wide VCR has been inflated to $2023/24 using the Australian Bureau of Statistics CPI weighted average of eight capital cities (series ID: A2325846C).

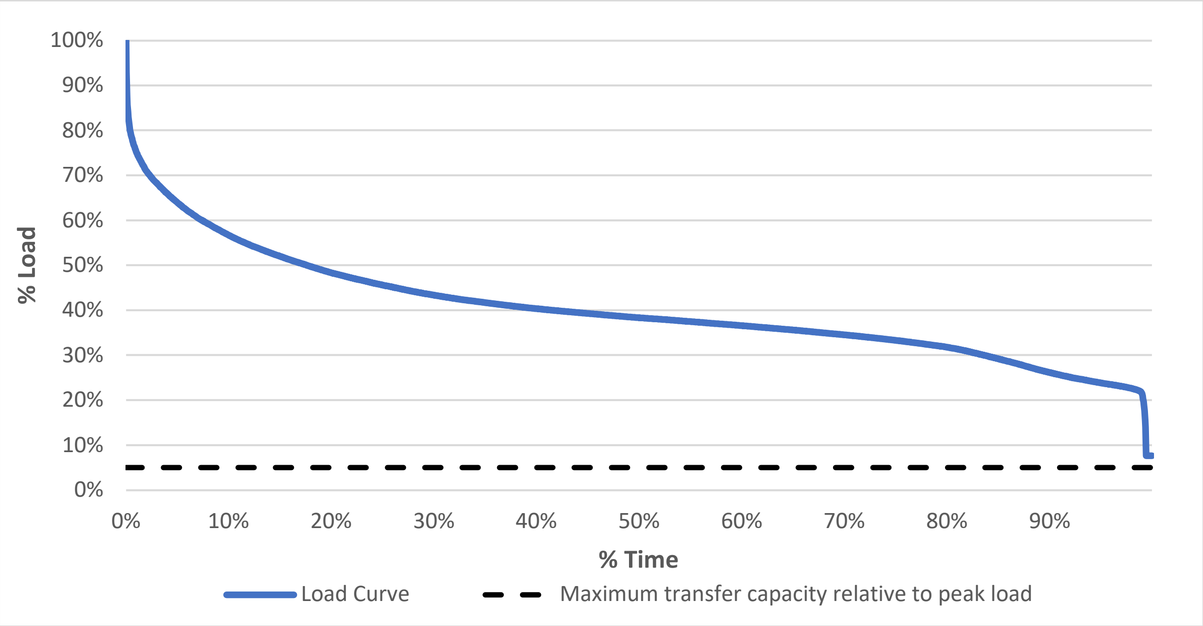
[4] AER, *Values of Customer Reliability – Final Report on VCR values*, December 2019, p. 84.

% of Annual Consumption	68.1%	10.7%	21.2%	
Number of Solar Customers	9,914	96	25	7,035
% of Customers with Solar	15.9%	3.6%	0.4%	
Average Annual Consumption (MWh)	8	19	585	11

2.3.6 Load Duration Curve

The load duration curve used in the analysis is presented in the Figure 4 below. It is assumed that the load types supplied will not change substantially into the future and therefore the load duration curve will maintain its characteristic shape.

Figure 4: Load duration curve



3 Proposed preferred network option

This section provides details of the credible options that Ausgrid has identified as part of its network planning activities. All costs and benefits presented in this document are in $2023/24, unless otherwise stated.

3.1 Option 1 – Replacement of SCFF sections of feeders 9E1 and 9E2 with XLPE along existing route

Option 1 involves the like-for-like replacement of the existing underground SCFF feeder sections with a modern equivalent (Cross Linked Polyethylene cables (XLPE)) in their existing configuration.

Specifically, Option 1 involves the replacement of approximately 1.0 kilometre of underground SCFF cable along the existing route configuration. This would require:

- Works at Sydney East BSP, Belrose TP and Kuringai STS;
- installation of two 132kV XLPE feeders of approximately 1.0km from Sydney East BSP to Belrose TP, with a proposed firm rating of 230MVA;
- metering, control and protection communication upgrades at Sydney East Bulk Supply Point and Kuringai STS, including installation of fibre inside Transgrid's Sydney East;
- decommissioning the Belrose transition point, and
- decommissioning of the existing SCFF feeder between Sydney East BSP and Belrose TP.

Upon commissioning of the new feeders, the existing SCFF feeder sections will be disconnected at both ends, oil tanks will be removed, and insulating fluid purged, with cable ends sealed and left in situ.

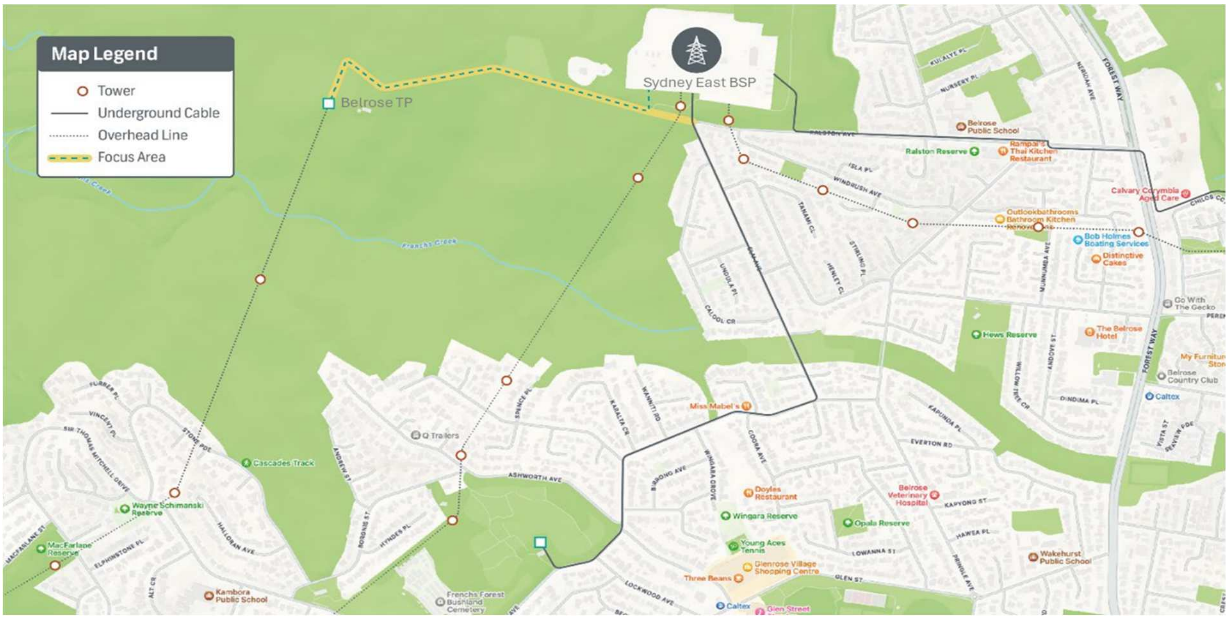
The estimated cost of this option is approximately $12.5 million (including decommissioning costs of approximately $565k). Optimal timing analysis indicates that construction of this option would commence in 2024/25, with commissioning a year later in 2025/26. Once commissioned, operating costs are expected to be approximately $12,500 per annum (0.1 per cent of capital expenditure).

3.2 Option 2 – Replacement of SCFF sections of feeders 9E1 and 9E2 with predominantly overhead lines

Option 2 involves replacing the underground SCFF feeder sections with predominantly overhead lines along the existing route. This option will improve reliability, reduce unserved energy and decrease operating expenditure over time compared to the base case of maintaining the existing cables. The scope includes:

- works at Sydney East BSP, Belrose TP and Kuringai STS to facilitate the new 132kV feeder connection;
- installation of two 132kV XLPE feeders of approximately 100m from Sydney East BSP to Ralston Ave, with a proposed firm rating of 230MVA;
- installation of two 132kV overhead powerlines of approximately 0.9 km from Ralston Ave to Belrose TP, with a proposed firm rating of 230MVA;
- metering, control and protection communication upgrades at Sydney East Bulk Supply Point and Kuringai STS, including installation of fibre inside Transgrid's Sydney East;
- installation of a new 132kV auto-closing scheme on both feeders;
- decommissioning the Belrose transition point, and
- decommissioning of the existing SCFF feeder between Sydney East BSP and Belrose TP.

Figure 5: Feeders 9E1 and 9E2 proposed route



Upon commissioning of the new feeders, the existing SCFF feeder sections will be disconnected at both ends, oil tanks will be removed, and insulating fluid purged, with cable ends sealed and left in situ.

The estimated cost of this option is approximately $7.8 million (including decommissioning costs of approximately $565k). Optimal timing analysis indicates that construction of this option would commence in 2024/25, with commissioning a year later in 2025/26. Once commissioned, operating costs are expected to be approximately $7,800 per annum (0.1 per cent of capital expenditure).

Ausgrid also considered several other options that have not been progressed. In general, these options were not progressed because they were found to be technically infeasible or economically infeasible. Table 2 below summarises Ausgrid's consideration and position on each of these options.

Table 2: Network options considered but not progressed

Option	Description	Reason why option was not progressed
Replace SCFF feeders with XLPE cables in separate trenches along existing route	Replace the SCFF feeders with XLPE cables in a separate trench	This option achieves the same outcome as Option 1 above, with a much higher capital cost without providing a commensurate increase in benefits. Therefore, this option is considered not economically feasible.
Retire 132kV feeders 9E1 and 9E2	Retirement of 132kV feeders 9E1 and 9E2, supplying Kuringai STS and downstream zone substations from an alternative source	This option would require an alternative source of supply to the four zone substations (St Ives, Pymble, Lindfield and Turramurra) in the upper north shore network area. The resulting cost would be considerably higher than the cost of options 1 and 2 and would take longer to be delivered.

Refer to the Final Project Assessment Report for further details about the options assessment methodology and scenario analysis.

3.3 Preferred option at this stage

Ausgrid considers that Option 2 is the preferred option that satisfies the RIT-D. It involves the commissioning of feeders 9E1 and 9E2, using overhead poles and wires.

Specifically, the scope includes:

- installation of two 132kV XLPE feeders of approximately 100m from Sydney East BSP to Ralston Ave;
- installation of two 132kV overhead poles and wires of approximately 0.9 km from Ralston Ave to Belrose TP;
- metering, control and protection communication upgrades at Sydney East Bulk Supply Point and Kuringai STS, including installation of fibre inside Transgrid's Sydney East;
- installation of a new 132kV auto-closing scheme on both feeders;
- decommissioning the Belrose transition point; and
- decommissioning of the existing SCFF feeder between Sydney East BSP and Belrose TP.

Option 2 has been determined to be the preferred option as it results in the highest net present value in the NPV modelling assessment across all scenarios, largely due to the lower capital costs associated with this option.

The estimated capital cost of this option is $7.8 million, including decommissioning costs of approximately $565k. Ausgrid assumes that the necessary construction to install the new feeders will commence in late 2024 following completion of the regulatory process, for commissioning in 2025/26.

Once the new installation is complete, operating costs are expected to be approximately $7,800 per annum (0.1 per cent of capital expenditure per annum).

Ausgrid has started engaging with key stakeholders such as the Northern Beaches Council, Metropolitan Local Aboriginal Land Council, and the local community to obtain early feedback on the preferred feeder route.

Ausgrid encourages community feedback and has committed to keep the community informed as the project progresses through:

- bespoke newsletters and community drop-in information sessions;
- in the lead up to and during construction, by door-knocks (as required), issuing notification letters and newsletters;
- launching and maintaining a dedicated project website, through the life of the project; and
- maintaining project email address and 24/7 community contact number.

Refer to the Final Project Assessment Report for further details about the options assessment.

4 Assessment of SAPS and non-network solutions

4.1 Required demand management characteristics

To be considered a feasible option, any demand management solution must be technically feasible, commercially feasible, and able to be implemented in sufficient time by 2025/26 for deferral of the network investment.

4.2 Available demand management funds

To identify the available funds for a possible demand management solution, Net Present Value (NPV) analysis was carried out where the net NPV for the network option is compared against the net NPV benefit of deferral scenarios of the preferred network option.

Table below shows the available funds for a deferral of the network investment for 1, 2 and 3 years.

Table 3: Required demand reduction and available funds at Ku-ring-gai load area

Required peak demand reduction	Available demand management funds ($)		
	1 Yr deferral	2 Yr deferral	3 Yr deferral
20MVA*	$54k	$60k	$17k

*To be viable, DM solutions must materially reduce demand at times other than at peak due to the replacement driver. Note that the 20MVA of DM reduction does not change the optimal replacement timing of the project. This figure has been selected to reflect the available funds for a possible demand management solution for a large DM reduction. Even at this point, it is not possible for DM solutions to offer more cost-effective solutions.

Available funds have been calculated accordingly.

- For a 1-year deferral, a 20MVA demand reduction in 2025/26 results in total available demand management funds of $54k, which is equivalent to $2.7/kVA/year,
- For 2-year deferral, a 20MVA demand reduction in 2025/26 and 2026/27 results in total available demand management funds of $60k, which is equivalent to $1.5/kVA/year, and
- For 3-year deferral, a 20MVA of demand reduction in 2025/26, 2026/27 and 2027/28 results total available demand management funds of $17k, equivalent to $0.3/kVA/year

4.3 Options considered

Ausgrid has considered Stand Alone Power Systems (SAPS) and other demand management solutions to determine their commercial and technical feasibility to assist with the identified need for Kuringai STS load area. Each of the solutions considered is summarised below.

4.3.1 Stand Alone Power Systems (SAPS)

SAPS self-generate, store and supply electricity to connected customers that are physically disconnected to the wider electricity grid. Typical SAPS are made up of solar panels, a battery storage system and a back-up diesel generator.

Ausgrid is currently trialing SAPS with selected customers living in fringe-of-grid areas of Ausgrid's network[5]. The program aims to explore how SAPS can provide an alternative electricity supply solution that improves reliability and safety of our service to remote and rural customers, as well as being sustainable and cost-effective.

Ausgrid's experience with proposals from SAPS providers during the trial has provided insights on the cost of SAPS. On average it would cost $50k-100k or more to supply a typical residential customer (based on their annual energy

[5] https://www.ausgrid.com.au/In-your-community/Stand-Alone-Power-Systems

usage) using a SAPS. Assuming a mid-point SAPS cost of $75k each, the amount of load that that Ausgrid would be able to supply via SAPS using all the available funds would be equivalent to only 1 to 2 residential customers. This is not sufficient to reduce, defer or postpone the proposed preferred network solution.

4.3.2 Other demand management options

There is no demand management solution mix that could meet the required demand reductions with the funds that are available. The costs of all demand management solutions considered exceed the $/kVA available for this project.

5 Conclusion

Based on the demand management options considered in Section 4, it is not considered possible that sufficient demand management measures could be feasibly implemented to achieve the required demand reduction to make project deferral technically and economically viable. Consequently, an Options Screening Report has not been prepared in accordance with rule 5.17.4(c) of the National Electricity Rules.