RIT-D Final Project Assessment Report

Providing supply to the Aerotropolis Core precinct

11 August 2023

Endeavour Energy

POWER together

Contents

1.0 Executive summary

This Final Project Assessment Report (FPAR) was 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 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 estimated to be in 2025, based on the connection requests received to date.

This FPAR follows publication of a Draft Project Assessment Report (DPAR) on 7 October 2022 which invited written submissions on the materials contained in the DPAR. On publication of the DPAR Endeavour Energy opened a six-week consultation period, during which time no submissions were received.

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 Aerotropolis Core Precinct which would prevent the connection of new customers and the curtailment of growth at customer 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 at a favourably strategic location within the area 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 because it has the highest net market benefits.

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 2025 and augment Bringelly Zone Substation in 2029/30 and 2033/34	67.5	37,558.9	46.7	37,512.2	1
2	Augment Bringelly Zone Substation in 2025 and staged establishment of North Bradfield Zone Substation in 2029/30 and 2033/34	74.0	37,558.9	48.2	37,510.7	2
3	Staged establishment of North Bradfield Zone Substation in 2025 and 2029/30 and augmentation of Bringelly Zone Substation in 2029/30 and 2033/34	68.0	37,552.8	46.9	37,505.9	3

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 and the difference in the NPVs. 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 centre point for connection of major 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.

Important developments subsequent to the publication of the DPAR

We note the following important developments that have occurred subsequent to the publication of the DPAR in October 2022. These developments do not result in material change to the economic evaluation nor the preferred option for the identified need in the Aerotropolis Core Precinct, however we have summarised these below:

- **Uplift in cost estimates** – following a review of Endeavour Energy cost estimates conducted in the later part of 2022 we have provided an approximate 25% uplift in certain components of major project cost estimates. These include certain material costs and civil and building costs related to major substations and the installation of major cables. This uplift is based on current market based pricing for those major project scope components. We have updated the cost estimates of our network options in the FPAR in comparison to the cost estimates provided in the DPAR which were provided in October 2022.

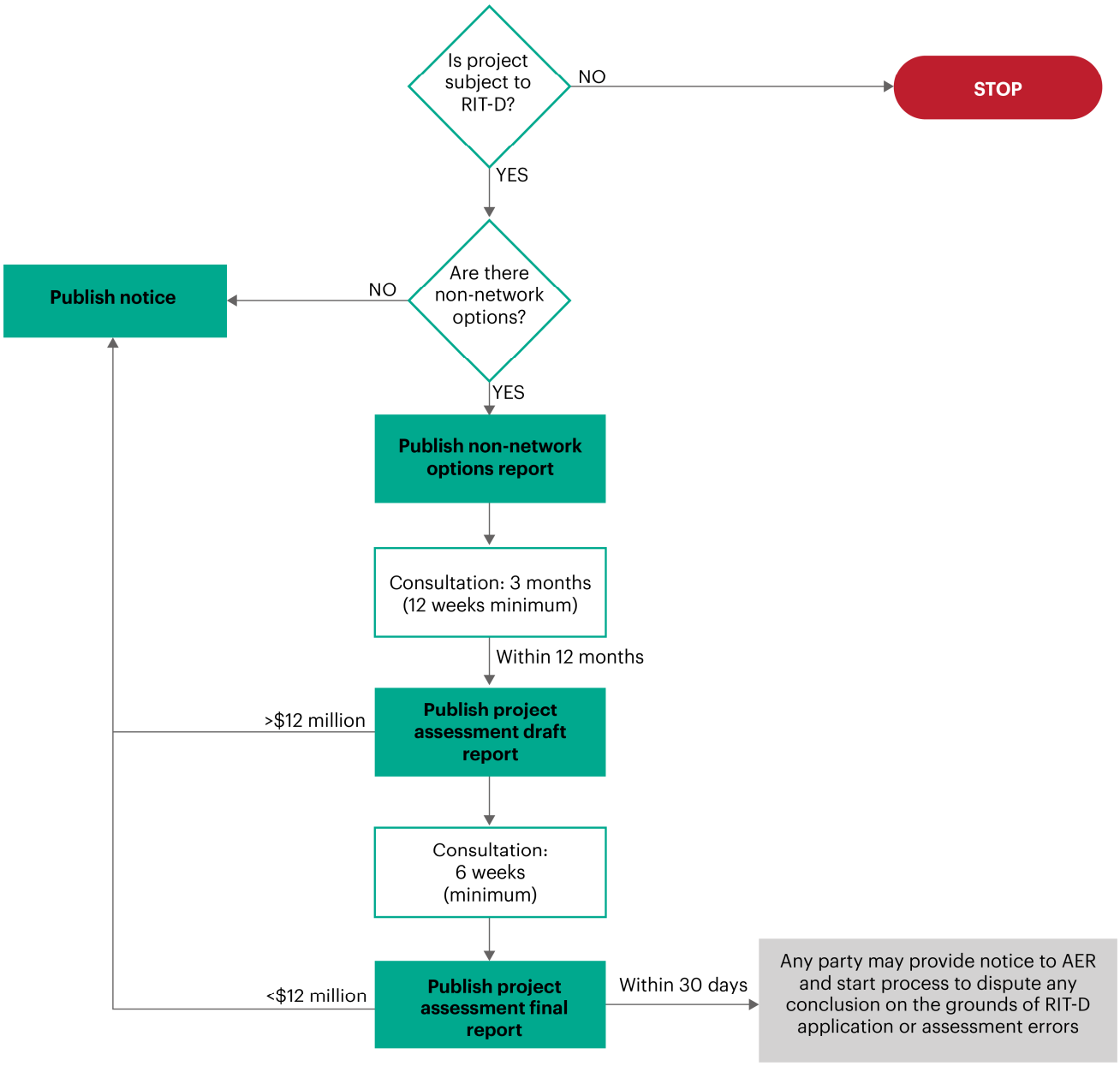
- **Implications from the recently released AER determination on a RIT-T dispute** with recommendations relating to the selection of scenarios and sensitivity analysis to test the robustness of the economic evaluation. We have carried forward the scenarios originally used in the DPAR for this project, however will make changes to the scenarios applied to future RIT-D projects. Endeavour Energy was not a party to this dispute, however we have reviewed the AER's determination and intend on incorporating the relevant principles from the RIT-T into our future RIT-D documentation.

This FPAR represents the final step of the consultation process in relation to the application of the RIT-D process undertaken by Endeavour Energy regarding providing supply to the Aerotropolis Core Precinct.

2.0 RIT-D process

This FPAR has been prepared by Endeavour Energy in accordance with the requirements of clause 5.17.4 of the National Electricity Rules. This report describes the application of the Regulatory Application Test – Distribution (RIT-D) for providing supply to the Aerotropolis Core Precinct. The RIT-D process is summarised in Figure 1 below. We have previously applied the RIT-D to determine the most efficient means of providing the foundation supply to the Aerotropolis precinct – a 132kV backbone feeder.[1]

Figure 1 – Overview of the RIT-D process



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

2.1 Completion of RIT-D Process

This FPAR represents the final stage of the consultation process in relation to the application of the RIT-D process undertaken by Endeavour Energy regarding providing supply to the Aerotropolis Core Precinct. It follows publication of a screening notice and DPAR, both of which were published in October 2022.

Endeavour Energy invited written submissions on the materials contained in the DPAR (over a six-week consultation period) and no submissions were received.

2.2 Contact details

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

3.0 Context of the project

The Aerotropolis Core Precinct is located 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 land uses. It neighbours the Agribusiness Precinct to the west, and the Badgerys Creek Precinct to the north –Figure 2. The Aerotropolis Core Precinct will be to the south of the Airport.

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

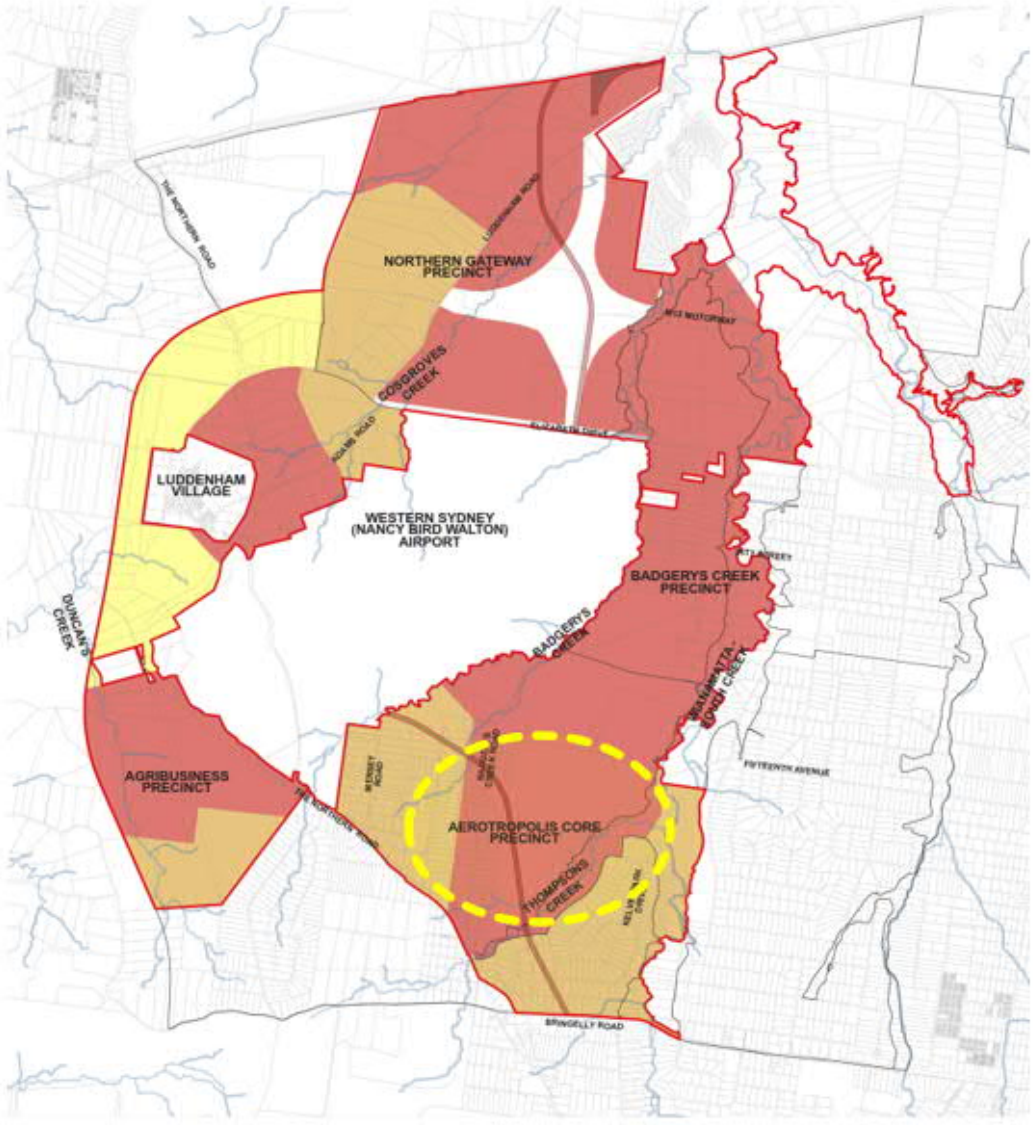
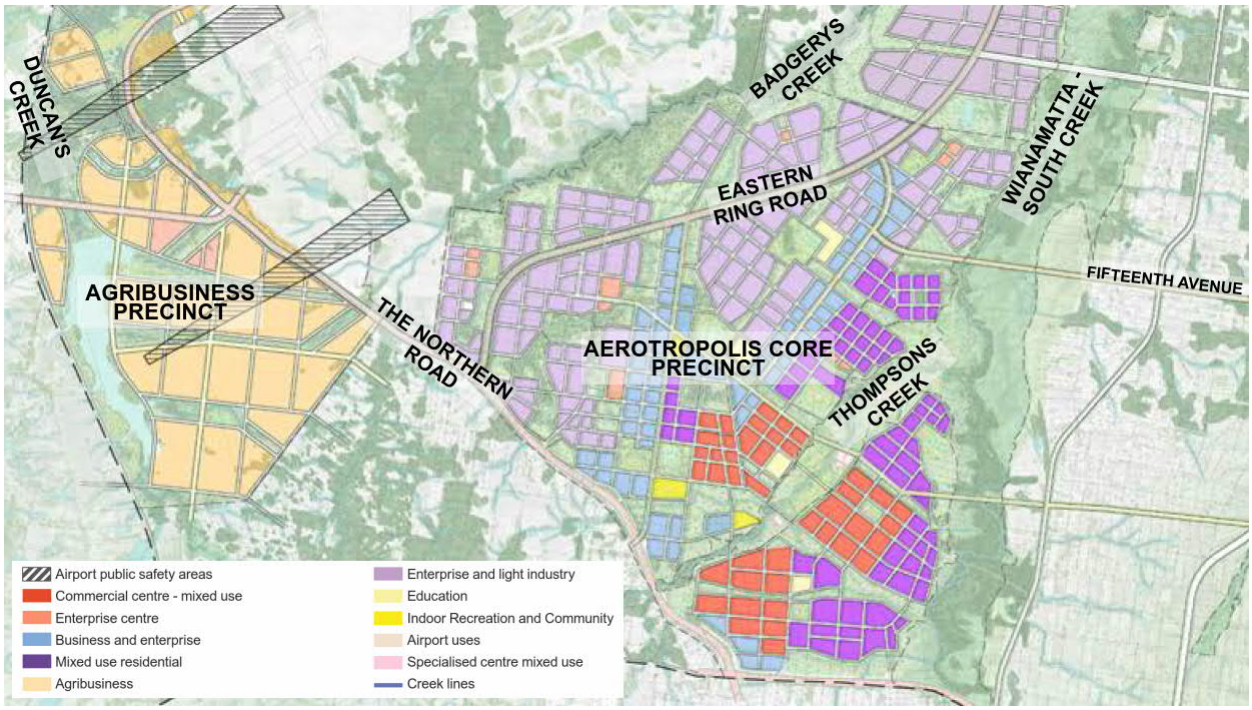


Figure 3 below shows a detailed colour coded map view of the Aerotropolis Core Precinct and the proposed land use and zoning for the area. The area will include mixed use covering commercial, enterprise and light industry and residential land use. The area will feature medium to high density buildings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

Figure 3 – Aerotropolis Core Precinct Proposed Land Use and Zoning



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. In particular, the Bringelly Zone Substation has a limited firm capacity of 19MVA that is set to be exceeded by 2025 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.

4.0 Network need

The proposed land use and zoning for the Aerotropolis Core Precinct 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 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 estimated 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 customer demand exceeds existing capacity.

The central scenario is 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.

The initial customer demand from the development can be serviced by 19MVA of available capacity at Bringelly Zone Substation however this capacity is estimated to be exceeded by 2024/25. If network augmentation is not undertaken then there will be significant unserved energy in our network over the next decade –Figure 5.

Figure 4 – Aerotropolis Core Precinct maximum demand forecasts from 2023 to 2041

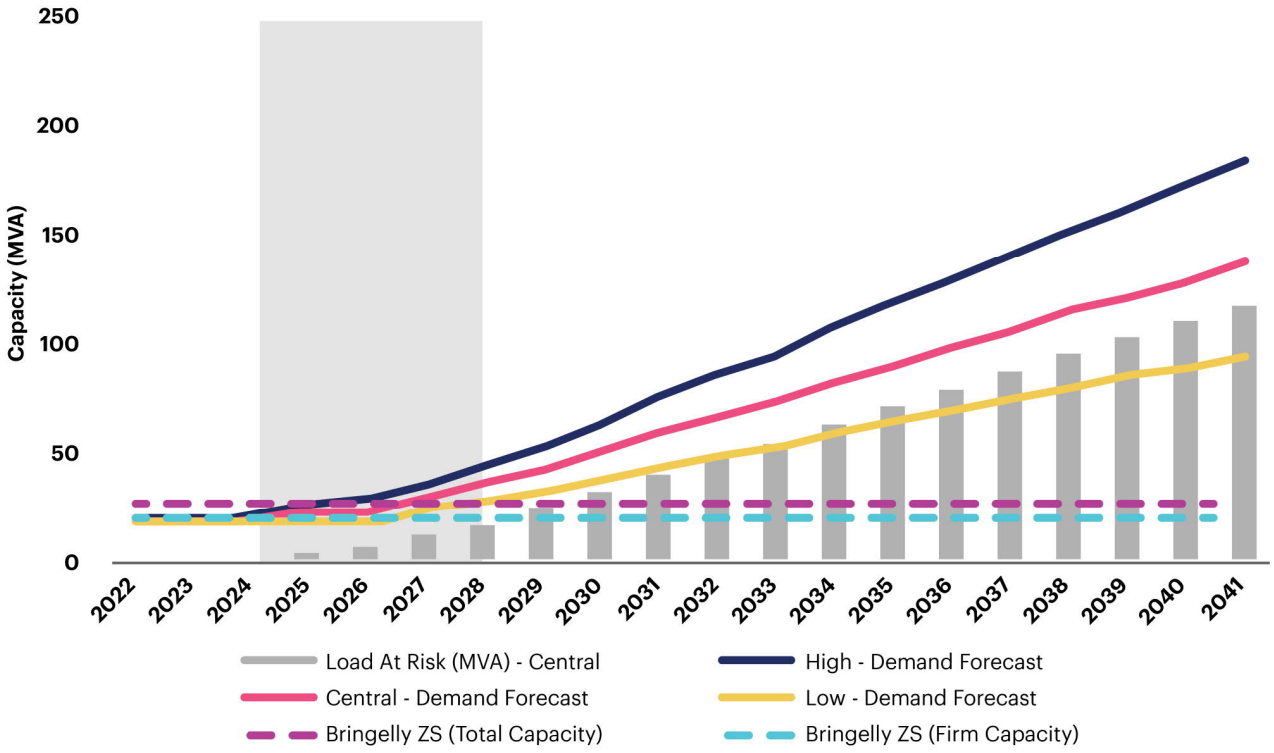
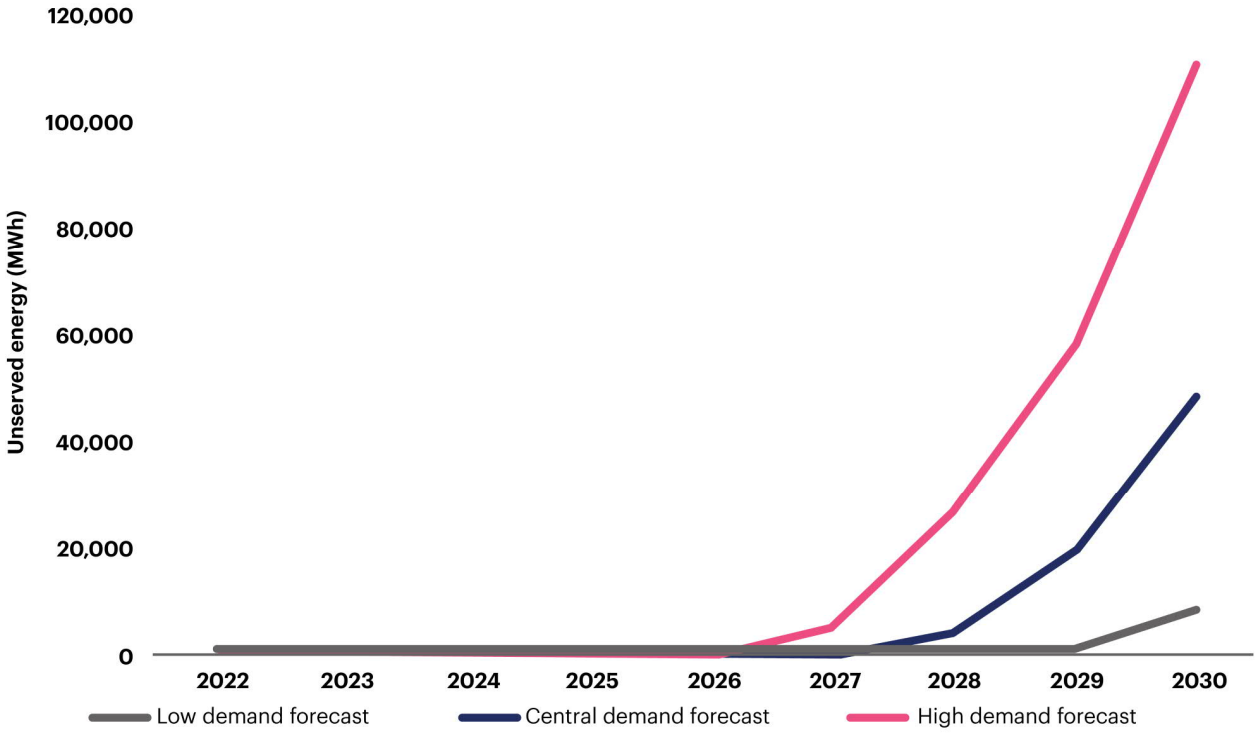


Figure 5 – Forecast unserved energy for the Aerotropolis Core Precinct under low, central and high scenarios



Although we expect that there will 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 customers. 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 upon, how to most efficiently provide supply to 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 customer connection requirement will exceed the existing network capacity. This is currently anticipated to be 2025, based on our demand forecasts which are in turn based on the requirement to connect new customers.

5.0 Preferred Option

The option that presents the highest net market benefit and is therefore considered as the preferred option is Option 1. This option involves the establishment of a 132/22kV zone substation at North Bradfield in a location favourable for the connection of major customers in the Aerotropolis Core Precinct and include a two staged augmentation to the existing Bringelly Zone Substation to further secure the supply to the precinct.

The total cost of this option is expected to be $67.5 million in 2022/23 dollars and construction is expected to commence in 2023/24 with commissioning of the North Bradfield ZS in 2025. The staged augmentation to Bringelly ZS providing a 22kV supply and connection capability would be fully commissioned in 2034.

A detailed breakdown of the scope of this option is provided in Section 6.0.

6.0 Credible options considered

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.

This section provides detailed information on the scope and cost of these options. It also discusses options that were considered but were not progressed further.

Each of the credible options involve establishing the North Bradfield Zone Substation 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 ZS 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 ZS and/or upfront or staged augmentation of Bringelly ZS).

Figure 6 provides an overview of the North Bradfield and Bringelly Zone Substations and their fit into the proposed and existing network infrastructure for the broader Aerotropolis precinct, with Figure 7 providing an aerial view of the development area and proposed network infrastructure.

Figure 6 – Overview of Aerotropolis precinct with proposed and existing network infrastructure

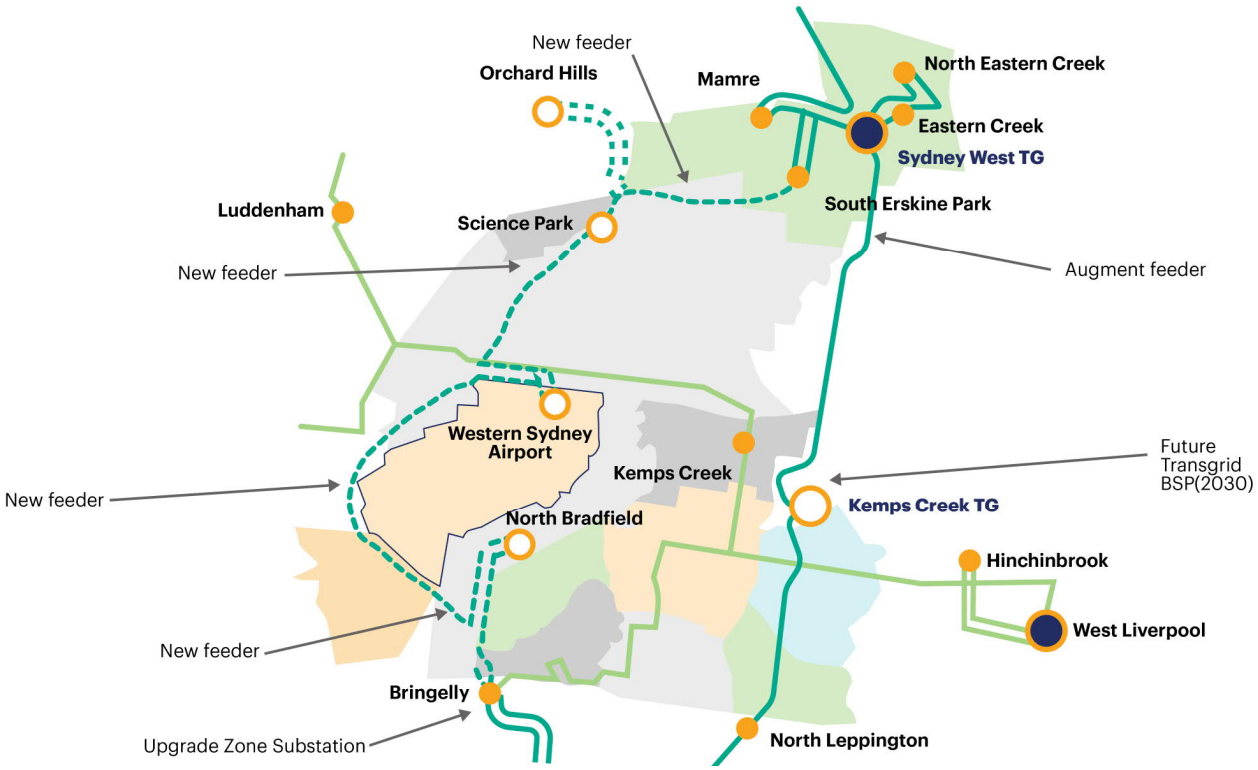
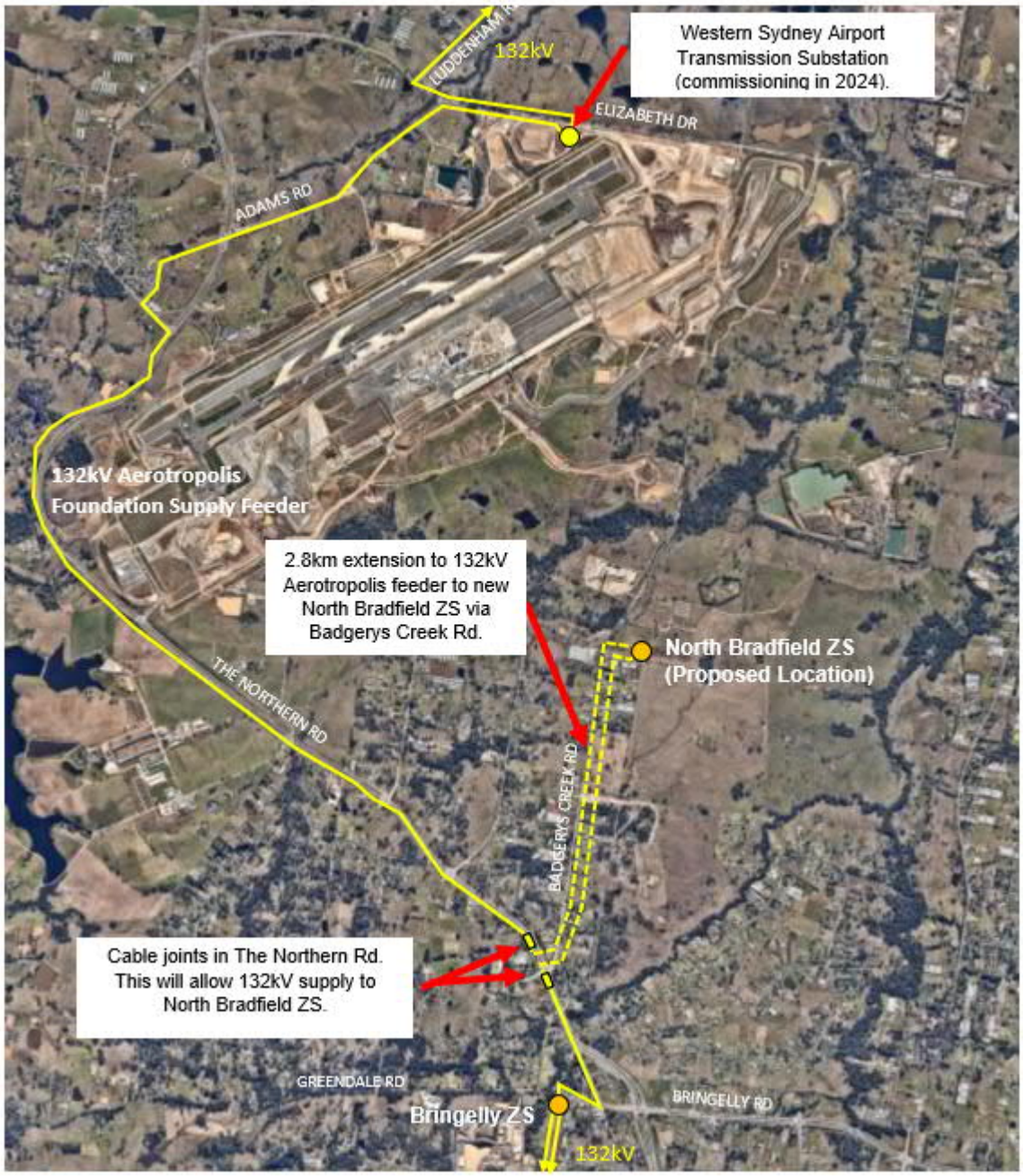


Figure 7 – Proposed North Bradfield ZS in relation to the existing and proposed 132kV supply.



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

Option 1 involves establishing a 45MVA firm 132/22kV North Bradfield Zone Substation within the Aerotropolis Core Precinct to be commissioned during 2025. The proposed location is central and favourable in lowering overall connection costs for new customers in the precinct. Supply to the zone substation would be established via two 132kV 2.8km feeder extensions along Badgerys Creek Road from the Aerotropolis feeder along the Northern Road. The new substation would be connected to the Aerotropolis backbone feeder, with one feeder terminating at the Bringelly ZS 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 ZS 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. This will provide further additional 22kV supply and connection capacity for the precinct by augmenting the existing Bringelly ZS.

The total cost of this option is estimated to be $67.5 million and construction of the North Bradfield ZS would commence in 2023/24 with commissioning in 2025. The first phase of the Bringelly ZS 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.

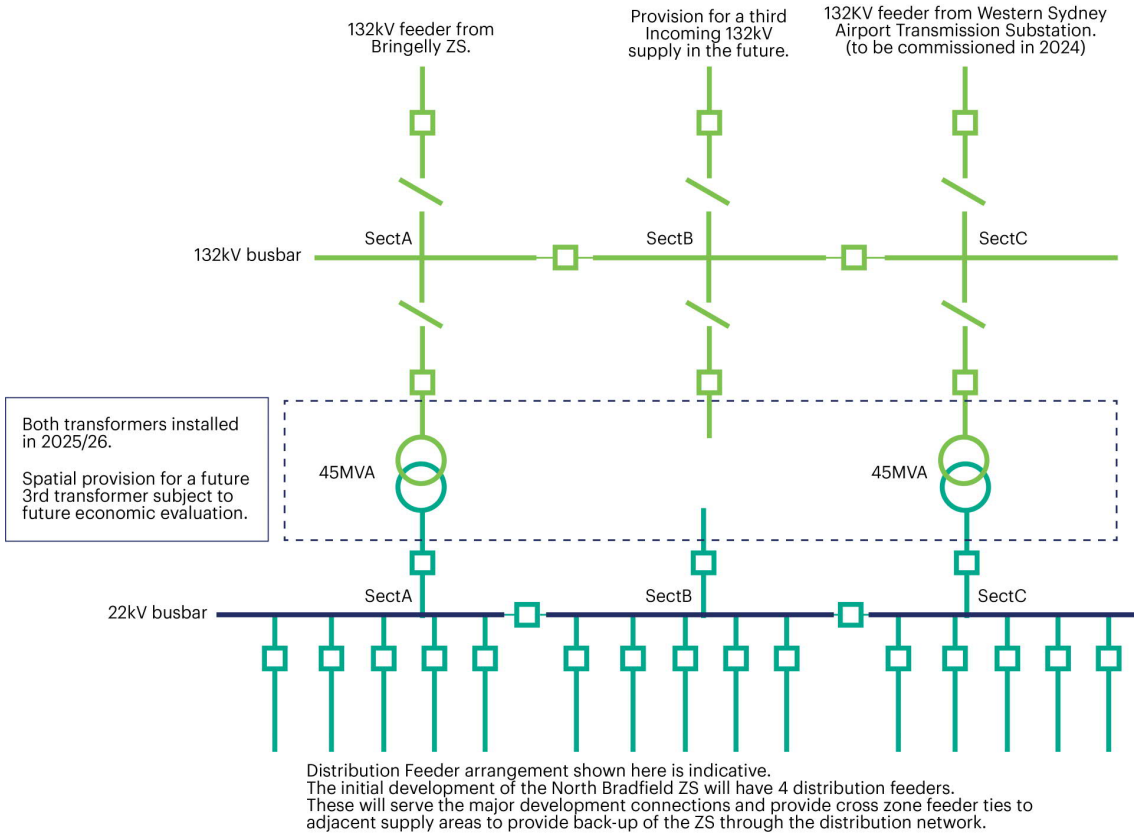
Table 2 provides an overview of the scope of works and capital cost of works for Option 1, with operating costs assumed to be 0.4 per cent of total capital expenditure.

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: • Third 45MVA transformer. • Third incoming 132kV feeder. • Grid BESS.	$21.5
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.	$20.0
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.	$7.0
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.	$15.0
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.	$4.0
Total	Establishment of North Bradfield Zone Substation and augmentation of Bringelly Zone Substation	$67.5

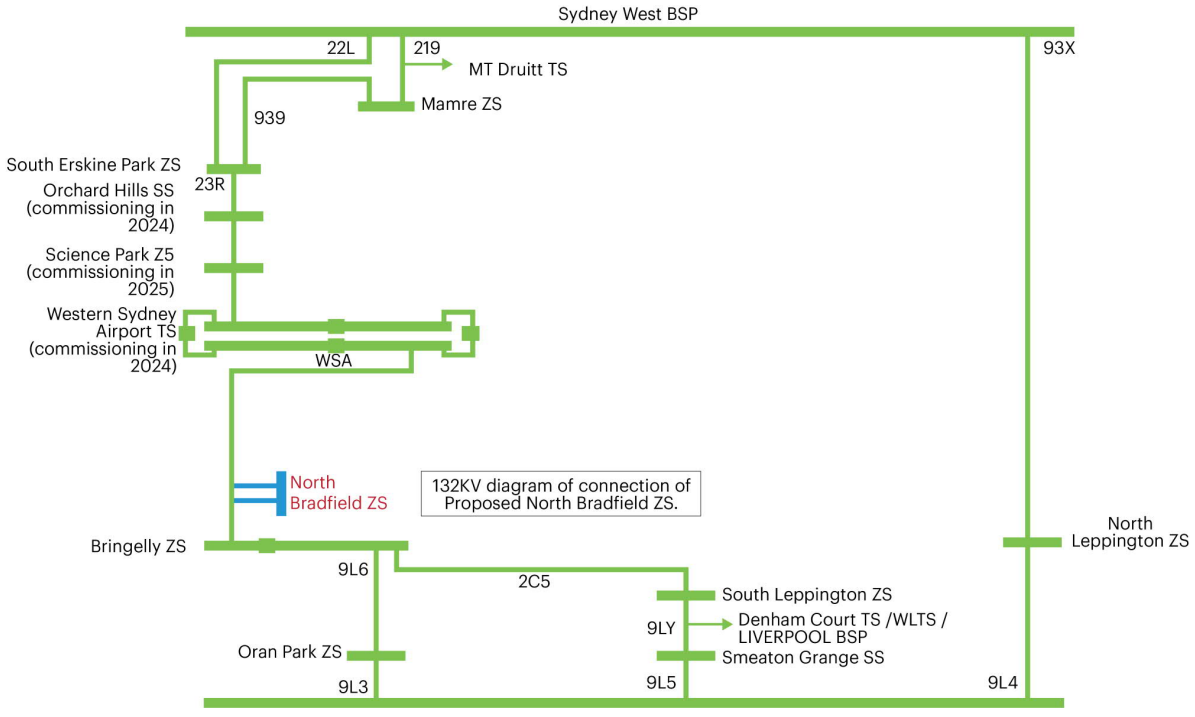
A simplified single line diagram is provided for this option below in Figure 8. This shows the North Bradfield ZS component of Option 1.

Figure 8 – Simplified line diagram of Option 1 (North Bradfield ZS)



The proposed connection of Option 1 to the 132kV network in shown in Figure 9 below.

Figure 9 – 132kV connection of Option 1



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

Option 2 would involve the augmentation of the Bringelly ZS by 2025 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 ZS 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 caused by a shortfall in supply.

Option 2 therefore also includes the staged establishment of North Bradfield ZS to be commissioned in 2029/30 and 2033/34. It would have the same key scope components as 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 $74.0 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 ZS would commence in 2023/24 with commissioning in 2025. The first phase of construction for the North Bradfield ZS 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 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 ZS 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.	$24.0
North Bradfield Stage 1	First stage of North Bradfield ZS: • One 45MVA 132kV/22kV power transformer. • 132kV switchgear. • 22kV switchgear. • Buildings for housing switchgear, protection & control equipment and amenities. Spatial provision for future: • Second and Third 45MVA transformer. • Third incoming 132kV feeder. • Grid BESS.	$17.0
North Bradfield Stage 2	Second stage of North Bradfield ZS: • One 45MVA 132kV/22kV power transformer. • Extend 22kV switchgear by installing additional building.	$6.0
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.	$20.0
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.	$7.0
Total	Augmentation of Bringelly ZS and establishment of North Bradfield ZS.	$74.0

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

Option 3 would involve establishing the North Bradfield Zone Substation within the Aerotropolis Core Precinct to be commissioned in stages. In particular, a single 45MVA transformer would be installed in 2025, with the installation of the second transformer deferred until 2029/30. Under this approach the North Bradfield ZS would not have a firm capacity until the second transformer would be 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 ZS.

The total cost of this option is estimated to be $68.0 million and construction of the first stage of the North Bradfield ZS would commence in 2023/24 with commissioning of the first transformer in 2025. 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 design and project management costs resulting from the stages in this option have been included in this cost estimate. There is a cost to demobilising and remobilising work sites to support the staging of major projects and a cost allowance for refreshing designs to allow for changes in standards, equipment and substation technology.

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.	$6.0
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.	$20.0
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.	$7.0
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.	$15.0
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.	$4.0
Total	Establishment of North Bradfield zone substation with connection to the Aerotropolis backbone feeder and augmentation of Bringelly zone substation.	$68.0

6.4 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 are not feasible based on standard industry practice and equipment available.

Furthermore, if a 33kV supply strategy were adopted for the Aerotropolis area then there would be a requirement for additional zone substations within the area with a consequential high cost for land acquisition and civil and building works avoided.

Accordingly, 33kV network options were not be progressed to the DPAR stage and consequently were not progressed to this FPAR.

7.0 Modelling & Assumptions

7.1 Assumptions

The RIT-D states that the preferred option is the credible option that maximises the present value of the net economic benefit to all those who produce, consume and transport electricity in the NEM.

The market benefit of a credible option is calculated by comparing the credible option in place with the state of the system in the base case. The emphasis in this situation is differences in the risks of involuntary load shedding.

The market benefits that can be considered under the National Electricity Rules are:

- Changes in voluntary load curtailment (considered a negative benefit);
- Changes in involuntary load shedding and customer interruptions caused by network outages;
- Changes in costs to other parties (timing of new plant, capital costs, operating and maintenance costs);
- Differences in timing of expenditure;
- Changes in load transfer capacity and the capacity of embedded generators to take up load;
- Option value;
- Changes in electrical energy losses; and
- Any other class of market benefit determined to be relevant by the AER.

The time period chosen for the NPV analysis was 30 years.

7.1.1 Energy at risk and expected unserved energy

A core justification for this project is based on the load at risk and energy not able to be supplied to customers waiting to connect to the network. This is different to the situation where existing connected customers risk losing supply by a fault on the network. The same VCR value has been applied as a default position to the energy at risk values established from the connection requests received. For a greenfield development such as this, where the forecast demand rapidly exceeds the available capacity in the network, the VCR benefits to be captured from implementing a project to address network constraints can rapidly rise to extremely large amounts. The Energy at Risk (EAR) has been estimated from the annual peak demand forecasts and load duration curves. EAR was capped at a constant value based on 2029/30 levels.

7.1.2 Load profile characteristics

Due to the fact that the area will not be fully developed for a few years we have assessed the identified need using a representative demand profile to capture time of day and seasonal variations in demand.

Specifically, the demand profile is based on the Moorebank Zone Substation load profile, an existing commercial, industrial and light enterprise area.

Figure 10 below presents the normalised load duration curve (LDC) and Figure 11 presents the peak load profile for a summer day assumed for the customer connections associated with the Aerotropolis Core Precinct.

Figure 10 – Normalised LDC assumed for customer connections expected within the Aerotropolis Core Precinct

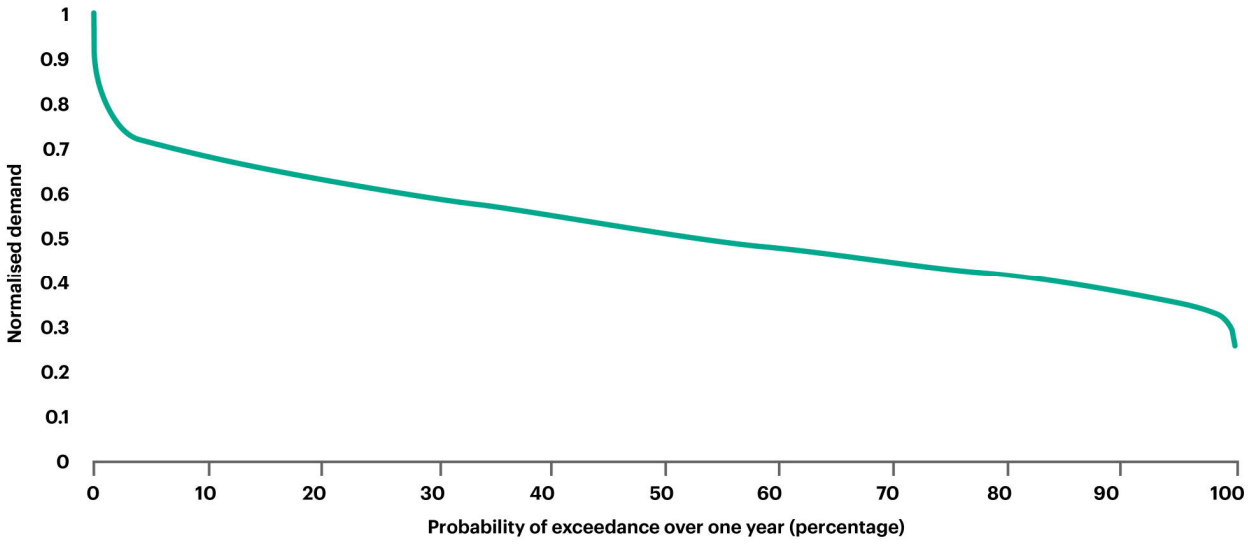
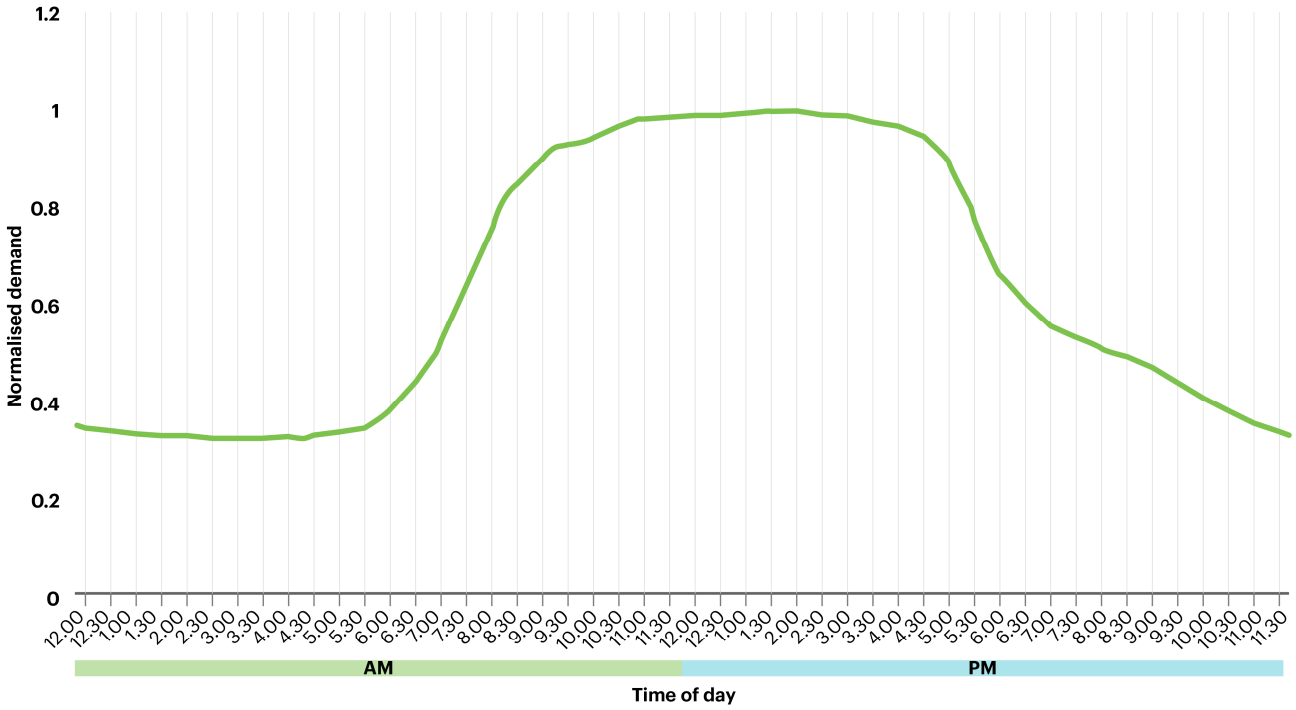


Figure 11 – Peak summer day profile for customer connections expected within the Aerotropolis Core Precinct



7.1.3 Value of customer reliability

The value of unserved energy is calculated using the Value of Customer Reliability (VCR). This represents an estimate of the value electricity consumers place on a reliable electricity supply. Endeavour Energy used a VCR of $43,540 per MWhr in the evaluation which is based on the VCR values provided by the AER, weighted in accordance with the composition of the commercial, industrial and residential demand within the Aerotropolis Core Precinct. A breakdown of this calculation is provided in Table 5 below.

Table 5 – Composite VCR used in the evaluation

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

7.2 Classes of market benefit considered

7.2.1 Changes in involuntary load shedding

Changes in involuntary load shedding and the associated customer interruptions caused by network outages are the sole market benefits that are considered material and have been quantified in this RIT-D assessment.

Increasing the supply capability in the Aerotropolis Core Precinct increases the supply available to meet the growth in demand within these areas. This will provide greater reliability for this area by reducing potential supply interruptions and consequent risk of involuntary load shedding. The present rules only allow for consideration of changes in involuntary load shedding for connected customers. The establishment of supply in a greenfield area where potential customers would otherwise have to go without supply is therefore captured using changes in involuntary load shedding.

7.3 Classes of market benefit not considered to be material

The classes of market benefits that are not considered material include:

- Differences in timing of expenditure;
- Changes in voluntary load curtailment;
- Option value;
- Changes in load transfer capacity;
- Changes in costs to other parties; and
- Changes in electrical losses.

These are further detailed below.

7.3.1 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 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.

7.3.2 Changes in voluntary load curtailment

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

Endeavour Energy has not estimated any market benefits associated with changes in voluntary load curtailment as there is insufficient capacity in the existing customer base to deliver sufficient voluntary demand reduction.

7.3.3 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.

Due to the certainty of the Aerotropolis Core Precinct being developed, there is little doubt about the need and use of the infrastructure investment and each option is considered equivalent in that respect. Option value has therefore not been considered in the economic analysis.

7.3.4 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 failure. The primary objective of this project is to facilitate connection of new customers in the area. Because the areas in and around the precinct are currently mainly serviced by historical rural and residential 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.

7.3.5 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.

7.3.6 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 proposed by this project requirement. 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 complex 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.

7.4 Scenarios and sensitivities

The central scenario parameters and relevant references in the FPAR are summarised in Table 6.

Table 6 – Central Scenario Parameters and references in the FPAR

Parameter	Central scenario
Maximum demand forecasts	Three demand forecast scenarios provided in Section 4.0.
Capital costs	Cost Estimates provided in Section 6.
Operating & Maintenance costs	0.4 per cent of capital expenditure.
Value of customer reliability	Section 7.1.3 .

7.4.1 Demand forecasts

The maximum demand forecasts have been derived from a projection of the customer connection applications and enquiries and the time series forecast is presented in Figure 4.

The central scenario has been developed from analysis of the customer connection request information. It is based on:

- An ultimate load forecast for the precinct based on surface area analysis;
- A timeframe to reach that ultimate load (the estimated time for this precinct to reach maturity is 30 years); and
- A load ramp up rate assumption (which is linear in this instance).

Probabilistic 'load realisation' factors have been applied to the development derived forecast, which in turn is calibrated by the actual connections applications that we receive over time. This load realisation factor is what differentiates the demand scenarios. In particular, the low scenario uses a lower load realisation factor than the central scenario, while the high scenario has been developed assuming a 100 per cent load realisation factor – suggesting that the full developer derived forecast will be realised in the expected timeframe.

Our demand forecast for the Aerotropolis Core Precinct includes several large spot loads that we consider to be committed and foundational to the requirement for this investment.

7.4.2 Capital costs

Capital cost estimates have been based on the scope of work presented for each option and are based on current market pricing for materials, labour and third party contracting. The cost estimates in the FPAR have been updated from the DPAR to reflect an uplift in costs observed in materials including copper cable and also in the cost of civil and building works, particularly civil works required for placement of underground cables.

For sensitivity analysis, these estimates have been varied by ± 25%.

7.4.3 Value of customer reliability

Our analysis adopts the value of customer reliability values published by the AER to calculate the expected unserved energy. The ratio of load types has been estimated and used to calculate the weighted aggregate VCR value and then applied to the energy at risk. Based on the estimated load composition of the subject area, a demand composition weighted VCR value of $43.54 per kWh has been derived and used in the RIT-D analysis. A variation of ±25% has been used for sensitivity testing in accordance with AER guidelines.

7.4.4 Discount rates

The discount rate used in the financial analysis will impact the estimated present value of net market benefits and may affect the ranking of credible options. Endeavour Energy has employed a real, pre-tax discount rate based on the latest AER determination as the low case. For sensitivity analysis, a symmetrical application was used to determine the high case.

7.4.5 Summary of sensitivities and scenarios

We have assessed three alternative future scenarios as part of the 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 and framework used for each scenario is provided in Table 7 below.

Table 7 – Scenarios used in the Aerotropolis Core Precinct NPV assessment

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

Endeavour Energy is aware of the recent AER determination on a RIT-T dispute which provided guidance on the selection of scenarios for economic assessment under the RIT-T and RIT-D. We have continued using the scenarios defined in the DPAR for this project and carried these through to the FPAR. Based on our interpretation of the recent determination, we will modify our selection of scenarios and the conduct of sensitivity analysis on future projects to ensure alignment to the principles. The DPAR for this RIT-D was published prior to the AER's determination on the recent RIT-T and we consider it unnecessary to rework the scenarios previously published in the DPAR based on a simple benefits test.

Endeavour Energy considers that the central scenario is most likely because it is based primarily on a set of expected central assumptions with regards to the key variables. 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.

8.0 Results of analysis

This section describes the results of the economic assessment for each of the credible options considered in this RIT-D.

8.1 Central case results

Table 8 presents the economic analysis of the options under the central case scenario including the present value of the benefits and costs.

Option 2 has a higher nominal cost, however a large proportion of the Option 2 cost is in later years and the PV cost difference between Option 1 and 2 are closer than the nominal cost terms.

Option 3, on the other hand, has equal costs to Option 1 in nominal terms, however has higher PV costs and produces marginally lower market benefits primarily due to the marginally higher load at risk estimate based on the initial single transformer option for North Bradfield ZS.

Overall, Option 1 has the highest net market benefit and is the preferred option.

Table 8 – Central case 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 2025 and augment Bringelly Zone Substation in 2029/30 and 2033/34	67.5	37,558.9	46.7	37,512.2	1
2	Augment Bringelly Zone Substation in 2025 and staged establishment of North Bradfield Zone Substation in 2029/30 and 2033/34	74.0	37,558.9	48.2	37,510.7	2
3	Staged establishment of North Bradfield Zone Substation in 2025 and 2029/30 and augmentation of Bringelly Zone Substation in 2029/30 and 2033/34	68.0	37,552.8	46.9	37,505.9	3

8.2 Sensitivity and scenario assessment

Endeavour Energy has carried out sensitivity analysis in the RIT-D assessment based on variations of key parameters. Specifically, Endeavour Energy has investigated as part of the scenarios changes in relation to the:

- Forecast demand, and hence quantity of involuntary load shedding;
- Value of customer reliability;
- Investment costs; and
- Discount rate.

In each scenario considered (and also the weighted scenario), Option 1 remained the preferred option – providing a high degree of confidence in this result.

8.3 Economic timing

The economic timing of the preferred option is the point in time when the existing network capacity is insufficient to supply new customers.

The supply to the Aerotropolis Core Precinct requires connection capacity to be made available as soon as the existing available capacity in the network is exhausted. Based on the current demand forecast, this is expected to occur in 2025. Consequently, this date is taken to be the economic timing for this project.

Endeavour Energy is constantly monitoring customer demand in this precinct via customer network connection requests and direct discussions with major customers and other utilities. Any material delays in the development of the Aerotropolis Core Precinct would require a reassessment of the economic timing.

9.0 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 RIT-D has identified three credible network-based options that can supply 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. There are also 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 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 ZS 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 $67.5 million and construction of the North Bradfield Zone Substation will commence in 2023/24 with commissioning in 2025. The first phase of the Bringelly ZS 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 FPAR 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 $48.5 Million.

CONTACT

If you have any comments or enquiries regarding this report please send them to the **Portfolio Management Office** at: consultation@endeavourenergy.com.au

endeavourenergy.com.au

Endeavour Energy

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