# Carlingford Transmission Substation reliability and safety risk mitigation

Notice on screening for non-network options
Endeavour Energy
November 2021

Endeavour Energy

## CONTACT

If you have any comments or enquiries regarding this report or wish to submit your ideas regarding possible demand reducing initiatives please send to the following email and addressed to Head of Asset Planning and Performance:

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# 1. Introduction

This Screening Test Report has been prepared by Endeavour Energy in accordance with the requirements of clause 5.17.4 of the National Electricity Rules (NER).

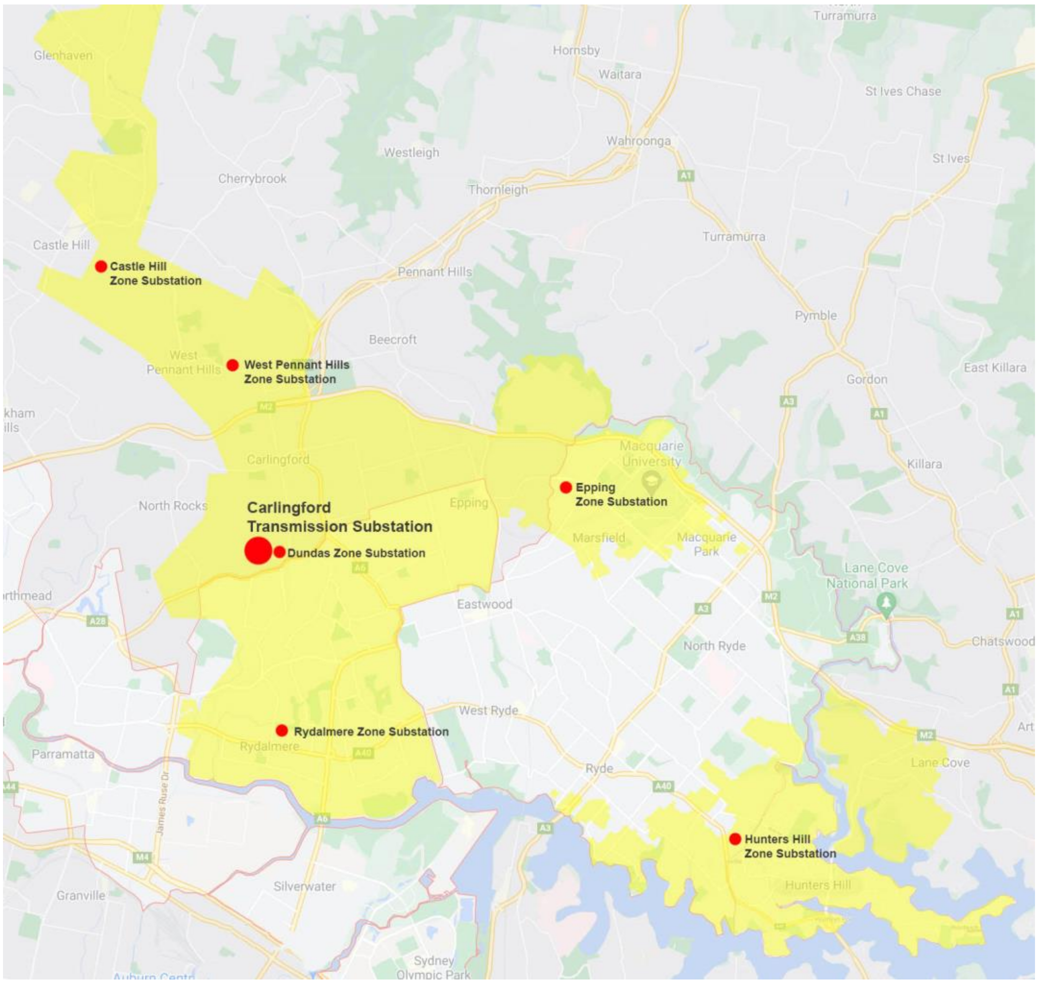
The purpose of this report is to explore the feasibility of a non-network option to address the reliability and safety risks posed by the deteriorating condition of the control building at Carlingford Transmission Substation.

Carlingford Transmission Substation is a 132/66kV substation which was originally built by the Electricity Commission of NSW in the early 1950's and expanded in the mid 1960's. The substation is situated between new high-rise residential development and James Ruse Agricultural High School.

The substation supplies Endeavour Energy's Castle Hill, Dundas, Rydalmere and West Pennant Hills zone substations and Ausgrid's Epping and Hunter's Hill zone substations. Between them, Carlingford Transmission Substation currently supplies over 62,900 customers with a mix of 62% residential, 35% commercial and 3% industrial in the local government areas of City of Parramatta, The Hills Shire, Ryde City Council and the Municipality of Hunter's Hill.

The location of Carlingford Transmission Substation and the area that it serves is shown in Figure 1 below.

Figure 1 - Carlingford Transmission Substation supply area



The substation also provides the sole supply to major industrial / commercial customers NorthConnex Tunnel, Mitsubishi Electric and Rheem, as well as 1,660 residential customers with life support systems. Currently our customer's collectively value unserved energy from the Carlingford Transmission Substation at $3.79 million per hour.

The 62,900 customers served by Carlingford Transmission Substation use a total of 225 MVA of electricity during the peak summer evening periods and have an average year-round demand of 113 MVA and an annual energy usage of 990 giga watt hours.

On this basis, the reliability of the electricity supply from Carlingford Transmission Substation is of paramount importance.

The need is that the roof of the control building is in poor condition with significant water leaks and a high and increasing risk of major failure. A roof failure is likely to cause damage to the protection and control systems which is likely to result in an inadvertent trip of the 132kV or 66kV busbars, feeders or transformers, resulting in the loss of supply from the substation for an extended period of time.

A further issue is the presence of asbestos throughout the control building. Although this issue is being managed, the asbestos presents a safety risk to personnel working in and around the building and to the public in street and the high school which is adjacent the building.

Carlingford Transmission Substation is normally supplied at 132kV via feeders 930 and 931 from Sydney West Bulk Supply Substation via Blacktown and Baulkham Hills transmission substations. A further two 132kV feeders 926 and 927 inter-connect with Ausgrid's 132kV network.

Given the identified need and credible network options for addressing that need exceed the $6 million threshold, in accordance with Section 5.17 of the National Electricity Rules, we are initiating a Regulatory Investment Test for Distribution (RIT-D).

**'Identified need' for this Regulatory Investment Test for Distribution (RIT-D)**

We have initiated a Regulatory Investment Test for Distribution (RIT-D) to investigate, and consult on, how to most efficiently address the risks to the reliability of the electricity supply to our customers and the safety risks posed by the deteriorating condition of the control building at Carlingford Transmission Substation.

The risks posed by the existing condition of the assets is substantial and increasing year by year. The economic evaluation of the preferred network option indicates that the optimum timing for investment to address identified need has passed and therefore the required timing for credible options to address the need is 2023.

The proposed refurbishment work to address the identified need was included as part of our most recent Distribution Annual Planning Report (DAPR).[1]

This non-network screening notice sets out the reasons why we consider that there will not be a non-network option that forms a potential credible option on a standalone basis, or that forms a significant part of a potential credible option for the Carlingford Transmission Substation RIT-D, ie, in accordance with NER clause 5.17.4(c), it represents the first formal stage of the RIT-D assessing how to most efficiently address the risks to the reliability of the electricity supply to our customers posed by the deteriorating condition of the control building at Carlingford Transmission Substation.

[1] Endeavour Energy, *Distribution Annual Planning Report*, December 2020, p 55, 57, 78.

The second formal stage of this RIT-D is a Project Assessment Report. Given that the cost of the preferred option is less than the threshold value of $11 million, the project assessment report will be a final project assessment report (FPAR), which will include a full net present value (NPV) option assessment. We currently intend to publish the FPAR in November. 2021.

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# 2. Key assumptions underpinning the 'identified need' for this RIT-D

This section sets out the key assumptions and methodologies that underpin the identified need for this RIT-D. These assumptions have been used in making our determination that that there will not be a non-network option that is a potential credible option on a standalone basis, or that forms a significant part of a potential credible option, ie, in accordance with NER clause 5.17.4(c).

## 2.1 Relevant area of our network

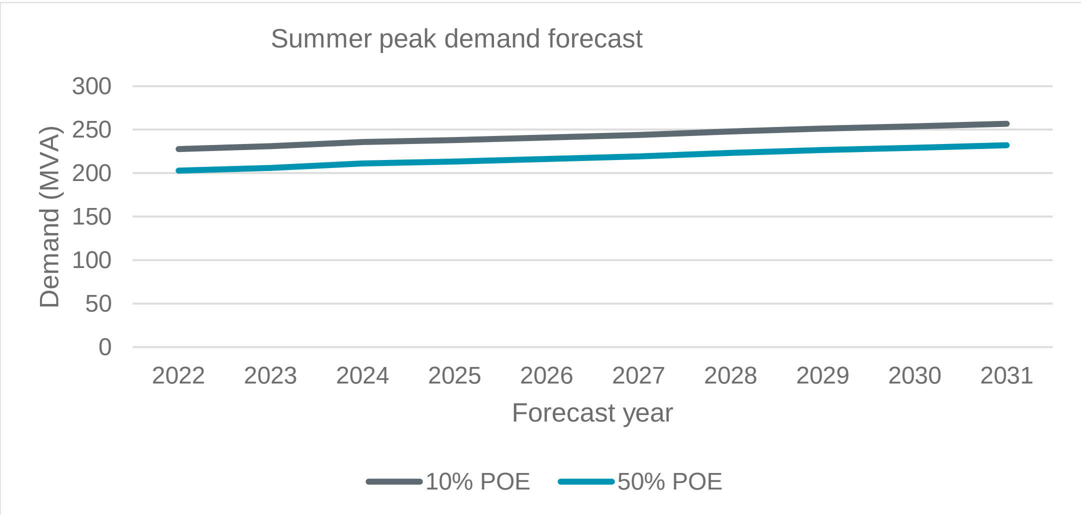
Carlingford Transmission Substation supplies over 62,900 customers over an area of 80 square km in the local government areas of City of Parramatta, The Hills Shire, Ryde City Council and the Municipality of Hunter's Hill. The mix of customers is 62% residential, 35% commercial and 3% industrial including major industrial and commercial customers NorthConnex Tunnel, Mitsubishi Electric and Rheem and 1,660 residential customers with life support systems

The location of Carlingford Transmission Substation and the area that it serves is shown in Figure **1** above.

## 2.2 Load forecasts

Figure 2 below shows our forecast peak summer load demand expected on Carlingford Transmission Substation with a 10% probability of being exceeded and a 50% probability of being exceeded.

Figure 2 – Carlingford Transmission Substation demand forecast, 2022-2031




## 2.3 Pattern of use

The load duration curve for Carlingford Transmission Substation throughout the year is shown in Figure 3 below and the load profile for a typical peak summer day is shown in Figure **4** – Peak summer day profile for Carlingford Transmission SubstationFigure **4**.

Figure 3 – The load duration curve for Carlingford Transmission Substation

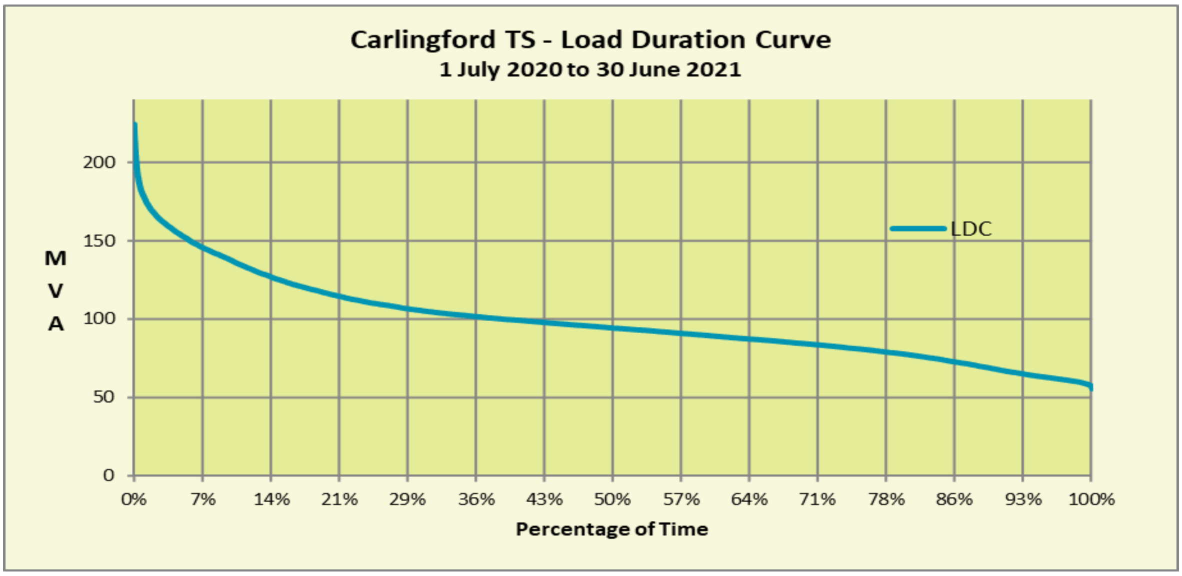
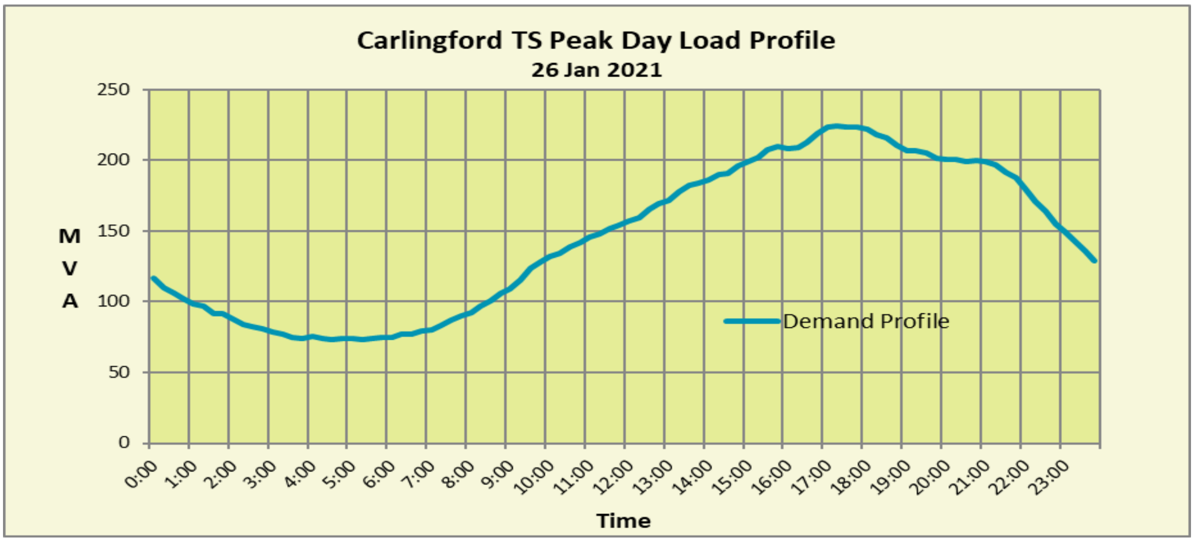



Figure 4 – Peak summer day profile for Carlingford Transmission Substation




## 2.4 Existing network

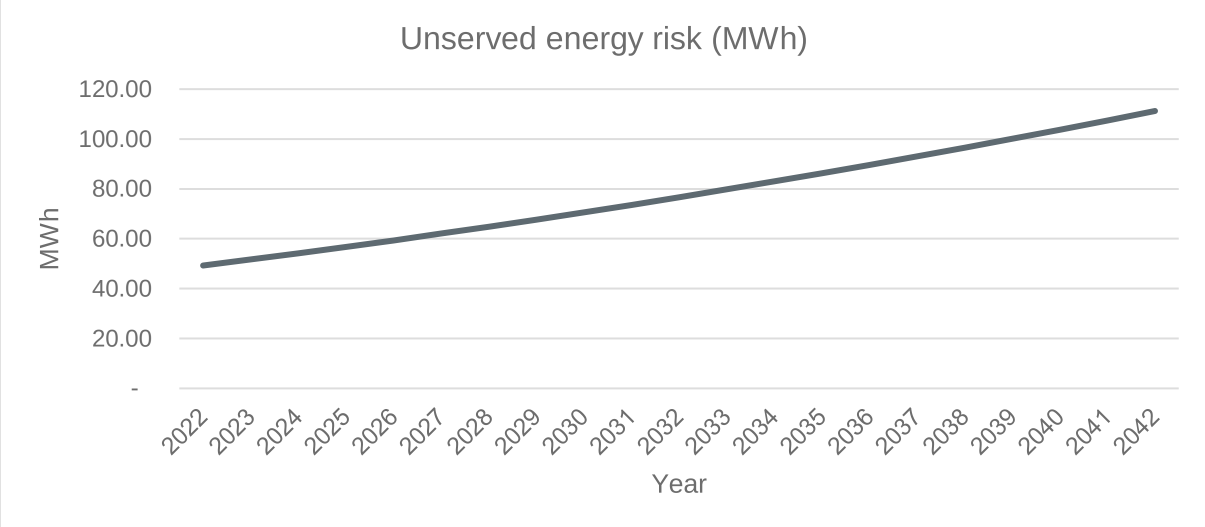
Carlingford Transmission Substation provides supply to the 62,900 customers it services through 10 x 66kV lines to six zone substations. The electricity is then distributed from each of the zone substations at 11kV. Two 66kV lines supply each zone substation in an essentially radial manner without any interconnection between these lines and other Transmission Substations. Therefore, the only backup supply available to these customers on loss of the supply from Carlingford Transmission Substation is through the 11kV network from adjacent zone substations supplied from another transmission substation. Due to the location of Carlingford Transmission Substation on the eastern edge of Endeavour Energy's network and the topology of the network, this transfer capacity is limited to 10MVA (to Endeavour Energy's zone substations) during the peak demand periods and around 20MVA on average throughout the year.

This existing back-up supply capacity has been included in our assessment of the identified need.

## 2.5 Expected unserved energy if action is not taken

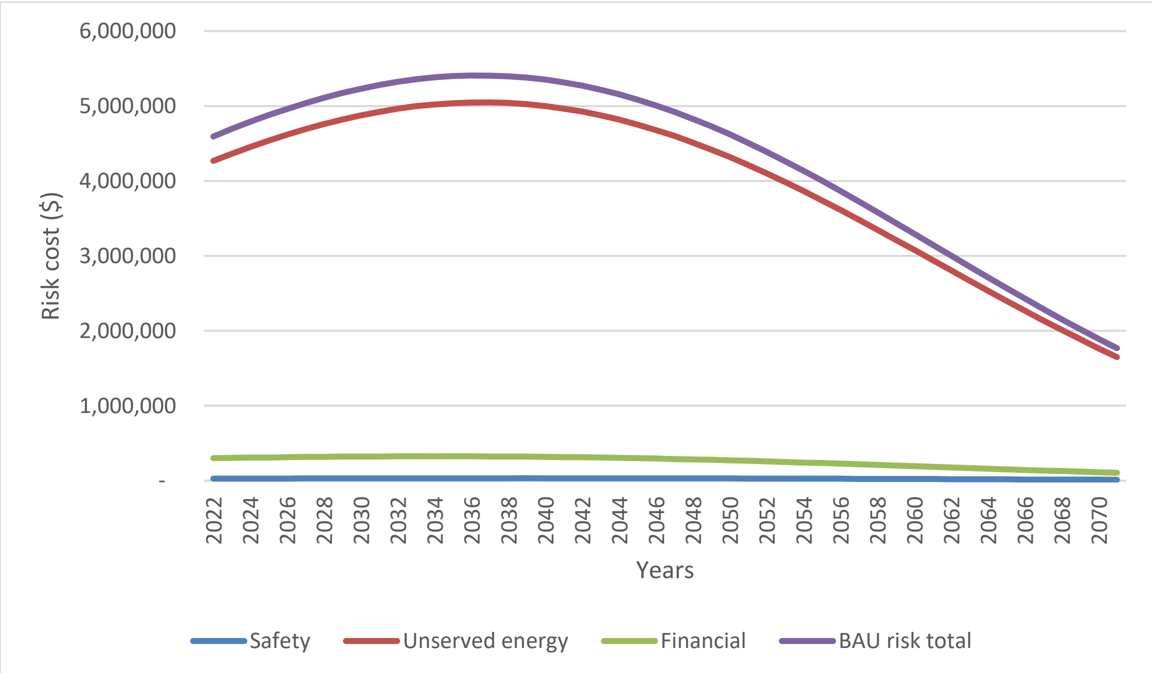
If action is not undertaken to address the identified need (the "business as usual" case), there is an increasing risk of failure which is likely to result in significant levels of unserved energy. Figure 5 below presents the estimated unserved energy if no action is taken.

Figure 5 – Expected unserved energy under the BAU case (ie, with no investment)




The above figure shows the likely energy at risk based on the likelihood of the asset failing in the next year on the basis that it hasn't failed this year. It is provided to show the magnitudes of energy at risk due to the identified need. In practice, asset failure will force reactive capital investment which will then mitigate future risks of asset failure. This shows up as a reactive investment (financial) risk associated with the identified need which will act to defer the future unserved energy risk. Figure 6 below shows the assessed business as usual risk costs over the next 50 years and demonstrates this effect.

Figure 6 – Business as usual risk



## 2.6 Proposed scenarios for the forthcoming RIT-D NPV assessment

We propose to assess three alternative future scenarios as part of the FPAR NPV assessment, namely:

- a central scenario – consisting of assumptions that reflect a central set of variable estimates, which, in our opinion, provides the most likely scenario;
- a low benefit scenario – reflecting a number of assumptions that give rise to a lower bound NPV estimate for each credible option, in order to represent a conservative view with respect to the potential market benefits that could be realised under each credible option; and
- a high benefit scenario – reflecting an optimistic set of assumptions, which have been selected to investigate an upper bound on reasonably expected market benefits; and

The value of risk includes variations in the value of the value of customer reliability, the value of the safety risks and financial risks which are also elements of the identified need.

A summary of the key variables/framework expected to be used for each scenario is provided in Table 1 below.

Table 1 – Proposed scenarios for the forthcoming RIT-D NPV assessment

| Variable | Scenario 1 – central values | Scenario 2 – low benefits/high costs | Scenario 3 – high benefits/low costs |
|---|---|---|---|
| Capital cost | Estimated capital costs | 25% increase in the estimated capital costs | 25% decrease in the estimated capital costs |
| Safety risk | Estimated safety risk cost | 30% decrease in the estimated safety risk costs | 30% increase in the estimated safety risk costs |
| Value of customer reliability (VCR) | Central value of VCR | 30% decrease in the central value | 30% increase in the central value |
| Financial risk | Estimated financial risk cost | 30% decrease in the estimated financial risk costs | 30% increase in the estimated financial risk costs |
| Discount rate | WACC | 30% increase in WACC | 30% decrease in WACC |
| Scenario weighting | 33.3% | 33.3% | 33.3% |

We propose to assess all credible options across a 50-year assessment period, which is commensurate with the likely life of the credit network option interventions.

# 3. Proposed network options to meet the identified need

We have identified two credible network options to meet the identified need. This section provides more information on the scope and cost of these options. It also outlines options that were considered but that we do not propose to progress further.

## 3.1 Option 1 – Refurbish the existing control building roof

This option includes provision of a new roof and ongoing protection for the steel structure of the building. This option will effectively defer the reliability risks presented by the collapse of the building due to structural damage or the failure of the roof due to water ingress for around 50 years.

The refurbishment works will also include stripping out the asbestos from all accessible parts of the building and permanently sealing in the asbestos containing materials which cannot be practically removed.

This work will effectively eliminate the asbestos risk to the public once the works are complete.

The estimated cost of Option 1 is $7.20 million in real FY22 terms.

## 3.2 Option 2 – Replace the control building with a new building

Option 2 includes the replacement of the existing control building with a new control building complete with new protection and control equipment. The asbestos contamination would be removed from the existing building and the building demolished and removed. This work will effectively eliminate the safety risks due to the asbestos so far as is reasonably practicable (SFAIRP). The cost of Option 2 is estimated to be $11.3 million.

## 3.3 Preferred network option

Option 1 addresses a large proportion of the reliability risk at a modest cost and eliminates the safety risk to public workers so far as is reasonably practicable (SFAIRP).

Option 2 reduces the reliability risk and safety risk to a similar extent as Option 1 but at a significantly higher cost than Option 1.

Therefore Option 1 is the preferred option.

Option 1 is estimated to cost $7.20 million (in real FY22 terms) and the investment is assessed as providing an NPV of $94.9 million with a benefit to cost ratio of 14.8.

The optimum timing for the works to be carried has been assessed by comparing the net annualised risk costs presented by the existing substation from new to the annualised cost of the preferred network option works. The optimum replacement year occurred in 2002 and therefore it is recommended that the project be carried out as soon as possible.

## 3.4 Options considered but not proposed to be progressed in the FPAR

We have also considered whether there are other credible options that could also meet the identified need. Table 2 below summarises the other options we have considered and outlines the reasons why these option(s) are not proposed to be progressed any further as part of this RIT-D.

Table 2 – Options considered but not progressed

| Option | Reason(s) for not progressing |
|---|---|
| Complete substation redevelopment | This option has been investigated extensively to understand whether there was value in replacing the existing aged outdoor substation assets with a compact indoor substation and freeing up land for sale/redevelopment purposes. However, cost benefit analysis indicates that this approach is likely to introduce significant risks and require significant initial investment and is not expected to provide any greater market benefits than the two options outlined above. This option is therefore not considered 'commercially feasible' under the RIT-D. |

## 4. Assessment of non-network solutions

Following a review of the load demands on Carlingford Transmission Substation and the nature of the existing load and network capability, Endeavour Energy has determined that there is unlikely to be a non-network option that could form a potential credible option on a standalone basis, or that could form a significant part of a potential credible option, for this RIT-D.

This section sets out the assessment behind this determination, which draws on the assumptions outlined in the sections above and considers the required technical characteristics that a non-network option would need to meet to meet the identified need.

### 4.1 Requirements that a non-network option would need to satisfy

We have considered the requirement that a non-network option would need:

- to be able to form a credible stand-alone option, or
- to defer the network investment.

A viable non-network option must be capable of providing electricity to all of Carlingford Transmission Substation's 62,900 customers continually, to allow the control building at Carlingford Transmission Substation to be retired, which would disable the functionality of the substation.

This requires a load of 50MVA minimum and peaking at around 225 MVA to be supplied as per the load duration curve and summer peak demand profile shown in Figure 3 and 4 above.

In order for non-network option to be credible it will have to supply this load for a cost of less than $7.20 million.

The required characteristics for non-network solutions set out above demonstrates that the amount of demand reduction and/or local storage/generation that would be required to be provided in order to represent a credible option for this RIT-D is of an order of magnitude which does not appear realistic. We therefore do not consider it technically feasible that a non-network solution can form standalone credible options that meet the entire identified need.

### 4.2 Assessment of specific non-network technologies

In addition to our general assessment of whether non-network options are likely able to form a potential credible option on a standalone basis or form a significant part of a potential credible option for the Carlingford Transmission Substation RIT-D, we have individually considered both demand management and new generation/storage below.

### 4.2.1 Demand management

Demand management is not a relevant approach as a significant amount of demand (from 50 MVA base demand to 225 MVA at peak) will need to be curtailed permanently in order to defer the investment.

By way of a recent example in our network, we implemented the Oakdale Energy Saver Program in late 2019 with the objective to achieve demand reduction to defer the construction of a new zone substation by one year. The program involved providing complimentary energy audits to customers in the Oakdale Industrial Park, comprised of mainly logistics and warehouse sites, and an incentive of $142/kVA for implementing permanent demand reduction initiatives was offered to participants. Only 2 MVA of potential demand reduction was identified from the twelve sites audited which is insufficient to meet the 8.1 MVA target reduction and, while the program ends on 31 March 2022, so far only one site has implemented an initiative which is a 175 kWp upgrade to their existing solar capacity.

We therefore consider demand management programs to not be technically feasible under the RIT-D for this particular network need.

### 4.2.2 Generation and/or storage

We note that all existing solar PV is already captured in the analysis. For summer demand, we expect to see dedicated solar PV provide benefit in reducing the duration of peak demand events (i.e. before sunset) but we forecast that this will have no impact on the eventual maximum peak demand that will occur after sunset.

Solar generation combined with grid battery energy storage could provide a technically viable solution but the cost is an order of magnitude higher than the proposed network option.

For example, for a battery energy storage system (BESS) to be effective it would need to be at least 250MVA in capacity and have at least 4 days storage requiring some 10,800MWh of energy storage capacity.

At current costs for large scale solar of $1,390/kW[2] and $450/kWh[3] for large scale battery storage, this system would have a cost of around $5.2 billion.

Moreover, the establishment of a BESS would require a suitable land which would further add to the cost and practical difficulties associated with this solution. For a BESS of this size, finding a suitable land in an established (brownfield) area will be a significant challenge.

We therefore consider that these technologies are not commercially feasible under the RIT-D for this particular network need.

### 4.2.3 Other non-network technologies

We consider it highly unlikely that power factor correction can address the significant amount of demand reduction required.

Control schemes and automation in a smart-grid require new buildings and building management systems and we do not consider there to be the magnitude of these to meet, or help meet, the identified need for this RIT-D.

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[2] Source: https://arena.gov.au/renewable-energy/large-scale-solar/... "The capital cost of LSS projects in Australia decreased by 25% between 2015 and the end of 2020 (from $1.87 to $1.39 per watt) according to the Clean Energy Regulator".

[3] GenCost 2020-21

# 5. Conclusion

Given the load that Carlingford Transmission Substation carries on a continual basis and the relatively low cost of the network options to address the identified risk compared to the cost of providing the service provided by Carlingford Transmission Substation by other means, it is concluded that there are no credible non-network solutions available for this identified need.

**Produced by Asset Planning & Performance branch**

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