RIT-D Draft Project Assessment Report

Providing supply to the Aerotropolis Core Precinct

7 October 2022

Endeavour Energy

CONTACT

If you have any comments or enquiries regarding this report please send them to the **Portfolio Management Office** at:

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1. Executive summary

This Draft Project Assessment Report (DPAR) was prepared by Endeavour Energy in accordance with the requirements of clause 5.17.4 of the National Electricity Rules (NER). It represents the second stage in the Regulatory Investment Test – Distribution (RIT-D).

The purpose of this report is to demonstrate the basis for selection of the preferred option to provide supply to the Aerotropolis Core Precinct.

The Western Sydney 'Aerotropolis' area is a greenfield development of a new city covering 11,000 hectares of land, which will spearhead Western Sydney's future urbanisation. The proposed development features a precinct-based land use and zoning approach that will require significant development of electricity infrastructure to meet the needs of the area over the long term. This includes the Aerotropolis Core Precinct, which is planned for dense urban development centred around a new central business district including the proposed Aerotropolis Metro Station. The precinct forms one of the priorities of the Aerotropolis Precinct Plan focusing on commercial, enterprise and light industry and including mixed density residential, retail and education. Developments in this area are expected to require approximately 140MVA of electricity supply capacity by 2041.

The identified need for this investment is 'reliability corrective action' because investment is required to comply with our NER obligations to connect customers. The timing of the identified need for this RIT-D is determined by when the forecast customer demand requiring connection will exceed the existing network supply capacity. This is currently expected to be in 2024/25, based on the connection requests received to date.

This report follows publication of an options screening notice that found that a non-network solution is unlikely to form a potential credible option on a standalone basis, or form a significant part of a potential credible option for the Aerotropolis Core Precinct RIT-D. This is due to the extent of forecast demand for the Aerotropolis Core Precinct, the expected cost of non-network options and the capacity of the existing network to facilitate non-network technologies. It also found that a SAPS (Stand Alone Power Supply such as a microgrid for example) solution could not contribute to meeting the identified need because the demand requirements of the greenfield development area are significant and therefore could not be supported by a network that is not part of the interconnected national electricity system with the ability to draw on grid-connected generation sources.

Although non-network options are not a credible alternative for the initial network investment to meet demand in the Aerotropolis Core Precinct, Endeavour Energy will continue to monitor developments in customer demand to assess whether an update to the evaluation in this RIT-D is needed should non-network options be a credible alternative to the subsequent stages of network investment of the credible options assessed in this DPAR.

Three options were determined to be credible in addressing the network need and have been assessed in comparison to a "do nothing" (or no proactive intervention) base case. These are:

- Option 1 — establish North Bradfield Zone Substation and augment Bringelly Zone Substation;
- Option 2 — augment Bringelly Zone Substation and stage the establishment of North Bradfield Zone Substation; and
- Option 3 — stage the establishment of the North Bradfield Zone Substation and stage the Bringelly Zone Substation augmentation.

The 'do nothing' option is not considered credible because it will result in significant expected unserved energy in the development area which would prevent the connection of new customers and the curtailment of growth at sites that would be supplied by the limited existing capacity in the area.

Each of the credible options involve establishing the North Bradfield Zone Substation (connecting to the 132kV Aerotropolis foundation supply backbone feeder) and augmenting the existing Bringelly Zone Substation to facilitate the connection of the expected customers in the Aerotropolis Core Precinct. However, the sequencing of the network investments (i.e., establishing North Bradfield Zone Substation and augmentation of Bringelly Zone Substation) differs between the credible options, as well as the timing of the investments (e.g., full or staged establishment of North Bradfield Zone Substation).

The economic assessment of the credible options is shown in table 1. Under the NER, the preferred option is the credible option that maximises the present value of the net economic benefit to all those who produce, consume or transport electricity in the National Electricity Market (NEM). Applying this criteria, Option 1 is the preferred option at this stage because it has the highest net market benefits.

However, we note that there is a less than one per cent difference between the net market benefits of each credible option. In light of this small difference, we consider that each of the credible options assessed are effectively equally ranked given the accuracy in the estimates used in the analysis. Scenario and sensitivity analysis was undertaken across a range of assumptions including forecast demand growth, discount rate, value of customer reliability (VCR) and capital expenditure. Neither the scenario or sensitivity analysis resulted in one option becoming more favoured than another and, as such, we consider that they remain effectively equally ranked in the assessment.

Notwithstanding, we continue to view Option 1 as the preferred option because, in addition to having the highest net market benefits, it has a number of practical advantages over the other credible options assessed. Specifically, Option 1 is expected to be the closest to the geographical development centre for connection of customers. It may therefore assist in facilitating the lowest cost of overall connection for our customers, while also minimising cable congestion along key routes coming into the precinct. The main route being Badgerys Creek Road but also the other main roads to be built or rebuilt and having the North Bradfield zone substation built in the proposed timeframe would allow for 132kV and 22kV feeders to be installed into the newly formed public roads and avoid their installation later into completed roads requiring disruption to vehicle transport in the area.

Table 1 – Economic assessment of credible options (weighted results)

Option	Description	Project capex nominal ($m)	PV of market benefits ($m)	PV of costs ($m)	NPV ($m)	Rank
1	Establish North Bradfield Zone Substation in 2024/25 and augment Bringelly Zone Substation in 2029/30 and 2033/34	56.8	37,558.9	42.4	37,516.5	1
2	Augment Bringelly Zone Substation in 2024/25 and staged establishment of North Bradfield Zone Substation in 2029/30 and 2033/34	62.7	37,558.9	43.6	37,515.3	2
3	Staged establishment of North Bradfield Zone Substation in 2024/25 and 2029/30 and augmentation of Bringelly Zone Substation in 2029/30 and 2033/34	56.8	37,552.8	42.1	37,510.7	3

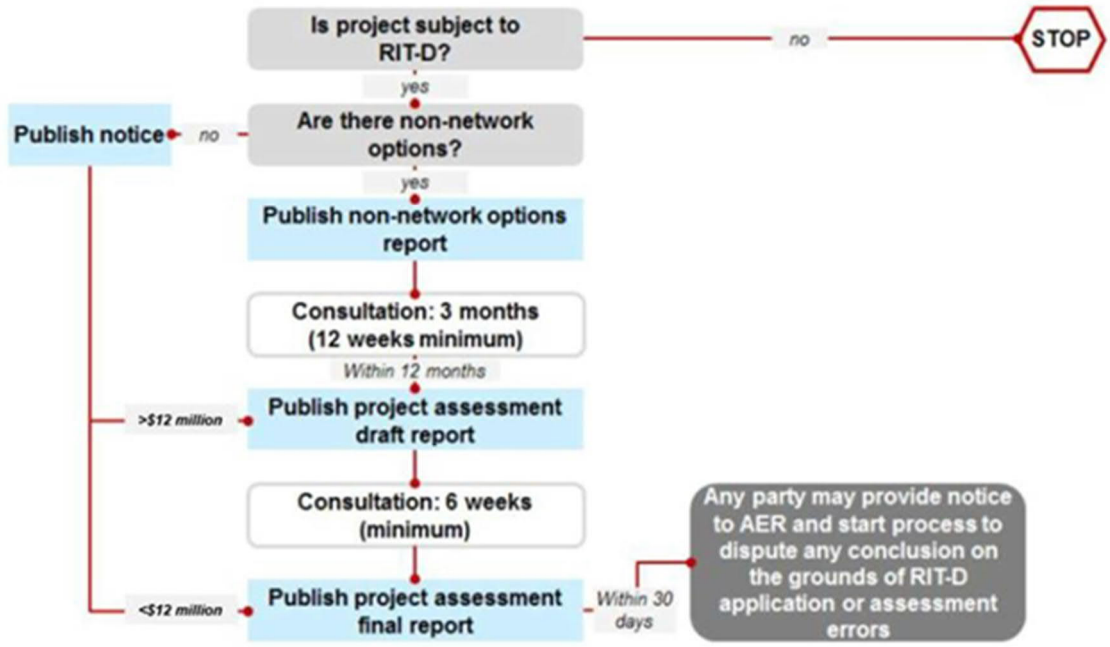
Endeavour Energy welcomes submissions from interested parties in relation to the preferred option outlined in this document. Submissions are due on or before **18 November 2022**. All submissions and enquiries should be directed to Endeavour Energy's Portfolio Management Office at consultation@endeavourenergy.com.au.

2. RIT-D process

This DPAR has been prepared by Endeavour Energy in accordance with the requirements of clause 5.17.4 of the NER. We have already applied the RIT-D to determine the most efficient means of providing the foundation supply to the Aerotropolis precinct – a 132kV backbone feeder.[1] This DPAR represents the second step in the RIT-D process to determine the most efficient means of providing supply to the Aerotropolis Core Precinct from the 132kV backbone. The RIT-D process is summarised in figure 1 below.

Endeavour Energy adopts a process of exploring feasible options in assessing the ability to supply new development areas in Western Sydney. However, for greenfield sites, Endeavour Energy needs to determine the length of time that the existing network will be able to sustain the prevailing precinct development rate. Endeavour Energy balances timely investment with the increase in demand as development progresses and our customers require connection to network.

Figure 1 – Overview of the RIT-D process



2.1 Submissions requested to the DPAR

Endeavour Energy welcomes submissions from industry participants and interested parties in relation to the preferred option outlined in this document. The consultation period is 6 weeks and submissions are due on or before **18 November 2022**. Any submissions and any subsequent response by Endeavour Energy may be published.

2.2 Contact details

All submissions and enquiries regarding this DPAR should be directed to Endeavour Energy's Portfolio Management Office at consultation@endeavourenergy.com.au.

[1] See: https://www.endeavourenergy.com.au/modern-grid/creating-the-modern-grid/network-planning/rit-d-projects.

3. 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.

3.1 Relevant area of our network

The Aerotropolis Core Precinct sits within the Western Sydney Airport development area which is also referred to as the Western Sydney Aerotropolis. It is planned for dense urban development centred around a new central business district including the proposed Aerotropolis Metro Station. The precinct forms one of the priorities of the Aerotropolis focusing on commercial, enterprise and light industry and including mixed density residential, retail and education. It neighbours the Agribusiness Precinct to the west, and the Badgerys Creek Precinct to the north –Figure 2. The Aerotropolis Core Precinct sits to the south of the Airport.

Figure 2 – Overview of the Aerotropolis and the Aerotropolis Core Precinct in relation to the Western Sydney Airport

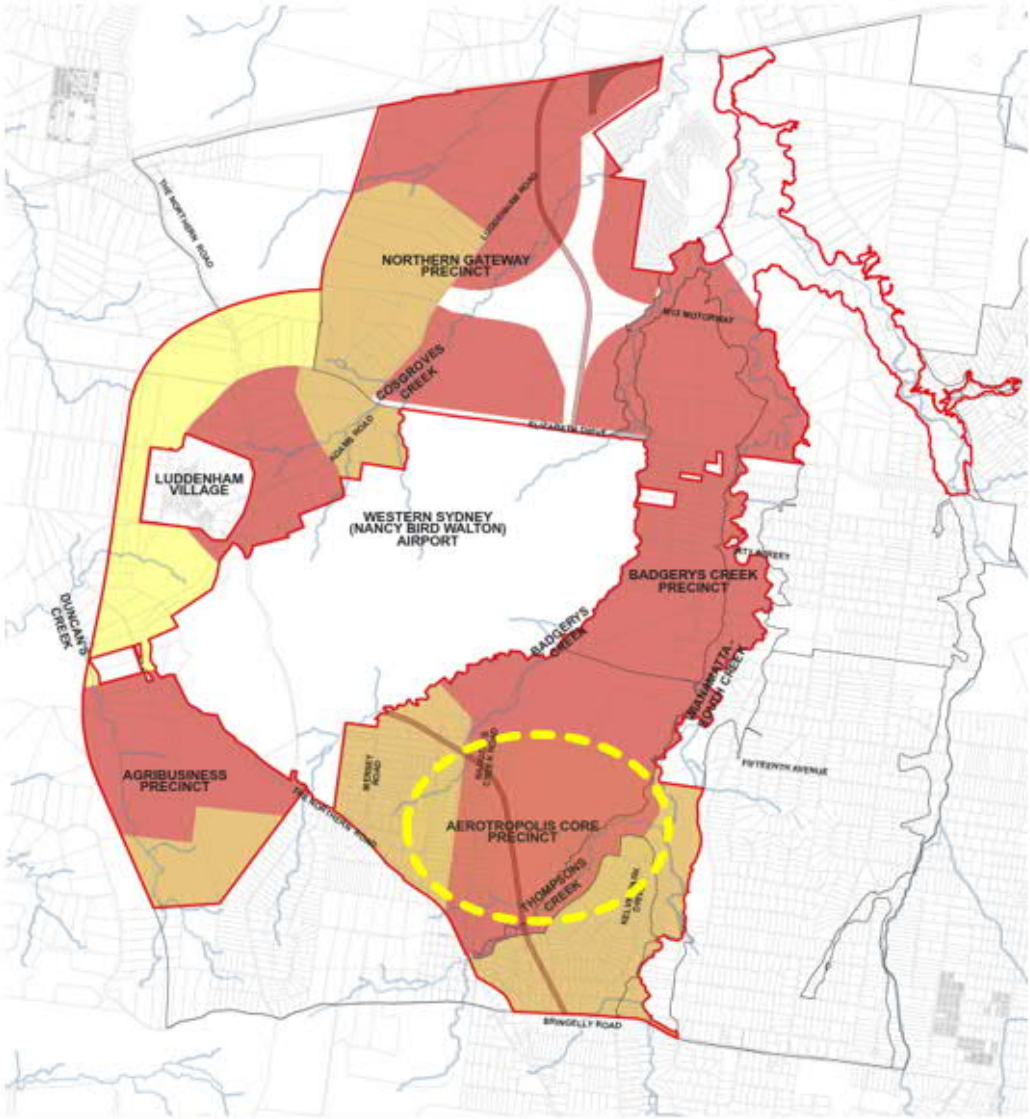
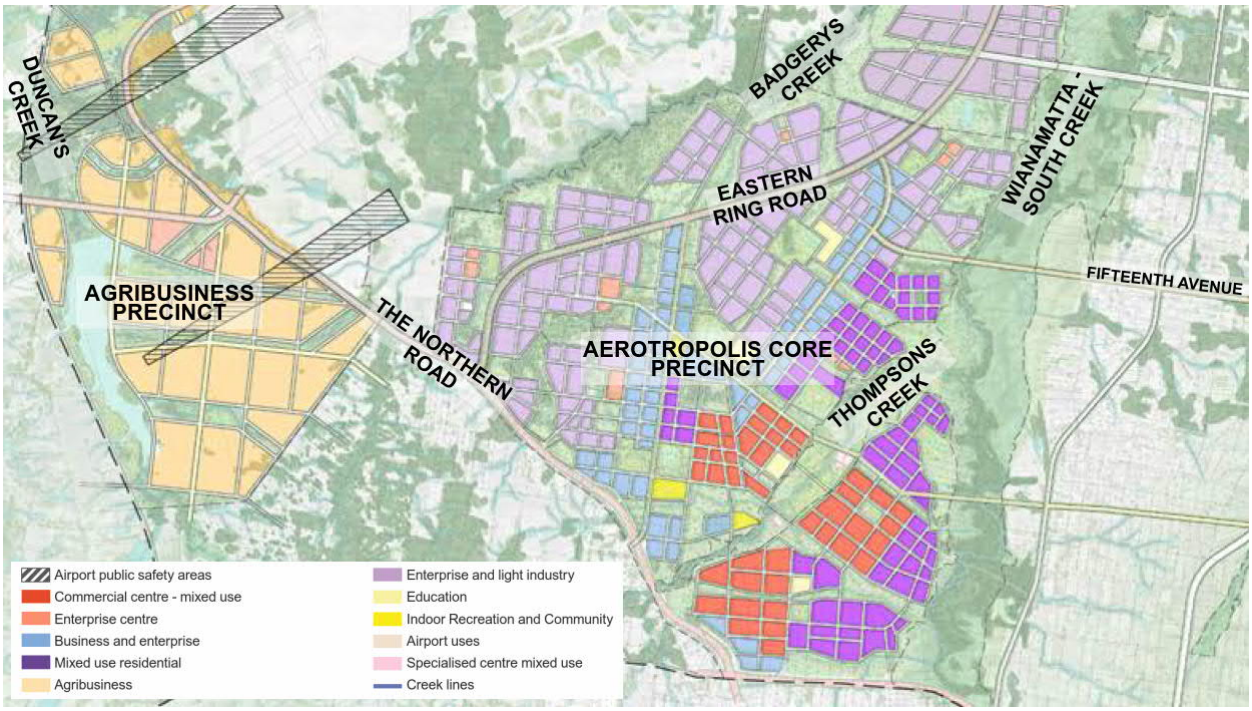


Figure 3 below shows a detailed colour coded map view of the Aerotropolis Core Precinct and the proposed land use and zoning for the area. The area will include mixed use covering commercial, enterprise and light industry and residential land use. The area will feature medium to high density buildings including building heights of up to 70m.

Figure 3 – Aerotropolis Core Precinct Proposed Land Use and Zoning



3.2 Load characteristics and demand forecast

The Aerotropolis Core Precinct proposed land use and zoning will provide a metropolitan centre with a focus on advanced manufacturing, research and development, professional services, creative industries and science, technology, engineering and mathematics-focused educational facilities. Residential developments will be centred around access to the planned Aerotropolis Metro Station.

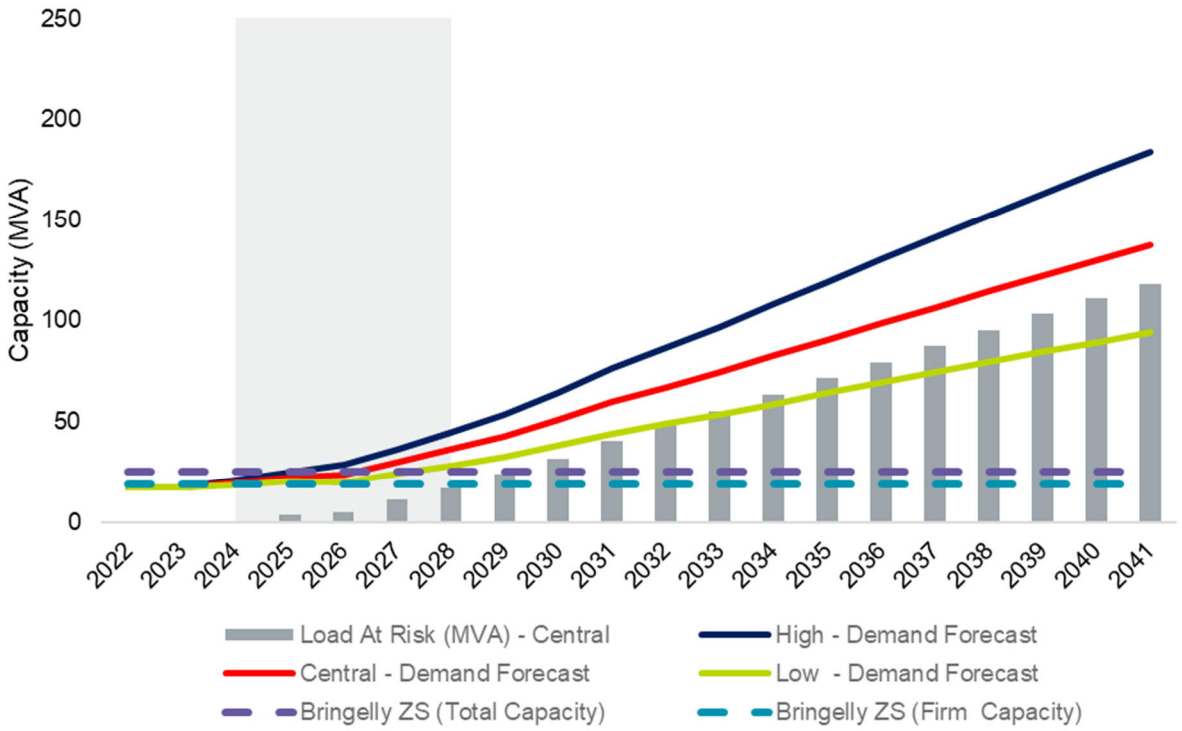
Key developments in the area include:

- the new Central Business District area within the Aerotropolis Core Precinct, which is expected to grow to a maximum demand of 67MVA over a 30-year period from 2026;
- the residual Aerotropolis Core Precinct to the north of the proposed CBD that will comprise enterprise and industrial developments, which is expected to grow to 97MVA maximum load over a 30-year period from 2024; and
- the southern portion of the Agribusiness Precinct, which is forecast to require 73MVA maximum load from 2027 onwards.

In total, the developments in this area are expected to require approximately 140MVA of capacity by 2041 to meet the forecast customer demand.

Figure 4 below shows our forecast maximum demand under a central, low and high demand scenario for the Aerotropolis Core Precinct. It also shows the available capacity (both total and firm) at the existing Bringelly Zone Substation, and the load at risk as connecting load exceeds existing capacity (the existing network is described in greater detail in section 3.4).

Figure 4 – Aerotropolis Core Precinct maximum demand forecasts from 2022 to 2041



The central scenario is primarily based on the proposed customer connections for the Aerotropolis Core Precinct. Endeavour Energy has close contact with developers and major customers (and their advisors) planning to connect to the network in this area. The demand forecast is based on an ultimate load estimate for the precinct, a time frame to reach that ultimate load and a load ramp up assumption, which in this case is linear. The estimated time for this precinct to reach maturity is 30 years. Probabilistic 'load realisation' factors have been applied to developer derived forecasts and that in turn is calibrated by the actual connection applications that we receive as time progresses.

A low growth scenario has been developed using a lower load realisation factor than the central scenario and a longer time frame to reach maturity.

A high growth scenario has developed on the assumption of a 100 percent load realisation factor suggesting that the full developer derived forecast will be realised within the expected time frame, and given that the subject area is a high density CBD, a higher power density (MVA/ha) value has been applied to the high growth scenario to account for full realisation of the land use and zoning plans for the area.

3.3 Expected pattern of use

Due to the fact that the area will not be fully developed for some time and the customers and their forecast loads are yet to connect, we have assessed the identified need using a representative demand profile, which assumes a representative load profile from an existing substation that we expect (at least initially), will have similar demand characteristics as the forecast load (i.e., capturing time and seasonal demand variations).

Specifically, the demand profile is based on the Moorebank zone substation load profile (an existing commercial/industrial and light enterprise site). The existing supply capacity to the area has been included in our assessment of the identified need.

Figure 5 below presents the normalised load duration curve (LDC) assumed based on the representative demand profile, while figure 6 presents the peak load profile for a summer day assumed for the load from the customer connections associated with the Aerotropolis Core Precinct based on the representative demand profile.

Figure 5 – Normalised LDC assumed for the customers expected in the Aerotropolis Core Precinct

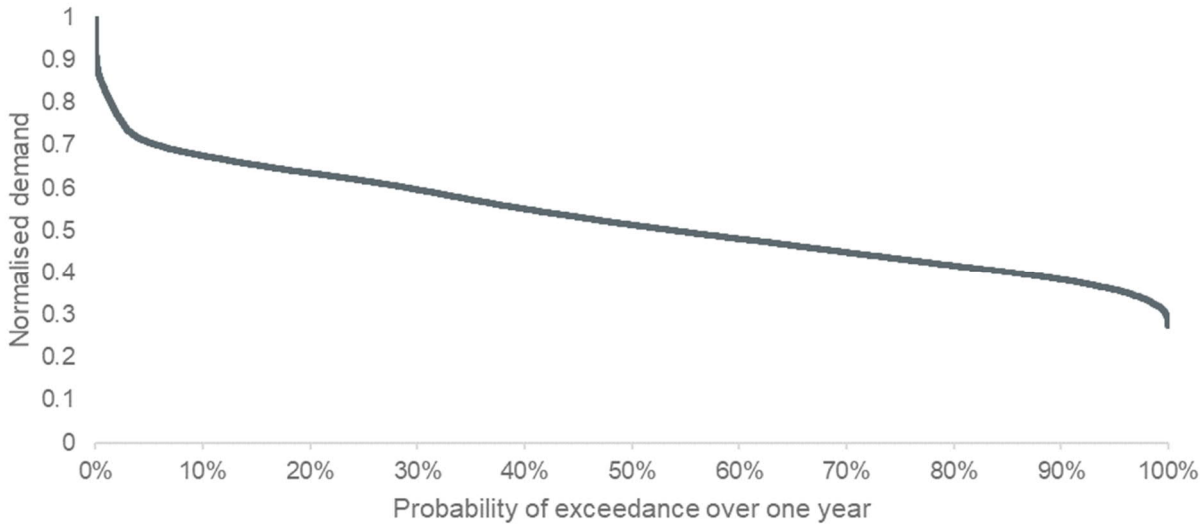
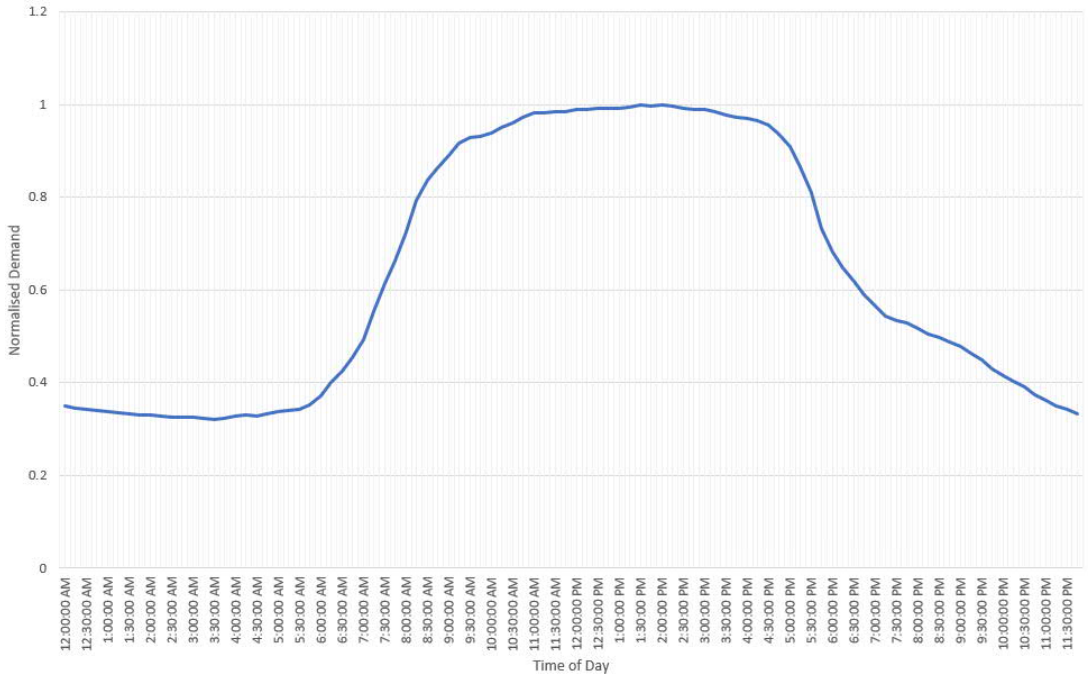


Figure 6 – Peak summer day profile for the customers expected in the Aerotropolis Core Precinct



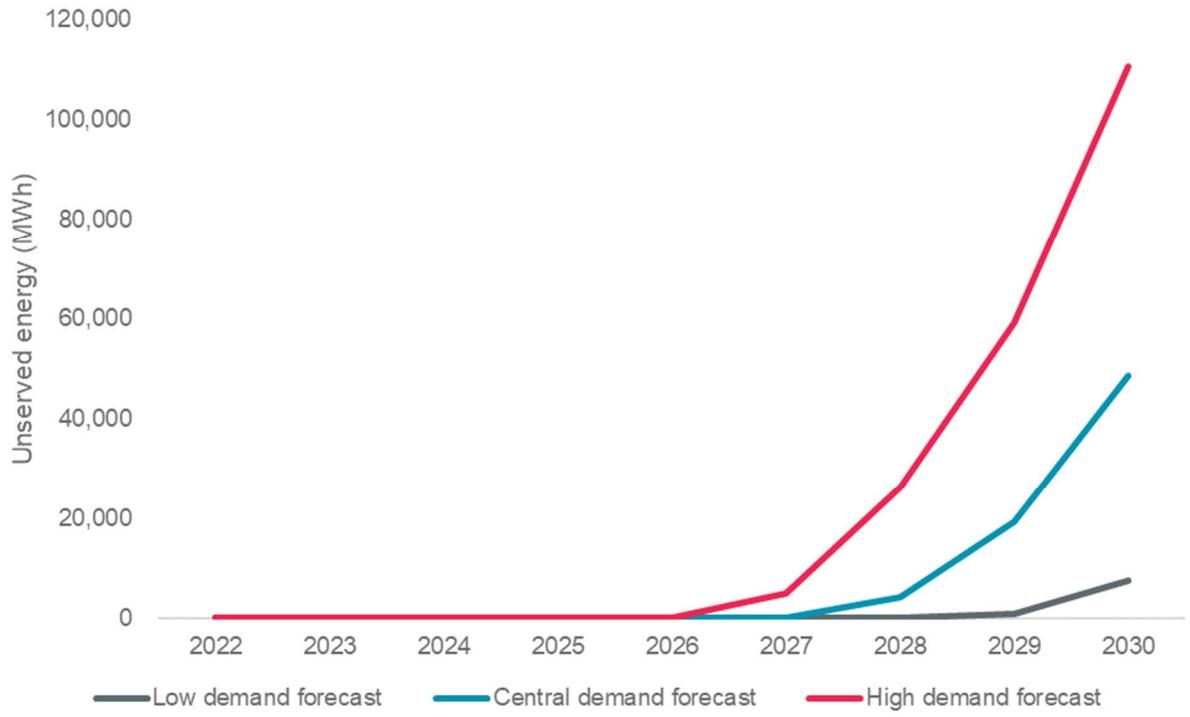
3.4 Existing network

The area around the Aerotropolis Core Precinct is currently serviced by the low capacity 11kV network from the Bringelly, Kemps Creek and Luddenham zone substations. This principally overhead network was established initially to service the rural residential load base in the area. It features relatively long route length 11kV feeders and low voltage reticulation. Figure 4 above illustrates that the existing distribution network in the Aerotropolis Core Precinct development area is insufficient to meet the supply needs of the Aerotropolis Core Precinct from 2023/24. In particular, the Bringelly zone substation has a limited firm capacity of 19MVA that is set to be exceeded by 2024/25 based on current demand forecasts and customer connection applications. The transformer capacity at Bringelly ZS is the main network constraint in relation to supply of the Aerotropolis Core Precinct and this constraint has been used to determine the load at risk used in the demand forecast.

3.5 Expected unserved energy if action is not taken

If network augmentation is not undertaken, there will be significant expected unserved energy (USE) in our network over the next decade with available capacity being exceeded from 2024/25. Figure 7 presents the expected USE if no action is taken.

Figure 7 – Forecast unserved energy for the Aerotropolis Core Precinct under low, central and high scenarios



Although we expect there to be significant market benefits associated with providing supply to the Aerotropolis Core Precinct, we consider the need for this investment a 'reliability corrective action' due to our regulatory obligations to connect new load. These regulatory obligations are set out in the box below.

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

We have initiated this Regulatory Investment Test for Distribution (RIT-D) to investigate, and consult on, how to most efficiently provide supply to major new customers in the Aerotropolis Core Precinct.

Endeavour Energy is required to connect customers under section 5.2.3(d) of the National Electricity Rules (NER), which state that "A Network Service Provider must:

> (1) Review and process applications to connect or modify a connection which are submitted to it and must enter into a connection agreement…
>
> (6) Permit and participate in commissioning of facilities and equipment which are to be connected to its network in accordance with rule 5.8;"

We therefore consider the identified need for this investment to be a 'reliability corrective action' under the RIT-D since investment is required to comply with the above NER obligations.

The timing of the identified need for this RIT-D, and so the required timing for credible options to address the need, is determined by when the expected load requiring connection will exceed the existing network capacity. This is currently anticipated to be 2024/25, based on our demand forecasts which are in turn based on our existing customers and new connections from new customers.

4. Proposed network options to meet the identified need

We have identified three 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 considered but that we do not propose to progress further.

Each of the credible options involve establishing the North Bradfield zone substation (connecting to the 132kV Aerotropolis backbone feeder) and augmenting the existing Bringelly zone substation to service the connection of the expected customer base in the Aerotropolis Core Precinct.

However, the sequencing of the network investments (i.e., establishing North Bradfield zone substation and augmentation of Bringelly zone substation) differs between the credible options, as well as the timing of the investments (e.g., full or staged establishment of North Bradfield zone substation).

Figure 8 provides an overview of how North Bradfield and Bringelly zone substations fit into the proposed and existing network infrastructure for the broader Aerotropolis precinct, with figure 9 providing an aerial view of the development area and proposed network infrastructure.

Figure 8 – Overview of Aerotropolis precinct with proposed and existing network infrastructure

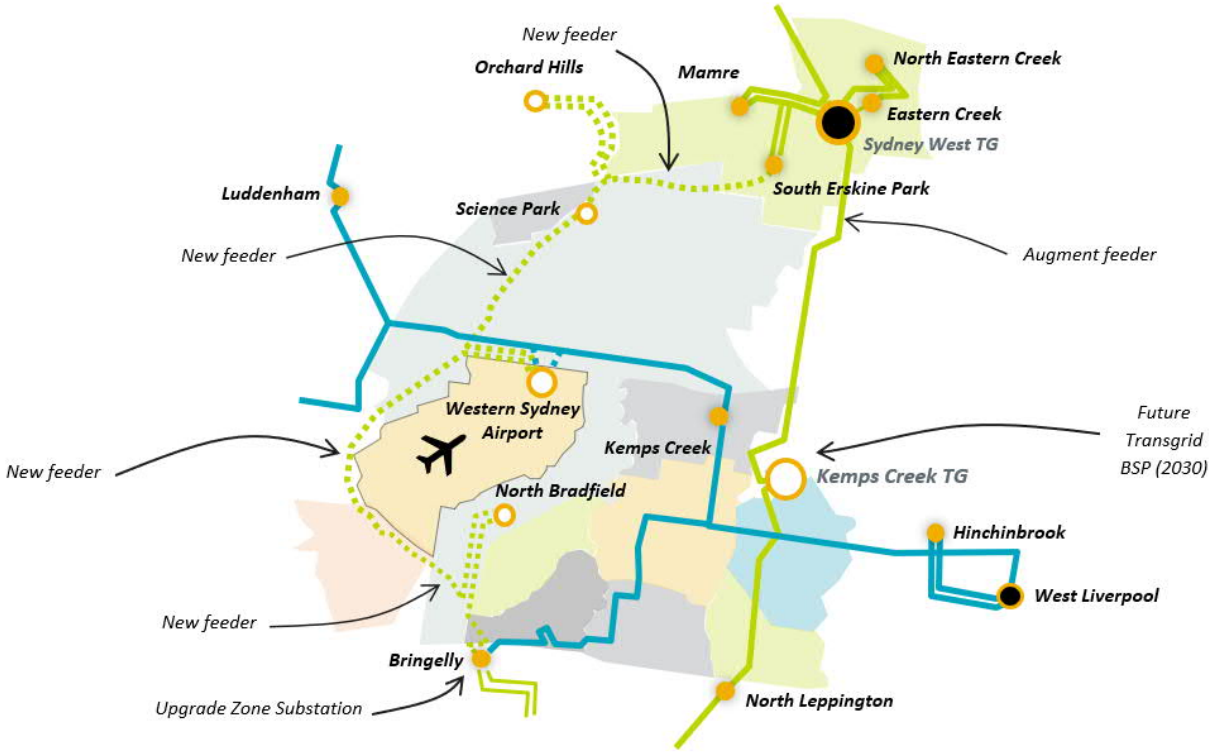
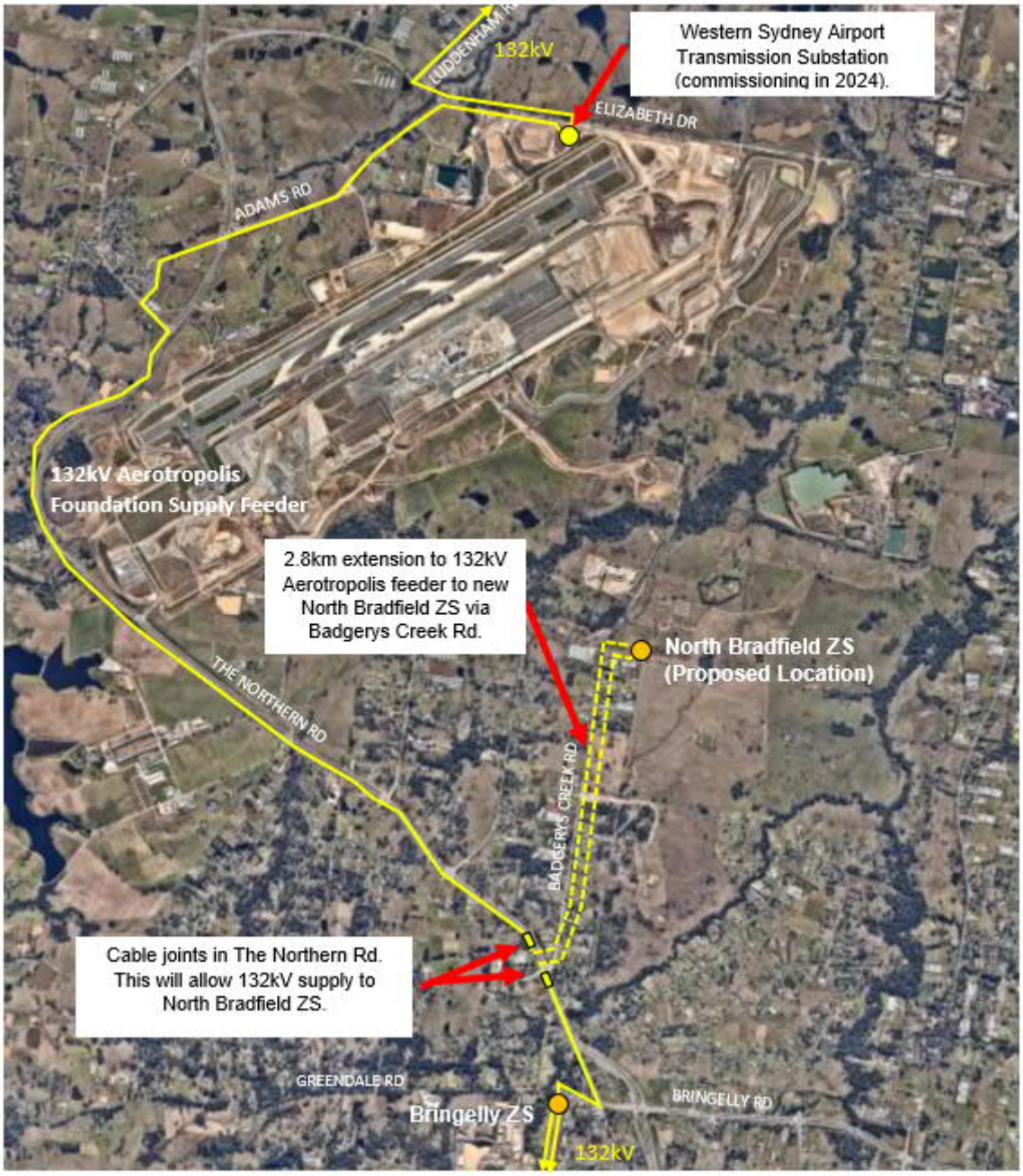


Figure 9 – Proposed North Bradfield ZS in relation to the existing and proposed 132kV supply.



The options set out below represent complete network solutions to supply the forecast demand of the Aerotropolis Core Precinct discussed in section 3.2. In particular, each involves an initial investment to service near-term load requirements to 2030, with subsequent stages of investment to cater for further load increases post-2030. However, we are cognisant that once the initial investment is made, there may be a material change in circumstances (such as a substantive presence of customers in the Precinct capable of offering network support) that warrants assessing whether non-network options could defer or displace the need for the subsequent stages of network investment. Endeavour Energy will monitor these changes and assess whether an update to the evaluation in this RIT-D is needed should non-network options be a credible alternative to the subsequent stages of network investment.

4.1 Option 1 – Establish North Bradfield ZS and augment Bringelly ZS

Option 1 involves establishing a 45MVA firm 132/22kV North Bradfield zone substation toward the north of the Aerotropolis Core Precinct to be commissioned by 2025/26. Supply to the zone substation would be established via two 132kV 2.8km feeder extensions along Badgerys Creek Road from the planned Aerotropolis feeder along the Northern Road. The new substation would be connected to the Aerotropolis backbone feeder, with one feeder terminating at the Bringelly zone substation and the other feeder terminating at the Western Sydney Airport transmission substation. These feeders would be built underground and avoid the use of poles for the alternative overhead lines.

Establishing the North Bradfield zone substation would provide sufficient capacity to connect new customers in the precinct up until the early 2030s. However, the demand forecasts indicate that by 2031/32 the forecast demand will exceed the installed capacity leading to additional load at risk. Option 1 therefore also includes augmentation of the existing Bringelly zone substation to alleviate this load at risk. In particular, an additional 45 MVA transformer would be installed at the substation in both 2029/30 and 2033/34. The augmentation works at Bringelly zone substation would be subject to independent investment testing prior to those works going ahead and using demand forecasts and cost estimates that would be prevailing at that time in the future.

The total cost of this option is estimated to be $56.8 million and construction of the North Bradfield zone substation would commence in 2022/23 with commissioning in 2025/26. The first phase of the Bringelly zone substation augmentation would commence in 2028/29 with commissioning in 2029/30, while the second phase would commence in 2033/34 and be commissioned in the same year.

Table 2 provides an overview of the scope of works and capital cost of works for Option 1, with operating costs assumed to be 0.4 per cent of total capital expenditure.

Table 2 – Scope of works and costs for Option 1

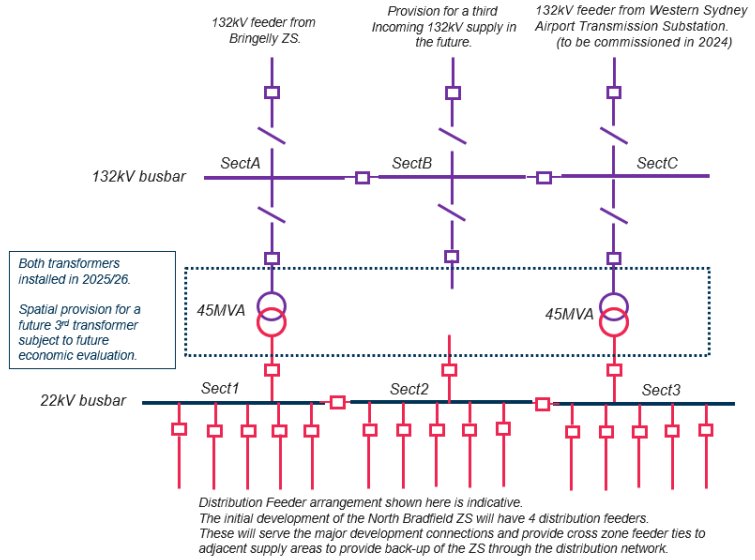
Scope	Description	Capital cost estimate ($M)

Zone Substation	Establishment of North Bradfield zone substation including:
	• Two 45MVA 132kV/22kV power transformers and associated bunds and fire walls.
	• 132kV switchgear
	• 22kV switchgear
	• Buildings for housing switchgear, protection & control equipment and amenities.
	• Spatial provision for future:
	  o Third 45MVA transformer
	  o Third incoming 132kV feeder
	  o Grid BESS
		$21.0

Transmission Mains	Connection of North Bradfield zone substation to the 132kV transmission network: • Connection to the 132kV Aerotropolis backbone feeder from Western Sydney Airport transmission substation to Bringelly zone substation with cables matching the size and type of the 132kV Aerotropolis backbone feeder. o 2 x 2.8km 132kV feeder extensions.	$12.8
Distribution	Distribution works include: • 22kV conversion of the Aerotropolis Core Precinct (from the existing 11kV) • Four 22kV distribution feeders • Four 11/22kV auto transformers • Installation of time clocks or smart meters at customer premises to ensure off peak hot water heating service to existing customers in the area and adjacent areas.	$5.0
Bringelly ZS Phase 1 FY2030	Phase 1 of Bringelly zone substation augmentation: • One 45MVA 132kV/22kV transformer and associated bunds and fire walls • Extension of the existing switchyard • Outdoor 132kV equipment works : busbar, feeder and transformer bays	$14.7
Bringelly ZS Phase 2 FY2034	Phase 2 of Bringelly zone substation augmentation: • One 45MVA 132kV/22kV transformer and associated bunds and fire walls • Installation of transformer bay and bus section circuit breaker	$3.3
Total	Establishment of North Bradfield zone substation and augmentation of Bringelly zone substation	**$56.8**

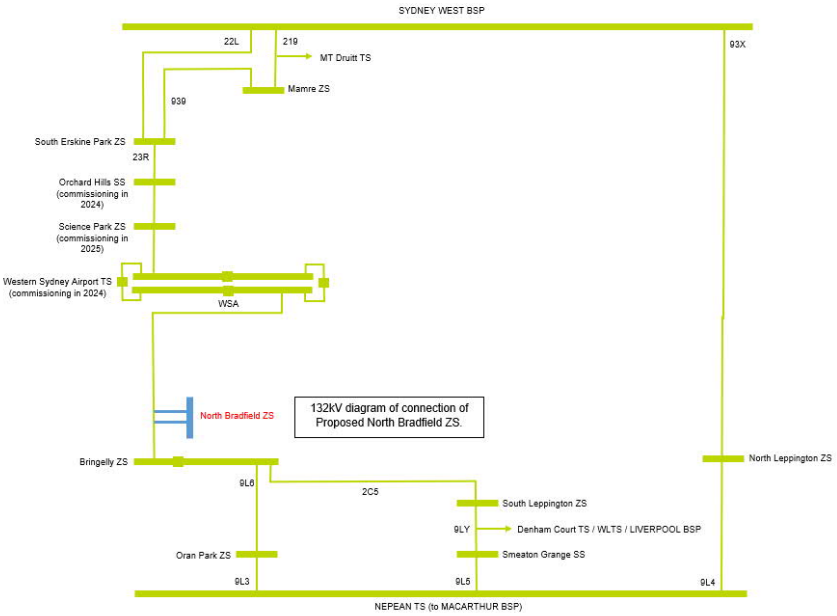
A simplified single line diagram is provided for this option below in figure 10.

Figure 10 – Simplified line diagram of Option 1



The proposed connection of Option 1 to the 132kV network in shown in Figure 11 below.

Figure 11 – 132kV connection of Option 1



4.2 Option 2 – Augment Bringelly ZS and stage North Bradfield ZS

Option 2 would involve the augmentation of the Bringelly zone substation by 2024/25 to service the growing customer demand in the Aerotropolis Core Precinct. In particular, two 45MVA 132/22kV transformers would be installed – providing the zone substation with 45MVA of additional firm capacity.

Although augmentation of Bringelly zone substation would provide sufficient capacity to service the new demand initially, the demand forecasts indicate that the forecast demand will exceed firm capacity by 2031/32 leading to additional load at risk.

Option 2 therefore also includes the staged establishment of North Bradfield zone substation to be commissioned in 2029/30 and 2033/34. It would have the same characteristics as under Option 1, i.e., supply would be established via two 132kV, 2.8km feeder extensions along Badgerys Creek Road from the planned Aerotropolis feeder along the Northern Road. The new substation would be connected to the Aerotropolis feeder, with one feeder terminating at the Bringelly zone substation and the other feeder terminating at the Western Sydney Airport transmission substation. These feeders would be built underground and avoid the use of poles for the alternative overhead lines.

The total cost of this option is estimated to be $62.7 million, with the additional cost relative to Option 1 reflecting additional cost for long route length distribution feeders being required as part of the proposed supply from Bringelly ZS in the network option. Augmentation of the Bringelly zone substation would commence in 2022/23 with commissioning in 2024/25. The first phase of construction for the North Bradfield zone substation would commence in 2028/29 with commissioning in 2029/30, while a second transformer would be installed in 2033/34.

Table 3 provides an overview of the scope of works, and the cost of those works, for Option 2. Operating costs are assumed to be 0.4 per cent of total capital expenditure.

Table 3 – Scope of works and costs for Option 2

Scope	Description	Cost Estimate ($M)
Bringelly ZS Augmentation	Bringelly zone substation augmentation: • Installation of two 45MVA 132kV/22kV transformers. • Extension of existing 132kV busbar to allow connection of new transformers. • Installation of 22kV switchgear. • Extension of the existing switchyard to accommodate the new transformers, extended 132kV busbar and the 22kV switchgear. • Five 22kV distribution feeders to supply the Aerotropolis Core precinct.	$23.9
North Bradfield Stage 1	First stage of North Bradfield zone substation: • One 45MVA 132kV/22kV power transformer. • 132kV switchgear. • 22kV switchgear. • Buildings for housing switchgear, protection & control equipment and amenities. • Spatial provision for future: o Second and Third 45MVA transformer o Third incoming 132kV feeder o Grid BESS	$16.0
North Bradfield Stage 2	Second stage of North Bradfield zone substation: • One 45MVA 132kV/22kV power transformer. • Extend 22kV switchgear by installing additional building.	$5.0
Transmission Mains	Connection of North Bradfield zone substation to the 132kV transmission network: • Connection to the 132kV Aerotropolis backbone feeder from Western Sydney Airport transmission substation to Bringelly zone substation with cables matching the size and type of the 132kV Aerotropolis backbone feeder. o 2 x 2.8km 132kV feeder extensions.	$12.8
Distribution	Distribution works include: • 22kV conversion of the Aerotropolis Core Precinct (from the existing 11kV) • Four 22kV distribution feeders and autotransformers. • Installation of time clocks or smart meters at customer premises to ensure off peak hot water heating service to existing customers in the area and adjacent areas.	$5.0
Total	Augmentation of Bringelly zone substation and establishment of North Bradfield zone substation with connection to the Aerotropolis backbone feeder.	**$62.7**

4.3 Option 3 – Stage North Bradfield ZS and stage Bringelly ZS augmentation

Option 3 would involve establishing the North Bradfield zone substation toward the north of the Aerotropolis Core Precinct to be commissioned in stages. In particular, a single 45MVA transformer would be installed in 2024/25, with the installation of the second transformer deferred until 2029/30. Under this approach the North Bradfield zone substation would not have a firm capacity until the second transformer is installed in 2029/30 and until then, it would rely on 6MVA of firm capacity from autotransformers and use the adjacent zone substation distribution network.

This option also includes augmentation of the Bringelly zone substation to service future load growth. Additional 45 MVA transformers would be installed in both 2029/30 and 2033/34 to increase the firm capacity of the Bringelly zone substation to supply part of the Aerotropolis Core precinct and provide backup supply in the event of an outage of the North Bradfield zone substation.

The total cost of this option is estimated to be $56.8 million and construction of the first stage of the North Bradfield zone substation would commence in 2022/23 with commissioning of the first transformer in 2024/25. The second transformer would then be installed in 2029/30. The first stage of the augmentation of the Bringelly zone substation would commence in 2028/29 with commissioning in 2029/30, with the second stage being commenced and commissioned in 2033/34.

Table 4 provides an overview of the scope of works and cost of works for Option 3. Operating costs are assumed to be 0.4 per cent of total capital expenditure. Endeavour Energy notes that additional preliminary design and project management costs resulting from the various stages in this option have not been included in this cost estimate. These costs are not considered to be material to the outcome of this RIT-D because they are small in the context of total project costs.

Table 4 – Scope of works and costs for Option 3

Scope	Description	Cost Estimate ($M)
North Bradfield Stage 1	First stage of North Bradfield zone substation: • One 45MVA 132kV/22kV transformer. • 132kV and 22kV switchgear. • Buildings for housing switchgear, protection & control equipment and amenities. • Spatial provision for future transformers, incoming 132kV feeder and BESS.	$16.0
North Bradfield Stage 2	Second stage of North Bradfield zone substation: • One 45MVA 132kV/22kV transformer. • Extend 22kV switchgear by installing additional building.	$5.0
Transmission Mains	Connection of North Bradfield zone substation to the 132kV transmission network: • Connection to the 132kV Aerotropolis backbone feeder from Western Sydney Airport transmission substation to Bringelly zone substation with cables matching the size and type of the 132kV Aerotropolis backbone feeder. o 2 x 2.8km 132kV feeder extensions.	$12.8
Distribution	Distribution works include: • 22kV conversion of the Aerotropolis Core Precinct (from the existing 11kV) • Four 22kV distribution feeders and autotransformers. • Installation of time clocks or smart meters at customer premises to ensure off peak hot water heating service to existing customers in the area and adjacent areas.	$5.0
Bringelly ZS Phase 1 FY2030	Phase 1 of Bringelly zone substation augmentation: • One 45MVA 132kV/22kV transformer and associated bunds and fire walls • Extension of the existing switchyard • Outdoor 132kV equipment works : busbar, feeder and transformer bays	$14.7
Bringelly ZS Phase 2 FY2034	Phase 2 of Bringelly zone substation augmentation: • One 45MVA 132kV/22kV transformer and associated bunds and fire walls. • Installation of transformer bay and bus section circuit breaker.	$3.3
Total	Establishment of North Bradfield zone substation with connection to the Aerotropolis backbone feeder and augmentation of Bringelly zone substation.	**$56.8**

4.4 Options considered but not progressed

Endeavour Energy considered a possible 33kV network option when first assessing the electricity supply needs of the broader Aerotropolis precinct. The local area near the Aerotropolis Core precinct has a 33kV supply from the West Liverpool TS, however this would require a new long route 33kV supply from that substation. West Liverpool TS is approximately 20km north east of the development area for the Aerotropolis Core precinct.

We had previously determined that a 22kV reticulation strategy would optimise the build out of the network for the Aerotropolis area. This is based on the longer feeder routes and higher capacity supply available from 22kV in comparison to 11kV distribution. As a result of the 22kV distribution network adoption, the 33kV network options for transmission and zone substations is not feasible based on standard industry practice and equipment available.

Accordingly, 33kV network options were not be progressed to the DPAR.

5. Assessment framework

This section outlines the methodology that we have applied in assessing the market benefits and costs associated with each of the credible options considered in this RIT-D.

5.1 Overview of the assessment framework

All costs and benefits for each credible option have been assessed in comparison to a do nothing, business-as-usual base case. Under this base case, Endeavour Energy would utilise the existing 11kV network to service the growing demand in the Aerotropolis Core Precinct. The consequence of not proceeding with any investment is significant USE due to the existing supply network being constrained and incapable of supplying the forecast demand from new customers in the area.

The RIT-D analysis has been undertaken over a 30-year period, from 2021/22 to 2050/51. We consider that this assessment period takes into account the size, complexity and expected life of the relevant credible options to provide a reasonable indication of the market benefits and costs of the option. Further, the Aerotropolis Core Precinct is expected to mature over a 30-year period and so the assessment period incorporates the expected demand growth development period. While the capital components of the credible options have asset lives greater than 30 years, we have taken a terminal value approach to incorporated capital costs in the assessment, which ensures that the capital costs of long-lived options is appropriately captured in the 30-year assessment period.

We have adopted a central real, pre-tax discount rate of 3.26 per cent as the central assumption for the NPV analysis presented in this DPAR. We have also tested the sensitivity of the results to changes in this discount rate assumption with a lower bound real, pre-tax discount rate of 2.22 per cent and an upper bound discount rate of 4.30 per cent (i.e., a symmetrical upper and lower rate in comparison to the central rate).

5.2 Market benefits are expected from reduced involuntary load shedding

We expect that the only relevant category of market benefits prescribed under the NER for this RIT-D relate to changes in involuntary load shedding. Our approach to valuing reductions in involuntary load shedding are outlined below.

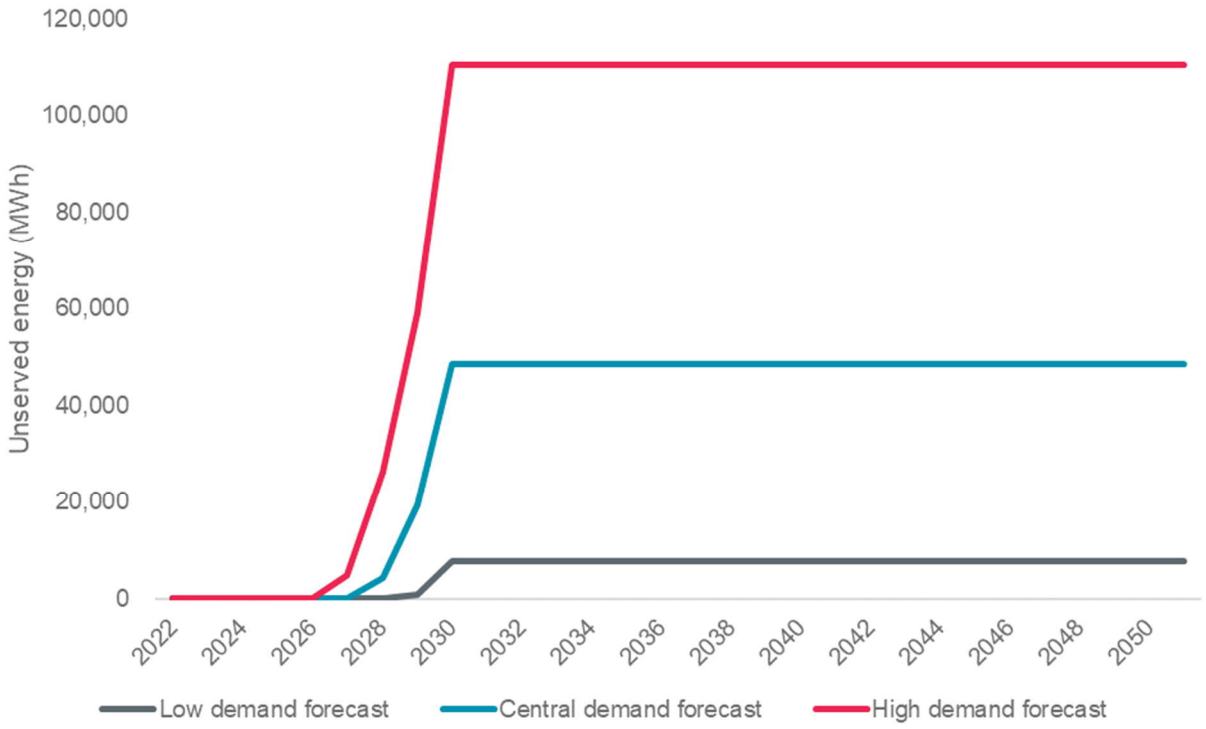
5.2.1 Reduced involuntary load shedding

Endeavour Energy has valued reduced and/or avoided involuntary load shedding by reference to our estimate of energy at risk, which is derived from the annual peak demand forecasts and load duration curves set out in section 3.

We have capped the expected future USE, in MWh, as part of the DPAR NPV assessment, because the uncapped value of USE will otherwise become unrealistically high (since, in reality, we would undertake investment to avoid widespread customer outages and inability of customers to connect to the network). Using the very large uncapped USE values has the potential to distort the comparison of net market benefits between credible options. The approach of capping USE in the base case is in-line with other RIT-Ds (and RIT-Ts) and does not affect the ranking of the overall options.[2,3]

Figure 12 illustrates the USE profile under the base case used in the NPV analysis, with USE values capped at the 2029/30 forecast level.

Figure 12 – Base case USE profile in NPV analysis



The value of unserved energy is calculated using the VCR. This represents an estimate of the value electricity consumers place on reliable electricity supply. The VCR value (in dollars per MWh) is applied to the difference in the MWh of USE calculated between the base case and each credible option.

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[2] We note that this is also consistent with the approach proposed by Dr Biggar in his review of the Powering Sydney's Future RIT-T (see: Biggar, D., *An Assessment of the Modelling Conducted by TransGrid and Ausgrid for the "Powering Sydney's Future" Program*, May 2017, p. 27). While Dr Biggar suggests capping the 'congestion cost' (calculated as the unserved energy valued at the VCR) in such assessments, we consider it more intuitive to cap the underlying unserved energy, in MWh, and continue to value it at the appropriate VCR. This is the approach that has been adopted by other DNSPs and is effectively equivalent to the approach proposed by Dr Biggar.

[3] See for example: Ausgrid, *Ensuring reliable supply for the Sydney Airport network area*, Final Project Assessment Report, 6 March 2020, p. 15.

We used a composite VCR value of $43,450 per MWh in the evaluation. This is based on the 2021 calendar year VCR values provided by the AER, weighted in accordance with the forecast composition of the commercial, industrial and residential demand within the Aerotropolis Core Precinct. A breakdown of this calculation is provided in the table below.

Table 5 – Composite VCR used in evaluation

Parameter	Commercial	Industrial	Residential
Demand composition of the Aerotropolis Core Precinct	55%	21%	24%
AER VCR	$44,830	$64,230	$21,290
Demand weighted VCR			**$43,540**

5.3 No other categories of market benefit are expected to be material

This section provides a brief overview of the reasons Endeavour Energy considers that the categories of market benefit (other than reduced involuntary load shedding) are not material for this RIT-D. These are:

- differences in timing of expenditure;
- changes in voluntary load curtailment;
- option value;
- changes in load transfer capability;
- changes in costs to other parties; and
- changes in electrical losses.

5.3.1 Differences in timing of expenditure

Differences in the timing of expenditure relates to the potential for a credible option to change the timing (or configuration) of other future investments to be made by or for the RIT-D proponent. Importantly, this relates to distribution investments that address identified needs other than those addressed by the credible option. Given that this investment is concerned with establishing the first stage of supply in the greenfield area of the Aerotropolis Core Precinct, we do not consider differences in the timing of expenditure to be material for this RIT-D.

5.3.2 Changes in voluntary load curtailment

Voluntary load curtailment is when customers agree to reduce their load to address a network limitation in return for a payment. A credible demand side option to enlist such customers to voluntarily reduce load could lead to a reduction in involuntary load shedding.

Endeavour Energy has not estimated any market benefits associated with changes in voluntary load curtailment. Although customers are now more broadly capable of providing greater levels of voluntary load curtailment, the greenfield nature of this investment is such that the area does not have the capacity to deliver sufficient voluntary demand reduction.

5.3.3 Option value

Endeavour Energy notes that the AER's view is that option value is likely to arise where there is uncertainty regarding future outcomes, the information that is available in the future is likely to change and the credible options considered by the RIT-D proponent are sufficiently flexible to respond to that change.

Although we have not explicitly quantified option value for this assessment, it is implicitly captured in the structure of our credible options (each of which have flexibility for future investment).

5.3.4 Changes in load transfer capability

Distribution investments can improve load transfer capacity where a credible option allows end users to gain access to a back-up power supply. This is a market benefit as backed-up power supplies can service end-users in the event of power supply failure. The primary objective of this project is to facilitate connection of new customers in the Aerotropolis Core Precinct. Because the areas in and around the Aerotropolis Core Precinct are mostly serviced by rural standard distribution networks, load transfers to other parts of the network cannot be meaningfully considered until adjacent areas are further developed in the future. Immediate changes to load transfer capacity are therefore not considered material for this RIT-D.

5.3.5 Changes in costs to other parties

In this instance, Endeavour Energy has not identified any changes in costs to other parties from developing the credible options identified in this document.

However, it is noted that the North Bradfield zone substation will provide a high capacity supply in close proximity to the planned development area and that this will tend to offer new major customers a lower cost in funding their part of network connection costs. These costs have been included in the assessment.

5.3.6 Changes in electrical losses

Endeavour Energy recognises that there would be small changes in the loss profiles for customers across the network due to changes in the network. Since the majority of customers to be connected will be general supply customers although there is likely to be some major customers that may be provided individual loss factors, the impact of the small change in loss profile for these customers is unlikely to have significant impact on the network wide distribution loss factors that will be applicable to these and other customers. These changes are captured as part of the annual review of distribution loss factors when more information about customer usage patterns is available. Changes in electrical losses have therefore not been modelled for this RIT-D.

5.4 Three different 'scenarios' have been modelled to address uncertainty

RIT-D assessments are required to be based on cost-benefit analysis that include an assessment of 'reasonable scenarios', which are designed to test alternate sets of key assumptions and whether they affect the identification of the preferred option.

We have assessed three alternative future scenarios as part of the DPAR 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 high benefit scenario – reflecting an optimistic set of assumptions which have been selected to investigate an upper bound on reasonably expected market benefits; and
- 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 future state of the world.

A summary of the key variables/framework used for each scenario is provided in table 6 below.

Table 6 – Scenarios used in RIT-D NPV assessment

Parameter/ scenario	Central scenario	High benefits	Low benefits
Capex	Central estimates	-25%	+25%
Demand	Central demand forecast (see section 3.2)	High demand forecast (see section 3.2)	Low demand forecast (see section 3.2)
VCR	Load-weighted AER VCR	+30%	-30%
Discount rate	3.26%	2.22%	4.30%
Maintenance costs	Central estimates	-25%	+25%

The above scenarios have been developed to comprehensively test the range of net benefits that can be expected from the credible options. We consider that this approach allows for a more robust test of the preferred option compared with applying individual sensitivity tests to single factors because multiple factors are varied together to determine their cumulative impact on the assessment.

Endeavour Energy considers that the central scenario is most likely because it is based primarily on a set of expected/central assumptions. We have therefore assigned this scenario a weighting of 50 per cent, with the other two scenarios being equally weighted with 25 per cent each.

6. Assessment of credible options

This section summarises the results of the NPV analysis, including the sensitivity analysis undertaken. All credible options have been assessed in comparison to a do nothing business-as-usual base case.

6.1 Gross market benefits estimated for each credible option

Table 7 below summarises the gross market benefit of each credible option relative to the base case in present value terms. The gross market benefit has been calculated for each of the scenarios outlined in the previous section. Because reduced involuntary load shedding is the only market benefit quantified for this RIT-D, the gross market benefits represent the value of avoided USE under each option.

Table 7 – Present value of gross economic benefits of each credible option relative to the base case ($M)

Option	Central scenario	High benefits	Low benefits	Weighted
Scenario weighting	50%	25%	25%	
Option 1	27,065.3	93,638.2	2,466.6	37,558.9
Option 2	27,065.3	93,638.2	2,466.6	37,558.9
Option 3	27,060.2	93,625.0	2,465.5	37,552.7

6.2 Estimated costs for each credible option

Table 8 below summarises the costs of each credible option relative to the base case in present value terms. The cost is the sum of the project capital costs and the operating costs associated with operating and maintaining the assets created under each of the options.

The cost of each option has been calculated for each of the three reasonable scenarios described above.

Table 8 – Present value of costs of each credible option relative to the base case ($M)

Option	Central scenario	High benefits	Low benefits	Weighted
Scenario weighting	50%	25%	25%	
Option 1	-42.4	-31.0	-53.5	-42.4
Option 2	-43.7	-32.2	-54.7	-43.6
Option 3	-42.2	-31.1	-52.8	-42.1

6.3 Net present value assessment outcomes

Table 9 below summarises the net market benefit in NPV terms for each credible option under each scenario. The net market benefit is the gross market benefit (as set out in table 7) minus the cost of each option (as set out in table 8).

Table 9 – Present value of net market benefit of each credible option relative to the base case ($m)

Option	Central scenario	High benefits	Low benefits	Weighted	Rank
Scenario weighting	50%	25%	25%		
Option 1	27,022.9	93,607.1	2,413.1	37,516.5	1
Option 2	27,021.6	93,606.0	2,411.9	37,515.3	2
Option 3	27,018.0	93,593.9	2,412.7	37,510.7	3

Under the NER, the preferred option is the credible option that maximises the present value of the net economic benefit to all those who produce, consume or transport electricity in the National Electricity Market (NEM). Applying this criteria, Option 1 is the preferred option at this stage because it has the highest net market benefits.

However, we note that there is a less than one per cent difference between the net market benefits of each credible option. In light of this small difference, we consider that each of the credible options assessed are effectively equally ranked given the accuracy in the estimates used in the analysis. Scenario and sensitivity analysis was undertaken across a range of assumptions including forecast demand growth, discount rate, value of customer reliability (VCR) and capital expenditure. Neither the scenario or sensitivity analysis resulted in one option becoming more favoured than another and, as such, we consider that they remain effectively equally ranked in the assessment.

Notwithstanding, we continue to view Option 1 as the preferred option because, in addition to having the highest net market benefits, it has a number of practical advantages over the other credible options assessed. Specifically, Option 1 is expected to be the closest to the geographical development centre for connection of customers. It may therefore assist in facilitating the lowest cost of overall connection for our customers, while also minimising cable congestion along key routes coming into the precinct. The main route being Badgerys Creek Road but also the other main roads to be built or rebuilt and having the North Bradfield zone substation built in the proposed timeframe would allow for 132kV and 22kV feeders to be installed into the newly formed public roads and avoid their installation later into completed roads requiring disruption to vehicle transport in the area.

The following section demonstrates that the sensitivity analysis we have undertaken does not result in one option becoming more favoured than another – reinforcing our view that Option 1 is preferred at this draft stage.

6.4 Sensitivity analysis results

We have undertaken a thorough sensitivity testing exercise to understand the robustness of the RIT-D assessment to underlying assumptions about key variables. Our sensitivity analysis has focused on testing the sensitivity of the total NPV benefit associated with the investment proceeding consistent with the timeframes described in section 4. We have not sought to determine the optimal timing because the investment is driven by reliability corrective action and future load will exceed capacity from 2024/25 (though 2024/25 is the earliest commissioning date possible).

Rather, we have assessed the sensitivity of the net benefits of each option to:

- changes in the discount rate;
- changes in the capital costs; and
- changes in the VCR.

The figures below demonstrate that these sensitivities do not result in one option becoming more favoured than another – reaffirming our view that they are effectively equally ranked in the assessment.

Figure 13 – Impact of varying the discount rate on the net market benefits of each credible option

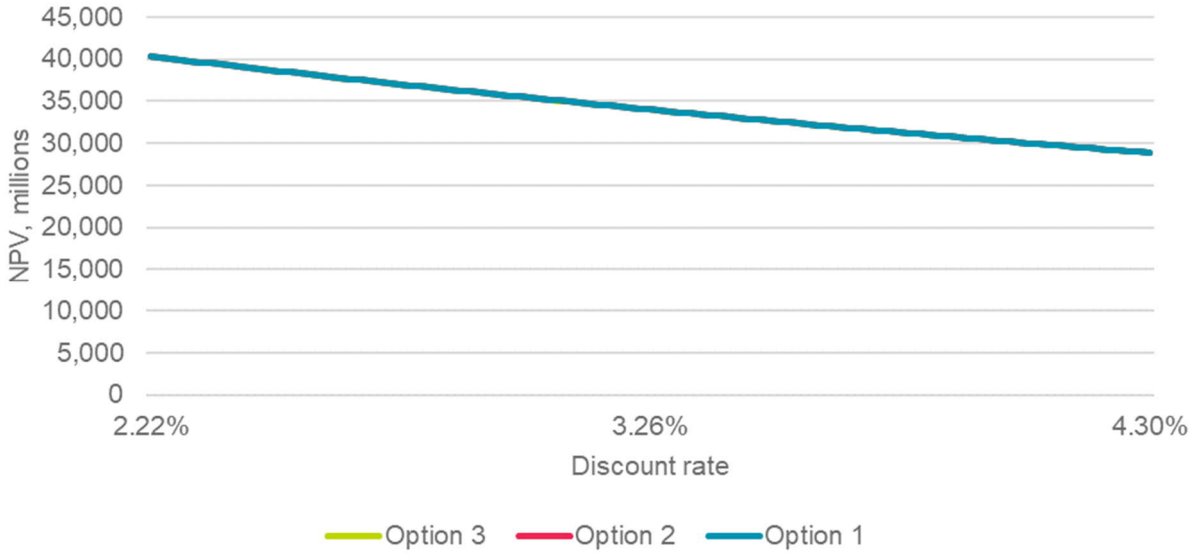


Figure 14 – Impact of varying capital costs on the net market benefits of each credible option

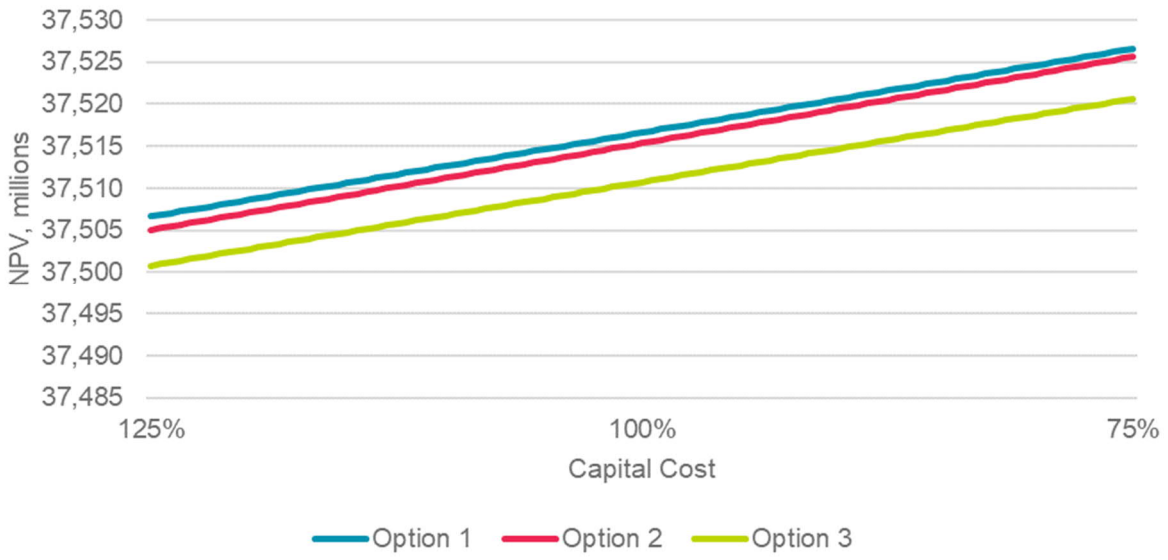
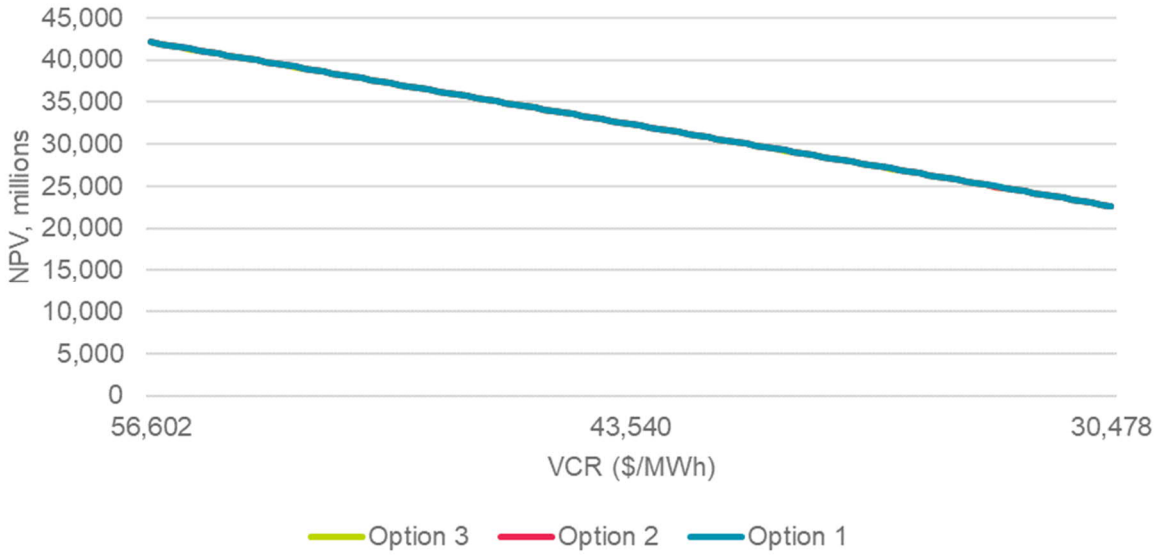


Figure 15 – Impact of varying the VCR on the net market benefits of each credible option



7. Conclusion

The development of the Aerotropolis Core Precinct is associated with the Western Sydney Airport and the significant development and investment throughout Sydney's Western Parklands City. Significant electricity demand growth and customer connection requirements in the Aerotropolis Core Precinct requires the establishment of new network infrastructure.

Although the existing network capacity may be able to service the initial customer connections, as demand continues to grow it will exceed the existing supply capacity meaning there will be a large amount of load at risk and unserved energy in the area. In particular, the Aerotropolis Core Precinct is expected to have demand of 140MVA by 2041, while the existing available firm supply capacity is 19MVA.

As outlined in the options screening notice, it is not considered feasible that a non-network solution, or SAPS solution, will form a potential credible option on a standalone basis, or form a significant part of a potential credible option for the Aerotropolis Core Precinct RIT-D.

This DPAR has identified three credible network-based options that can technically meet the required network demand. Each of the credible options involve the establishment of the North Bradfield Zone Substation (connecting to the 132kV Aerotropolis backbone feeder) and augmenting the Bringelly Zone Substation to facilitate the connection of the expected customers in the Aerotropolis Core Precinct. However, the sequencing of the network investments (i.e., establishing North Bradfield Zone Substation and augmentation of Bringelly ZS) differs between the credible options, as well as the timing of the investments (e.g., full or staged establishment of North Bradfield Zone Substation).

In particular, the options are:

- Option 1 — establish the North Bradfield Zone Substation and augment the existing Bringelly Zone Substation;
- Option 2 — augment Bringelly Zone Substation and stage the establishment of the North Bradfield Zone Substation; and
- Option 3 — stage North Bradfield Zone Substation and stage the Bringelly Zone Substation augmentation.

Each of these options were considered in an economic evaluation, and Option 1 was selected as the preferred option. Although the outcome of the assessment is that each of the options were effectively ranked the same, there are a number of practical reasons Option 1 is preferred. Specifically, Option 1 is expected to be the closest to the development centre for connection of loads. It may therefore assist in facilitating the lowest cost of overall connection for our customers, while also minimising cable congestion along key routes coming into the precinct. The main route being Badgerys Creek Road but also the other main roads to be built or rebuilt and having the North Bradfield zone substation built in the proposed timeframe would allow for 132kV and 22kV feeders to be installed into the newly formed public roads and avoid their installation later into completed roads requiring disruption to vehicle transport in the area.

The total cost of this option is estimated to be $56.8 million and construction of the North Bradfield Zone Substation will commence in 2022/23 with commissioning in 2024/25. The first phase of the Bringelly Zone Substation augmentation will commence in 2028/29 with commissioning in 2029/30, while the second phase of the augmentation will commence in 2033/34 and be commissioned in the same year.

Although the economic assessment presented in this DPAR has assessed the full cost of Option 1, Endeavour Energy is only seeking to incur the costs associated with stage one of Option 1 – the establishment of the North Bradfield Zone Substation – at this time $38.8 Million.

We will continue to monitor the development of demand and will assess whether an update to the evaluation in this RIT-D is needed should non-network options be a credible alternative to the subsequent stages of network investment.

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