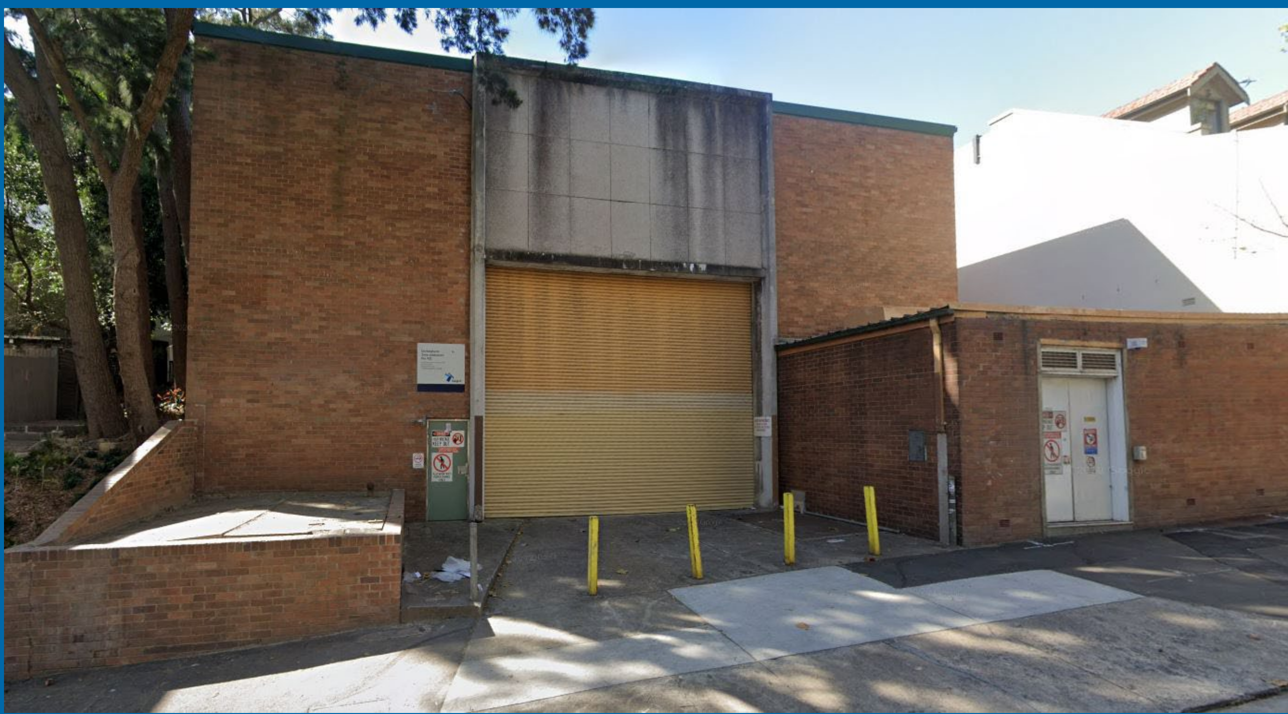
Addressing increasing risk of 33kV feeders supply Darlinghurst Zone Substation

NOTICE ON SCREENING FOR SAPS AND NON-NETWORK OPTIONS



11 March 2026

Ausgrid

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Addressing increased risk of 33kV feeders supplying Darlinghurst Zone Substation

Notice on screening for SAPS and non-network options – 11 March 2026

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 Darlinghurst zone load area of Ausgrid's network.

The Darlinghurst Zone Substation (ZS) is located in, and contributes to the reliable supply of electricity to, the Eastern Suburbs network area. This ZS currently supplies approximately 9,000 customers in the area, with a summer forecast load of 20 MVA (which is below the substation's rated capacity of 24 MVA).

The Darlinghurst ZS was commissioned in 1966 and many of the original assets are still in service. It is currently supplied from the Surry Hills Sub-transmission Substation (STS) through two underground 33 kV gas pressured cables (or 'feeders').

The 33 kV gas pressured feeders from the Surry Hills STS to Darlinghurst ZS are becoming less reliable and are approaching the end of their useful life, posing an increased risk of customer outages.

In 2018, Ausgrid's Eastern Suburbs area plan review determined that the preferred strategy to address the ongoing asset condition issues at Darlinghurst ZS was to decommission the gas cables in two stages – namely:

- Stage 1 (initiated in 2018, and completed in 2024) – addressing the condition of two of the four 33 kV gas cables (and the 11 kV compound-insulated switchgear) by transferring the 11 kV load to the compound insulated switchgear to Campbell Street ZS and retiring the associated assets; and
- Stage 2 (which had a targeted completion date in 2028/29) – addressing the condition of the two remaining gas cables (and 11 kV air-insulated switchgear) by transferring the residual load to Campbell Street ZS to enable retirement of the assets.

Ausgrid is therefore undertaking a RIT-D to assess options for addressing the risk associated with the ageing 33 kV gas pressured feeders, to ensure we continue to satisfy our reliability and performance standards.

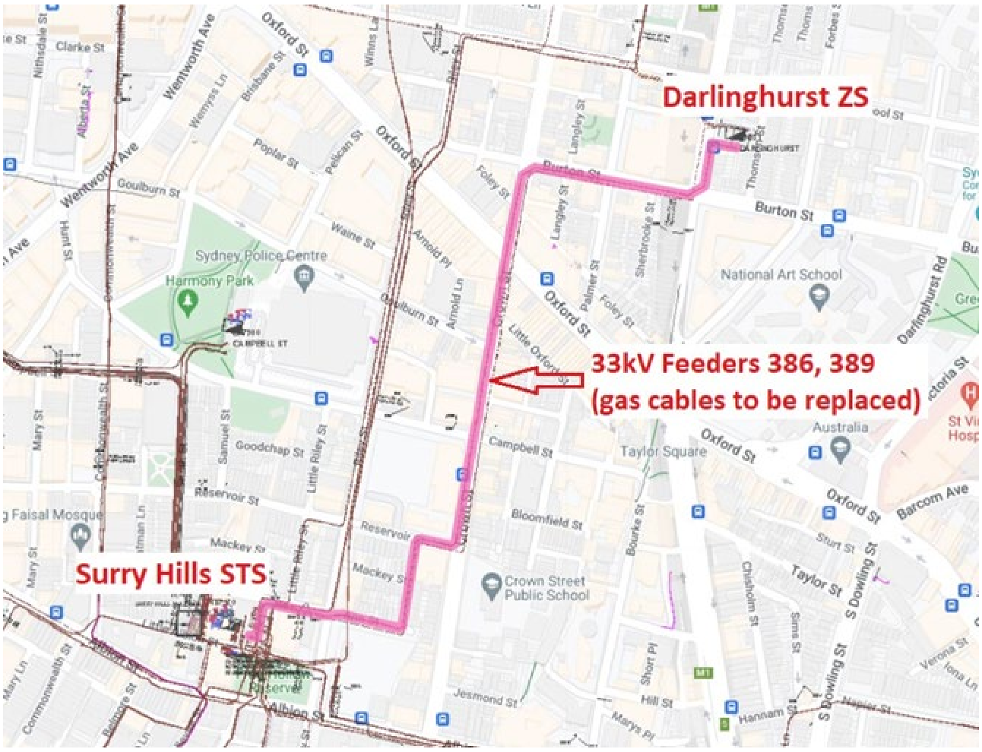
No exemptions listed in the NER clause 5.17.3(a) apply and therefore Ausgrid is required to apply the RIT-D to this project. This notice has been prepared under cl. 5.17.4(d) of the NER and summarises Ausgrid's determination that no SAPS and non-network option forms all or a significant part of any potential 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 addressing increased risk of 33kV feeders supplying Darlinghurst Zone Substation

2 Description of the identified need

2.1 Overview of the relevant network area

The Darlinghurst ZS is a 33/11 kV ZS that was commissioned in 1966 and is currently supplied by the Surry Hills STS via two 33 kV gas pressured feeders (feeders 386 and 389). The ZS supplies customers located in the Eastern Suburbs network area, including residential, commercial and industrial customers.

Figure 2.1 - Existing location of 33kV gas pressured feeder cables



The gas pressured cables that connect the Darlinghurst ZS to the Surry Hills STS are approaching the end of their useful life and are becoming more difficult to maintain. Gas pressured insulated cables have been used in Ausgrid's network from 1906 until the mid-1980s for sub-transmission feeders, and these types of cables are prone to leaks due to the high operating pressures.

Gas pressured cables are difficult to effectively repair, such that any repairs themselves take a prolonged period of time to complete and require the entire cable to be re-gasified. Once repaired, it takes a considerable amount of time for the gas to diffuse throughout the cables and displace any air that was introduced by the defects or during the repair work. For these reasons, gas pressured cables are becoming obsolete in modern electricity distribution networks.

Since early 2012, Ausgrid has developed and implemented a strategy to replace or retire its fleet of 33 kV gas pressured cables and, since the strategy was proposed, only 26 km of the original 185 km of gas pressured cables remain in service. The two gas pressured cables between the Darlinghurst ZS and the Surry Hills STS make up approximately 2 km of the cables still in service.

Between 2018 and 2024, Ausgrid addressed the condition of two of the initial four 33 kV gas cables (and the 11 kV compound-insulated switchgear) at the Darlinghurst ZS by transferring the 11 kV load to the compound insulated switchgear to Campbell Street ZS and retiring the associated assets. This work predated the requirement in the NER for the RIT-D to be applied to replacement works.

Without action, the remaining two 33 kV gas pressured cables currently connecting the Darlinghurst ZS and the Surry Hills STS are expected to continue to deteriorate, resulting in long repair times and prolonged outages to customers in the Eastern Suburbs network area.

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 this RIT-D is seeking to address relates to increasing customer supply risks derived from the condition of the 33k V cables. If action is not taken to address the deteriorating condition of this equipment, then the analysis shows that the unserved energy modelled will put these performance standards at risk.

By addressing the reliability concerns from the aging cables, the investment will deliver material net market benefits for customers from a reduction in expected unserved energy (EUE) and avoided maintenance and repair costs.

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 FPAR provides additional detail on the assumptions used, and methodologies applied, to estimate the costs and market benefits as part of this RIT-D.

2.3.1 Probability of assets failing increase with age

Ausgrid has adopted well-accepted models for each major class of network asset to estimate the probability of failure. In general, the probability of failure increases with asset age.

Figure 2.2 below shows unavailability plotted, on a logarithmic scale, for a representative 10 km stretch of cables aged zero to one hundred years.[3] It also maps to these curves the age of the current underground gas pressure cables at the Darlinghurst ZS and, in doing so, highlights how these cables are now 15 years past the 'standard' asset life for such cables (noting that they will be 18 years passed their standard asset life by the time the preferred credible option can be commissioned).

Gas pressured cables typically exhibit unavailability rates 3 to 10 times higher that modern equivalent cable technology (i.e., Cross Linked Polyethylene or 'XLPE' cables). For gas cables over 40 years old, there is an unavailability 'elbow' where forced outages increase exponentially.

For gas pressured cables, our model is also based on the assumption that the condition of a cable is dependent upon its age. The Ausgrid Crow-AMSAA model shows that the availability of gas pressure cables is expected to decline if the cables are retained past an age of 50 years.

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[1] System Average Interruption Duration Index.

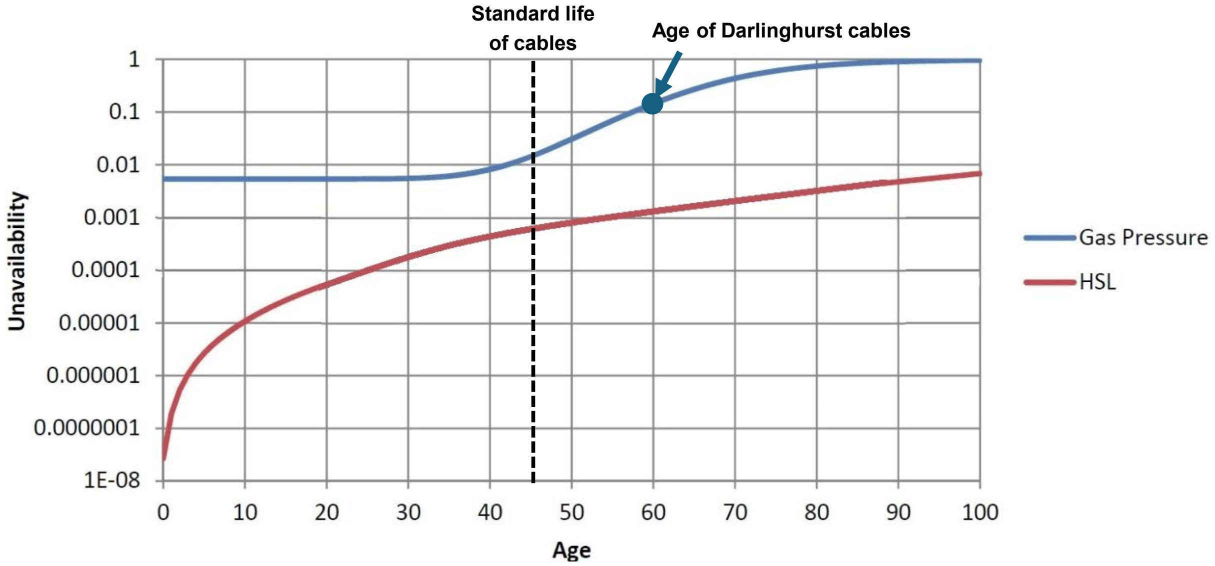
[2] System Average Interruption Frequency Index.

[3] For this RIT-D, it is only 'gas pressure' cables that are relevant for the Darlinghurst ZS, i.e., the blue line.

For switchboards, Weibull analysis is used to derive a probability distribution function for the asset's age at time of failure.

Ausgrid considers the methodologies applied are consistent with industry practice. A detailed discussion of the probability of failure and asset availability for both cables and switchboards is provided in Appendix D of the FPAR.

Figure 2.2 - Unavailability of underground cable technologies



2.3.2 Expected Unserved Energy (EUE) Forecast

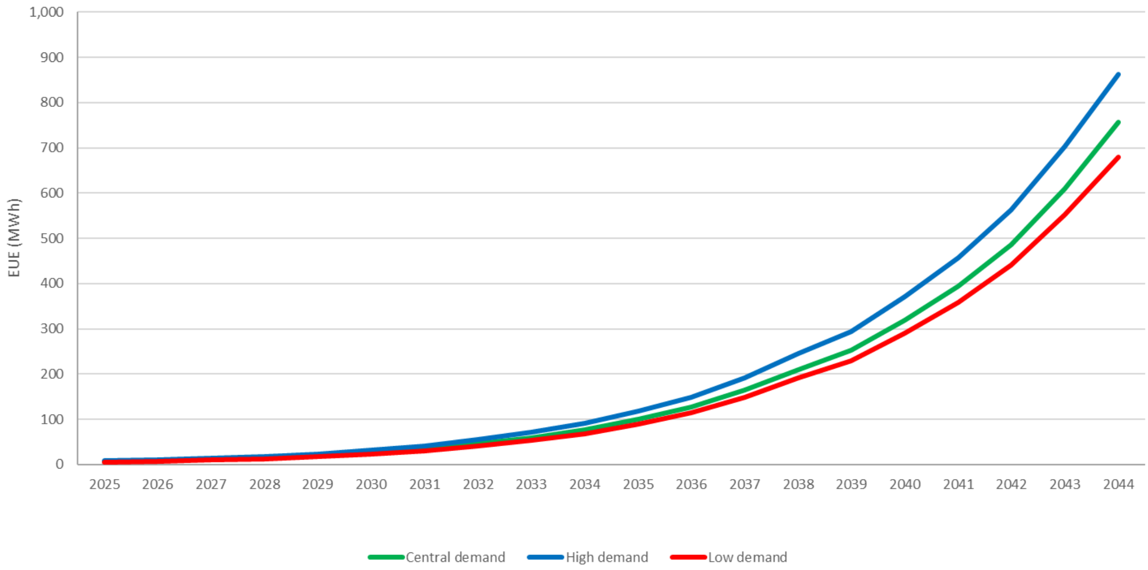
Ausgrid has adopted probability models to estimate expected failure of different network assets. A summary of the models adopted, and the key parameters used are summarised in the Appendix D of FPAR, which includes different network asset type such as switchboards and underground cables.

We have investigated how assuming different load forecasts going forward changes the EUE (and therefore net market benefits) under the proposed options.

In particular, we have investigated three future load forecasts for the area in question – namely a central forecast that represents expected load growth using our 50 per cent probability of exceedance ('POE50') forecasts, as well as a low forecast using the POE90 forecasts and a high forecast using the POE10 forecasts.

Figure 2.3 below shows the modelled levels of 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).

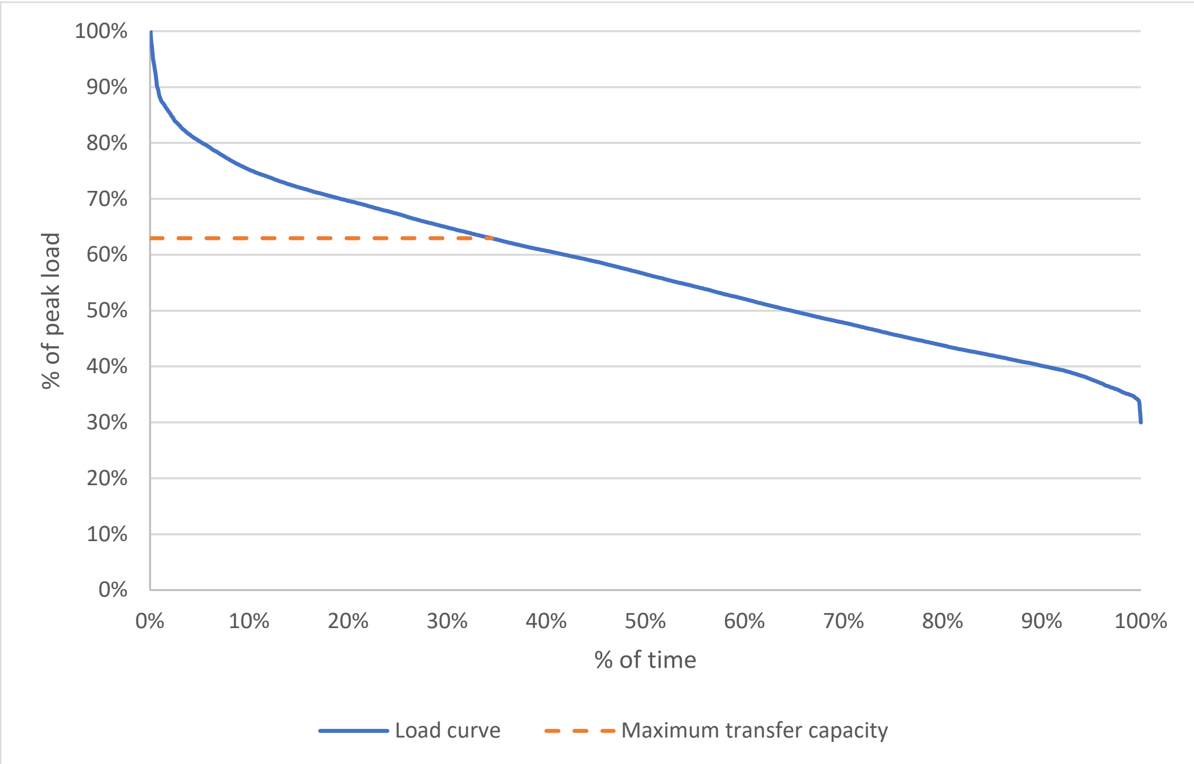
Figure 2.3 - Forecast EUE under each of the three demand forecasts



2.3.3 Characteric load duration curve

The load duration curve used in the analysis is present in Figure 2.4 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 2.4 - Load duration curve



2.3.4 Load transfer capacity and supply restoration

Darlinghurst zone substation load area is classified as urban and has 11kV interconnections with Campbell St and Paddington ZSs. In the event of a total loss of supply to Darlinghurst zone substation, approximately 63 per cent of peak load can be recovered within days via the load transfer capacity of the existing network.

Ausgrid considers that the time required for restoration after a typical cable failure of the type in the Darlinghurst ZS can vary between 24 and 28 days depending on the type of failure, with some complex failure cases requiring up to 60 days. Detailed restoration assumptions are set out in Appendix D of FPAR.

As part of restoring supply after an outage, the Darlinghurst ZS has load transfer capabilities that can mitigate the severity of involuntary load shedding. In particular, the Darlinghurst ZS has 11 kV interconnections with the Campbell St, Paddington and Surry Hills zone substations.

In the event of a total loss of supply to Darlinghurst ZS, approximately 63 per cent of the load can be recovered by switching to adjacent zone substations via the 11kV network after a time delay (i.e., by closing and opening normally open points on the network).

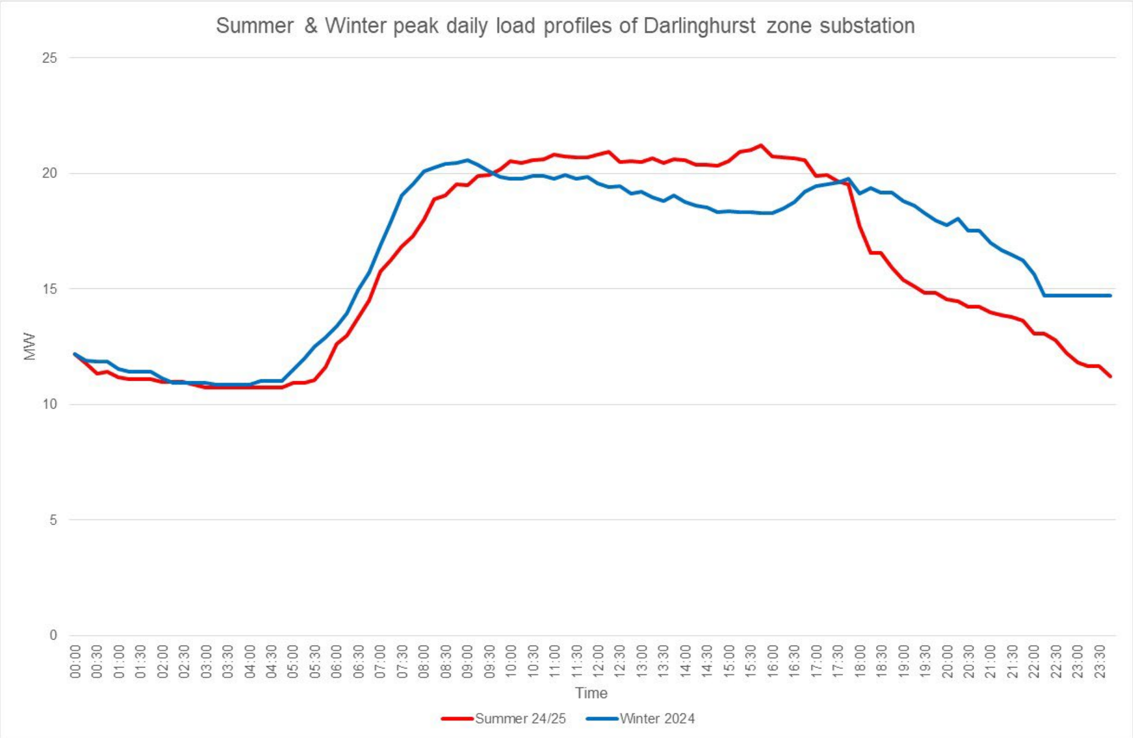
These load transfers can help mitigate any consequent unserved energy to customers following failures of assets at the Darlinghurst ZS. Ausgrid has factored the ability to transfer load into its assessment of forecast unserved energy. In addition, mobile generation sets can also be used to restore loads.

Whilst load to many customers can be restored through switching operations in the 11 kV network combined with the use of mobile generation sets, the full incident recovery process (i.e., cable and/or substation equipment repairs) can take several weeks (which may result in unserved energy over this period).

2.3.5 Pattern of use

The Darlinghurst zone substation supplies customers located in the Eastern Suburbs network area, including residential, commercial and industrial customers. Based on the financial year (FY2025), there are 94.3% residential customers using 21.1% of energy, 15.7% non-residential customers using 78.9% of energy. The peak time occurred in early evening both in winter and summer. Figure 5 below shows the peak day profile of Darlinghurst zone substation.

Figure 2.5 - Peak daily load profiles of Darlinghurst zone substation



2.3.6 Customer characteristics

Darlinghurst zone substations serve a mixture of residential and non-residential customers. A breakdown of the customer characteristic for the 2024/25 period is shown in Table 2.1 as follows.

Table 2.1 - customer characteristics of Darlinghurst zone

Item	Residential	Small Non-Residential	Large Non-Residential	Total
Number of Customers	7,044	1,249	62	8,355
% of Customers	84.3%	14.9%	0.7%	
Annual Consumption (MWh)	24,033	30,772	59,038	113,843
% of Annual Consumption	21.1%	27.0%	51.9%	
Number of Solar Customers	43	24	3	70
% of Customers with Solar	0.6%	1.9%	4.8%	
Average Annual Consumption (MWh)	3	25	952	14

3 Two credible options have been assessed

This section provides details of the two credible network options that Ausgrid has identified as part of its network planning activities. Each option has been developed following an assessment of the various potential dimensions for addressing the obsolete 33 kV gas pressured cables and ensuring reliable supply of electricity to the Eastern Suburbs network area.

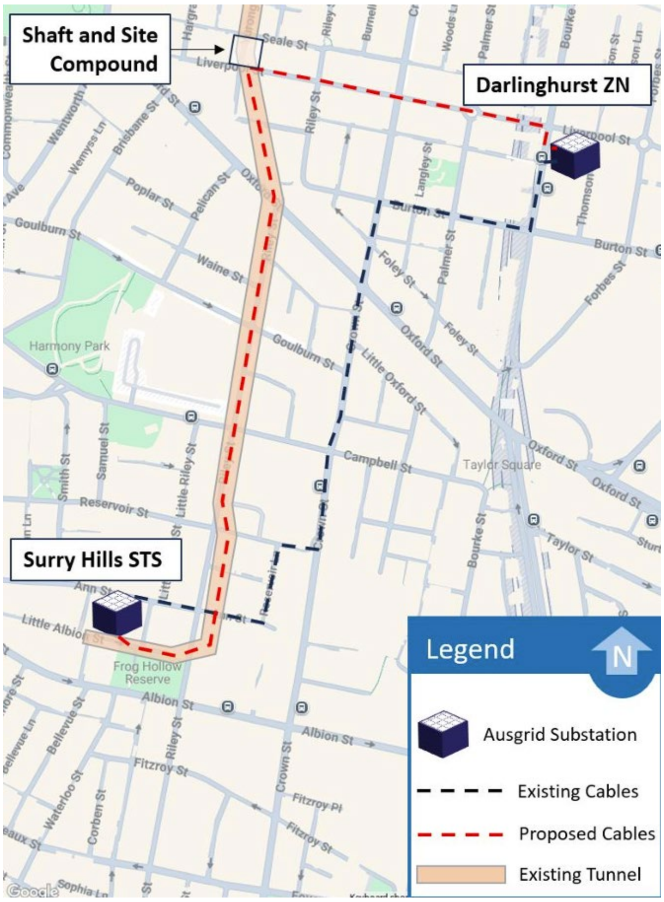
All costs and benefits presented in this FPAR are in 2024/25 dollars, unless otherwise stated.

3.1 Option 1 – Replace ageing 33kV gas pressured cables

Option 1 involves replacing the existing 33 kV gas pressured cables 386 and 389, with new cables, making use of an existing underground cable tunnel network to minimise disruption to the local community. The use of the existing cable tunnel network reduces the required trenching from approximately 1.2 km to only 0.38 km.

Figure 3.1 presents the location of the existing 33 kV gas cables (to be decommissioned under this option) and the proposed new cables.

Figure 3.1 – Option 1 proposed new cable location and existing cable location

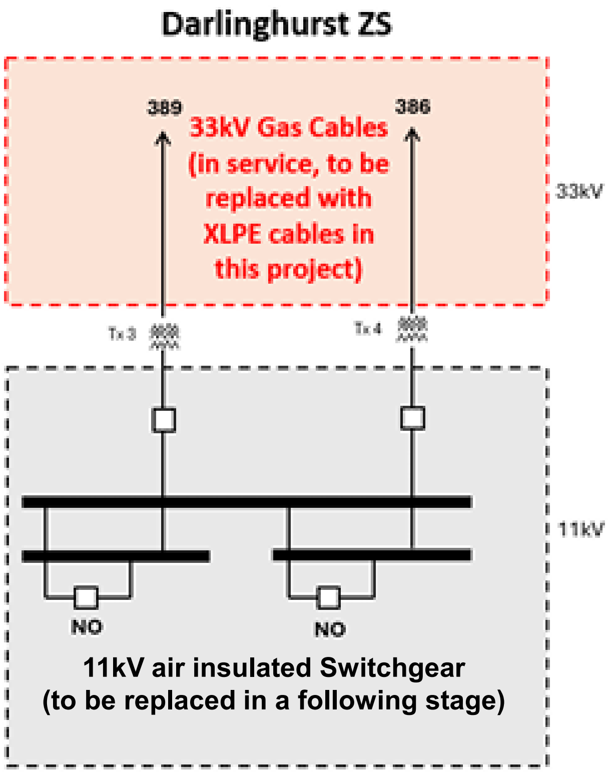


This option involves the installation of two new 33 kV feeders between the Surry Hills STS and the Darlinghurst ZS. These feeders will utilise 630Cu3 XLPE cable in ducts, achieving a rating of at least 650A per feeder with either one in service. The new feeders will be connected to the:

- existing 33 kV feeder panels at the Surry Hills STS; and
- existing Tx.3 and Tx.4 primary side at the Darlinghurst ZS.

A schematic diagram of this option is presented in Figure 3.2 below, with the specific new network elements shown in red.

Figure 3.2 – Option 1 proposed network arrangement



The scope of works for Option 1 includes:

- works at Surry Hills STS and Darlinghurst ZS to facilitate the 33 kV connections;
- construction of a cable shaft in Yurong Street to form a connection to the existing City East Cable tunnel (CECT);
- construction of a new 33 kV ductline along Liverpool Street in Darlinghurst;
- installation of two 1 km long 33 kV XLPE feeder cables through the CECT shaft and Liverpool Street ductline;
- communication upgrades at both ends; and
- decommissioning of the existing gas pressured cables between the Surry Hills STS and the Darlinghurst ZS.

The estimated construction capital cost of this option is $8.0 million, with an estimated decommissioning cost of $0.2 million.

Option 1 is expected to take three years to complete, with commissioning expected in 2028/29. Once commissioned, it will require approximately $14,000/ year in planned routine maintenance costs.

3.2 Option 2 – Retire Darlinghurst 33/11 zone substation

Option 2 involves retiring the existing Darlinghurst ZS and transferring 11 kV loads to the Campbell Street ZS.

The scope of works includes:

- decommissioning the existing 33 kV gas pressured cables between Surry Hills STS and Darlinghurst ZS;
- decommissioning the existing 11 kV switchgear and other remaining assets at the Darlinghurst ZS;
- selling the existing land where the Darlinghurst ZS in currently situated; and
- installing an additional 50 MVA transformer unit and 11 kV switchgroup at the Campell Street ZS.

The estimated construction capital cost of this option is $29.3 million, with an estimated decommissioning cost of $2.4 million.

This option also involves the sale of the land where Darlinghurst ZS is located (estimated at $10 million after remediation), which partially offsets the total cost of this option.

Once commissioned, Option 2 is expected to require $19,000/ year in planned routine maintenance costs.

Option 2 is expected to take three years to complete, with commissioning assumed in 2035/36.

3.3 Options considered but not progressed

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. The table below summarises Ausgrid's consideration and conclusion on each of these options.

Table 2: Network options considered but not progressed

Description	Reason why option was not progressed
	Network options
Complete greenfield project – New Darlinghurst 33/11 kV ZS.	Under this option a new Darlinghurst ZS would be established. The scope of works would consist of those outlined in Option 2 as a temporary transfer, prior to establishing a new Darlinghurst ZS at the original site. This option is estimated to cost upwards of $60 million, making it approximately double the cost of Option 2 and triple the cost of Option 1. In addition, under this option, the land that the existing site is located on would likely not be sold (and, if it were, a new site would need to be acquired), which would further increase the capital costs compared to Option 2 (where the land would be sold). Due to materially higher costs, and the fact that no additional benefits (or cost reductions) are expected, Ausgrid considers this option is not economically feasible and has not considered it further.
	Non-network and SAPS options
Using non-network solutions either in combination with, or in-place of, a network option.	Ausgrid has considered how non-network solutions (e.g., demand management) could potentially defer the timing of the preferred network solution and whether the EUE could be cost effectively reduced. An assessment of the potential for non-network options has shown that these alternatives would not be cost effective due to the magnitude of the load reduction required. This result is driven by the significant amount of EUE that the identified network options allow to be avoided, compared to the base case, and the likely cost of non-network solutions. In addition, these solutions would not resolve the escalating reactive maintenance costs associated with continued use of the cables. This is detailed further in the separate Options Screening Notice released in accordance with clause 5.17.4(d) of the NER.
Transferring and/or connecting customers to SAPS	Ausgrid has considered the feasibility of SAPS, informed by its trial of SAPS with selected customers living in fringe-of-grid areas of Ausgrid's network. Based on Ausgrid's trial, the cost of SAPS would limit the number of customers available to reduce demand given the deferral funds available and consequently, the reduction in demand would not be sufficient to defer or postpone the network solution. In addition, these solutions would not resolve the escalating reactive maintenance costs associated with continued use of the cables. This is detailed further in the separate Options Screening Notice released in accordance with clause 5.17.4(d) of the NER.

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

3.4 Preferred option at this stage

Ausgrid considers that Option 1 is the preferred option that satisfies the RIT-D. It involves two new 33 kV feeder cables between the Surry Hills STS and the Darlinghurst ZS to replace the existing, ageing 33 kV gas pressured feeder cables.

The scope of this option includes the:

- works at Surry Hills STS and Darlinghurst ZS to facilitate the 33 kV connections;
- construction of a cable shaft in Yurong Street in Darlinghurst to form a connection to the existing CECT;
- construction of a new 33 kV ductline along Liverpool Street in Darlinghurst;

- installation of two 1 km long 33 kV XLPE feeder cables through the CECT shaft and Liverpool Street ductline;
- communication upgrades at both ends; and
- decommissioning of the existing, ageing gas pressured cables between the Surry Hills STS and the Darlinghurst ZS.

The estimated capital cost of this option is approximately $8.2 million, comprising:

- $6.8 million for commissioning two new 33 kV feeder cables;
- $1.2 million for the construction of a cable shaft in Yurong Street; and
- $0.2 million for the decommissioning of the old 33 kV feeder cables.

Planned routine network operating costs under this option are expected to be around $14,000/year once commissioned, which is approximately 30% lower than the current annual routine maintenance costs for the two ageing cables at the Darlinghurst ZS.

Overall, Option 1 is the lowest cost of the two credible options assessed in this FPAR and delivers the greatest net benefits.

Ausgrid expects that the necessary construction would commence as soon as practicable after this RIT-D and end in 2027/28, with commissioning occurring at the beginning of 2028/29.

Ausgrid considers that this FPAR, and the accompanying detailed analysis, identify Option 1 as the preferred option and that this satisfies the RIT-D. Ausgrid is the proponent for Option 1.

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 2028/29 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 4.1 shows the available funds for a deferral of the network investment for 1, 2 and 3 years.

Table 4.1 - Required demand reduction and available funds at Darlinghurst zs load area

Required peak demand reduction	Available demand management funds ($)		
	1 Yr deferral	2 Yr deferral	3 Yr deferral
4MVA*	$68k	$17.5k	$0

*To be viable, DM solutions must materially reduce demand at times other than at peak due to the replacement driver. Note that the 4MVA 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 4MVA demand reduction in 2028/29 results in total available demand management funds of $68k, which is equivalent to $17/kVA/year,
- For 2-year deferral, a 4MVA demand reduction in 2028/29 and 2029/30 results in total available demand management funds of $17.5k, which is equivalent to $2/kVA/year, and
- For 3-year deferral, a 4MVA of demand reduction in 2028/29, 2029/30, and 2030/31 results total available demand management funds of $0.

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 Darlinghurst 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[4]. 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.

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

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 usage) using a SAPS. Assuming a mid-point SAPS cost of $75k each, the amount of load that Ausgrid would be able to supply via SAPS using all the available funds would be about one residential customer. 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.