RIT-D Draft Project Assessment Report

Aerotropolis Foundation Supply

26 October 2021

Endeavour Energy

Contents

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).

The purpose of this report is to demonstrate the basis for selection of the preferred option to address the network limitations for the Aerotropolis Foundation Supply.

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. The full development of the area is estimated to result in more than 100,000 jobs and 100,000 homes.[1,2] Based on Endeavour Energy's load density forecasts and the proposed zoning of the area, the ultimate load of the area is estimated to be between 600MVA and 800MVA.

The identified need for this investment is 'reliability corrective action' since 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 expected load requiring connection will exceed the existing network capacity. This is currently anticipated to be 2024/25, based on the connection enquiries received to date.

This report follows publication of a Screening Report 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 RIT-D. This is due to the extent of forecast load for the Aerotropolis area, the expected cost of non-network options and the capacity of the existing network to facilitate non-network technologies.

Four options were assessed and only three were determined to be credible in addressing the network need. The options assessed are listed below:

- Base Case : Do Nothing
- Option 1 : 132 kV from South Erskine Park ZS to Bringelly ZS, using a mix of overhead (OH) and underground (UG) lines following an Endeavour Energy easement
- Option 2 : 132 kV from Sydney West BSP (TransGrid) to Bringelly ZS, using a mix of OH and UG across TransGrid's 330 kV easement and existing distribution corridor, and
- Option 3 : 132 kV from South Erskine Park ZS to Bringelly ZS, UG, mostly in public road reserve with limited need for easements.

The 'Do Nothing' option is not considered credible as it will result in significant expected unserved energy in the development area which would prevent the connection of new loads and the curtailment of growth at sites that are currently fed under temporary supply arrangements.

Option 1 involves the construction of a 26.5km 132kV feeder with 275MVA capacity that spans between South Erskine Park zone substation (ZS) to the Bringelly ZS. The feeder will have both overhead sections (10.6km) and a longer section that is underground (15.9km), using our existing distribution corridor.

[1] https://www.planning.nsw.gov.au/Plans-for-your-area/Priority-Growth-Areas-and-Precincts/Western-Sydney-Aerotropolis/Western-Sydney-Aerotropolis-explained

[2] https://www.planning.nsw.gov.au/News/2020/Planning-for-the-biggest-jobs-boom-in-NSW-history

Option 2 involves the construction of a 27km 132kV feeder with 275MVA capacity that spans from South Erskine Park ZS to Bringelly ZS. The feeder uses TransGrid's 330kV easement and existing distribution corridor.

Option 3 involves the construction of a 26.5km 132kV feeder with 275MVA capacity that spans the same route as Option 1 between South Erskine Park ZS and the Bringelly ZS. The feeder will be located entirely underground, mostly in public road reserve and therefore would require limited easements.

The economic assessment of the credible options is shown in Table 1. Option 3 presents the greatest net present value (NPV) of the market benefits considered in the evaluation. The assessment period for calculating the NPV is 20 years. Market benefits are based predominantly on expected unserved energy (USE) which is monetised by using Value of Customer Reliability (VCR). The VCR values used by Endeavour in its modelling are based on the Values of Customer Reliability Report published by the Australian Energy Regulator (AER) in December 2019.

Table 1: Summary of Credible Options

Option	Description	Project capex nominal ($M)	PV of Market Benefits USE ($m)	PV of Costs ($M)	NPV ($M)	Rank
1	132kV South Erskine Park ZS to Bringelly ZS (Mixed OH & UG)	106.1	141,638	58.9	141,579	3
2	132kV Sydney West BSP to Bringelly ZS (Mixed OH & UG)	104.1	141,642	57.5	141,585	2
3	132kV South Erskine Park ZS to Bringelly ZS (UG only)	66.1	141,643	42.8	141,600	1

Considering the capital cost, value of market benefits, identified risks and NPV, the preferred option is Option 3.

Sensitivity analysis was undertaken across a range of assumptions including forecasted load growth, discount rate, VCR and Capex. In each scenario considered, Option 3 remained the preferred candidate, indicating there is a very high degree of confidence in this result.

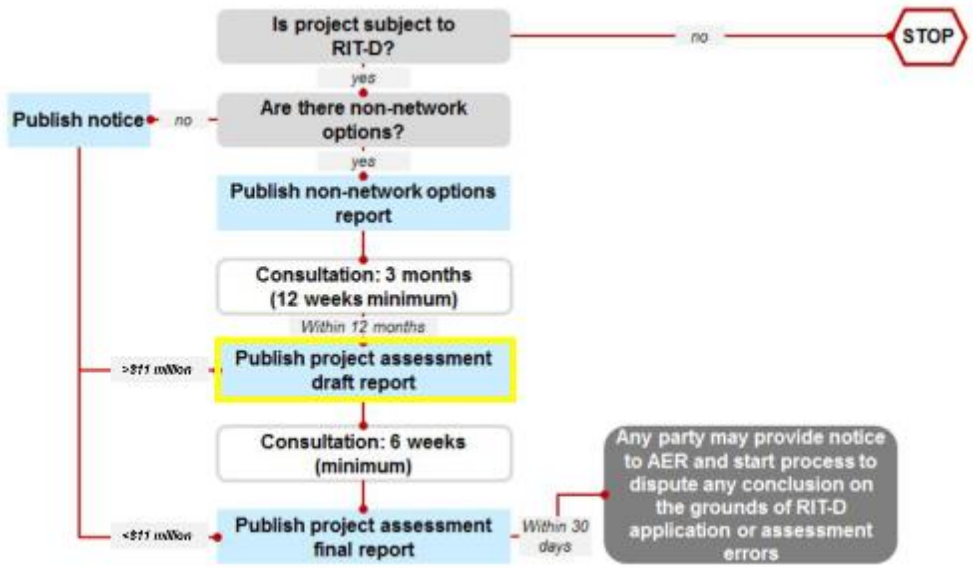
Endeavour Energy seeks written submissions from interested parties in relation to the preferred option outlined in this document. Submissions are due on or before 7 December 2021. All submissions and enquiries should be directed to Endeavour Energy's Head of Asset Planning and Performance at consultation@endeavourenergy.com.au.

2. RIT-D Process

This DPAR was 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 Investment Test – Distribution (RIT-D) for addressing network limitations in the Aerotropolis development area.

Endeavour Energy adopts a process of exploring feasible methods of supply in assessing the ability to supply development applications. 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 needs to balance timely investment with the ramping up of demand as the development progresses. This is required to mitigate the risks of stalling developments due to delayed supply of power to the area which has an adverse impact on the supply of land for housing, as well as commercial and employment needs.

Figure 1 - The RIT-D Process



2.1 Submissions requested to the DPAR

Endeavour Energy seeks written submissions from market 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 7 December 2021. 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 Head of Asset Planning and Performance at consultation@endeavourenergy.com.au.

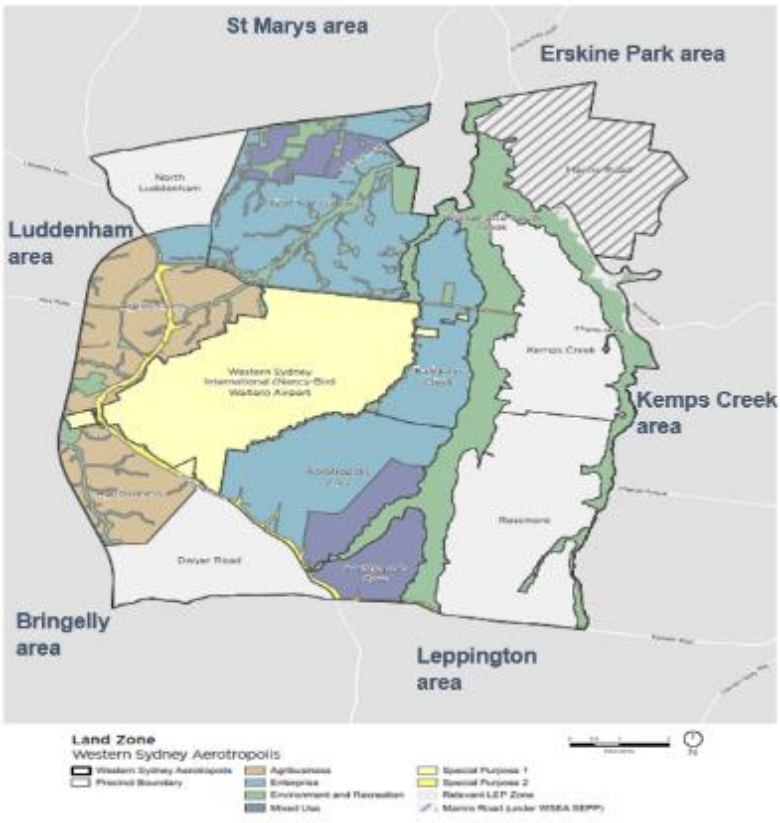
3. Context of the Project

The Greater Sydney Commission has established a clear, overarching vision for Sydney that includes the development of a third city in Western Sydney ('Western Parkland City'), underpinned by the Commonwealth government's investment in the new Western Sydney International (Nancy Bird Walton) Airport as well as the development of the Sydney Metro-Western Sydney Airport line and road infrastructure. also include a Metro rail line from St Marys to the new airport, major road developments (including the M12 motorway) and the anticipated establishment of industries including agribusiness, transport and logistics, defence, aerospace, education and advanced manufacturing. The airport will also attract tourism and entertainment developments within the surrounding areas.

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. **Figure 2** shows the Land Use Zoning for the area and the boundary of the precincts within the Aerotropolis.

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. The full development of the area is estimated to result in more than 100,000 jobs and 100,000 homes.[3,4]

Figure 2 – Western Sydney Aerotropolis Precinct Land Zones[5]



[3] https://www.planning.nsw.gov.au/Plans-for-your-area/Priority-Growth-Areas-and-Precincts/Western-Sydney-Aerotropolis/Western-Sydney-Aerotropolis-explained

[4] https://www.planning.nsw.gov.au/News/2020/Planning-for-the-biggest-jobs-boom-in-NSW-history

[5] NSW Government, *Western Sydney Aerotropolis Summary of Key Planning Documents*, December 2019, p. 11.

4. Network Need

The existing network is a low capacity 33kV network that was originally designed to meet the existing and historical rural and residential load base. The current network is also predominantly overhead construction and will likely require future replacement or relocation due to the road widening development throughout the area to cater for the increased transport requirements of the Aerotropolis.

Based on Endeavour Energy's load density forecasts and the proposed zoning of the total Aerotropolis area, the ultimate load of the entire area is estimated to be between 600MVA and 800MVA. Endeavour Energy has monitored the load density of the nearby and adjoining areas in the Western Sydney Employment Lands at Eastern Creek, Mamre and South Erskine Park industrial estates.

While the total ultimate demand of the Aerotropolis area and the Western Parkland City will develop over the next 50 years, there are requirements for connection of major loads in the short- to medium-term that require distribution network augmentation. Specifically, the following major loads are expected to connect in the next few years and will be supported by the network:

- Sydney Science Park in 2021/22; fed initially from Luddenham.
- Northern Gateway and University of Sydney Employment Lands in 2022/23;
- Adams Rd precinct (a warehousing and logistics estate adjacent to the Western Sydney Airport) in 2022/23;
- Western Sydney Airport in 2023/24;
- Sydney Metro – Western Sydney Airport line in 2024/25.

We have already received formal connection applications for Western Sydney Airport, Sydney Metro and Sydney Science Park for their initial and future power requirements.

A number of these new loads are backed by Government commitments, for example:

- the Australian Commonwealth Government and the NSW Government have committed to the Western Sydney Airport, with commercial operations starting in 2026[6]; and
- the NSW Government recently granted planning approval for the Sydney Metro – Western Sydney Airport line, with testing occurring one year prior to its commissioning in 2026.[7] Sydney Metro have already started work on construction supplies, with significant load required for tunnel boring machines and other associated construction.
- In addition, the NSW Government has already rezoned all land around the Aerotropolis in preparation for these developments.

Table 2 shows the combined demand forecast for the Western Sydney Aerotropolis area including all the currently known customer connection applications.

[6] DPIE, *Western Sydney Airport: Airport Plan*, July 2020, p. viii. Details on the Western Sydney Airport are available from https://www.westernsydneyairport.gov.au/. Prime Minster press release on Sydney Metro and Western Sydney Airport available from https://www.pm.gov.au/media/new-agreement-keeps-sydney-metro-western-sydney-airport-jobmaker-project-track

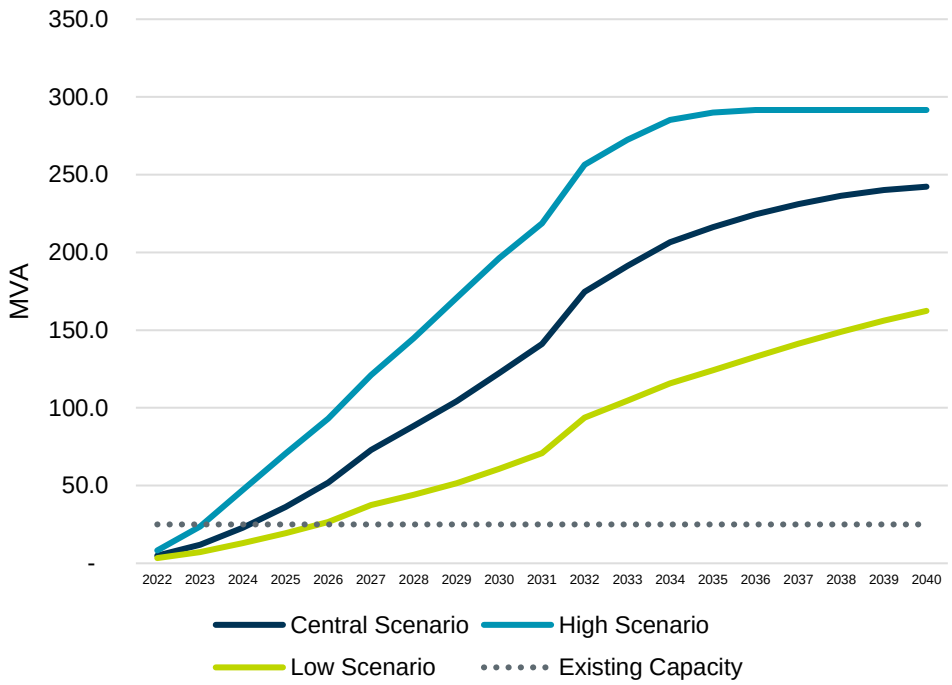
[7] DPIE, *Sydney Metro – Western Sydney Airport: State Significant Infrastructure Assessment*, July 2021, p 6. Prime Minster press release on Sydney Metro and Western Sydney Airport available from https://www.pm.gov.au/media/new-agreement-keeps-sydney-metro-western-sydney-airport-jobmaker-project-track

Table 2 – Combined Demand Forecast for the Western Sydney Aerotropolis (2022 to 2040)

Aerotropolis Load Points	2022	2023	2024	2025	2026	2027	2028	2029	2030	…	2040
Sydney Science Park	0	2	3	6	9	14	18	24	30	…	75
Northern Gateway & USyd Employment Lands	0	2	4	7	11	16	22	29	36	…	90
Adams Road Precinct	1	2	5	8	13	17	21	23	25	…	25
Western Sydney Airport	1	2	5	7	10	17	17	17	17	…	34
Sydney Metro	3	6	9	12	15	17	20	23	28	…	46
Diversified Load	**5**	**12**	**23**	**36**	**52**	**73**	**88**	**104**	**122**	**…**	**242**

The existing distribution network in the Aerotropolis area has 25MVA of supply capacity and is insufficient to meet the supply needs of the Aerotropolis area from 2024/25, even under the low demand scenario outlined in **Figure 3** (which we consider to be an extreme lower bound).

Figure 3 Aerotropolis Foundation Supply (132kV) Demand Forecast 2022



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

We have initiated a Regulatory Investment Test for Distribution (RIT-D) to investigate, and consult on, how to most efficiently facilitate the connection of the new major loads in the Western Sydney Aerotropolis area.

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 the connection enquiries received to date.[8]

Importantly, no construction on new distribution investments will commence until there is a high degree of certainty that the anticipated loads will be seeking connection to our network at the timing indicated. Further, we note that new customers will contribute to the costs of the investment (as well as the cost of the wider network), via their 'Distribution Use of System' tariffs.

The distribution network augmentation to support the development of the Aerotropolis area was included as part of our regulatory proposal to the Australian Energy Regulator (AER) for the current regulatory control period[9] and also discussed in our most recent Distribution Annual Planning Report (DAPR).[10]

A non-network screening notice has been published in accordance with NER clause 5.17.4(c), and found that there is unlikely to be a non-network option that could form a potential credible option on a standalone basis, or that could form a significant part of a potential credible option. This notice is available online[11]. This DPAR represents the next formal stage of the RIT-D process and provides information and outcomes from economic assessment of network-based options for the Western Sydney Aerotropolis area.

5. Preferred option

The option that presents the greatest net market benefit and thus considered as the preferred option, is Option 3. This option is a 132 kV feeder of 275MVA capacity from South Erskine Park ZS to Bringelly ZS, underground, mostly in public road reserve with limited need for easements.

The feeder will traverse from South Erskine Park ZS (northern end) to Bringelly ZS (southern end) as shown in

Figure 4. The route length is 26.5km and includes the utilisation of the existing cable ducts installed on the new alignment of the Northern Road. The feeder will enable connection of the Sydney Metro Stabling Facility (Future Metro Substation).

[8] While a number of loads are expected to connect prior to 2024/25, we have interim supply arrangements in-place for these loads. These interim arrangements are expected to become insufficient from 2024/25.

[9] Endeavour Energy, *Revised Regulatory Proposal*, January 2019, p 21-22.

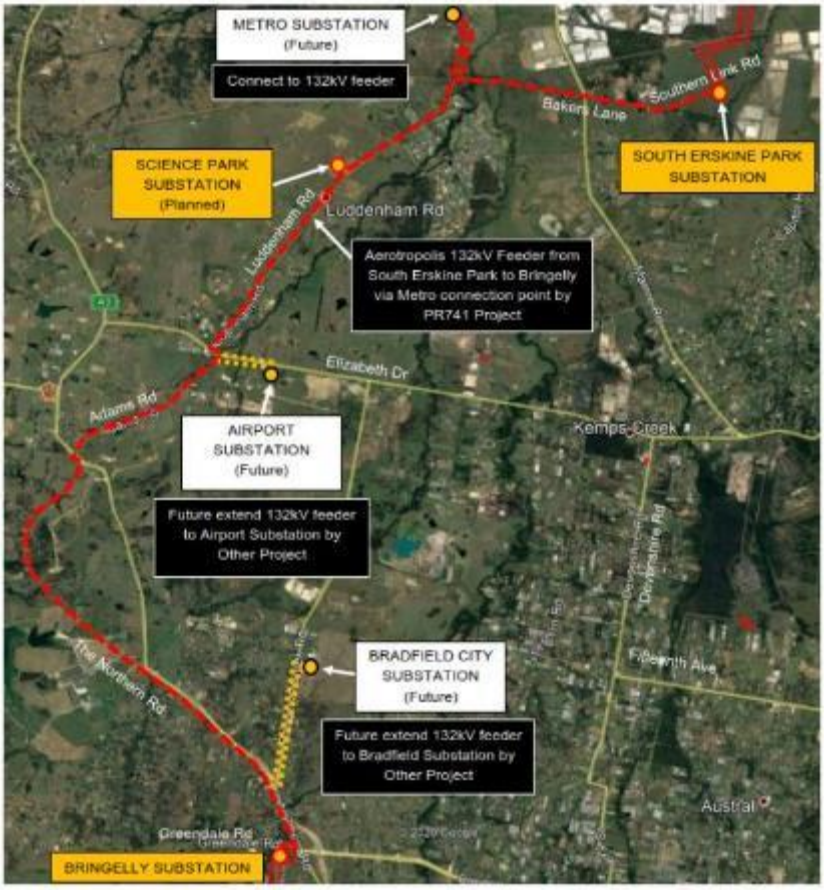
[10] Endeavour Energy, *Distribution Annual Planning Report*, December 2020, p 67.

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

This option uses a total UG construction avoiding the significant issues and risks of OH and provides a highly credible preferred network option for the Aerotropolis development. This option represents the lowest economic cost and demonstrates Endeavour's commitment to the development of the Aerotropolis and the timely connection of major customers, loads and supports future development in the industrial area to the West of the airport.

The total cost of this option is estimated to be $66 million. Construction could start in 2021/22 and be completed in 2024/25, with commissioning of the feeder in the same year as construction is complete.

Figure 4 – Aerotropolis 132kV backbone feeder preferred line route



There is a notable reduction in cost for this option when compared to the other options since it is entirely underground. On a conventional unit rate bases, the component cost of OH would be lower than the underground option, however it is noteworthy that the costs of acquiring additional easements, which are significant for 132kV lines and the surging land value in Western Sydney result in the UG becoming the lower cost choice. These easements would be required even if the assets are established within the road reserve, as an overhead line, including the safety clearance required around the overhead conductors, would require utilisation of privately owned land fronting onto the roadway.. This option also avoids significant outages during construction as there are no joint use poles impacted.

A complete breakdown of costs is provided in **Table 6**.

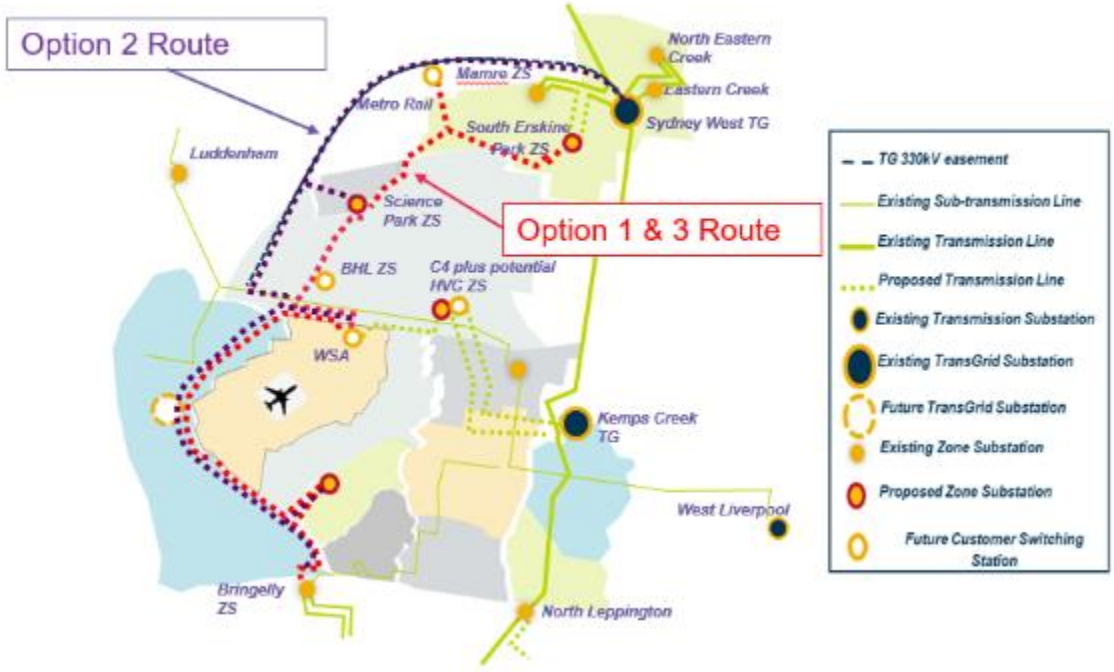
6. Credible options considered

There were several options considered in the evaluation, of which 3 network-based options were determined to be credible. Non-network options were considered as part the screening report but were not considered to be credible due to the large greenfield development requirements. The credible options are listed below, and details are further discussed in this section.

- Do Nothing : Base case;
- Option 1 : 132 kV option from South Erskine Park ZS to Bringelly ZS, mixed overhead and underground lines following an Endeavour Energy easement
- Option 2 : 132 kV option from Sydney West BSP (TransGrid) to Bringelly ZS, using TransGrid's 330 kV easement and existing distribution corridor, and
- Option 3 : 132 kV option from South Erskine Park ZS to Bringelly ZS, underground, mostly in public road reserve with limited need for easements.

An overview of the routes for Options 1, 2 and 3 are shown in Figure 5.

Figure 5 - Indicative routes showing major connection points and existing infrastructure.



6.1 Base Case ('Do Nothing' option)

A baseline risk position has been established based on a 'Do Nothing' option. The project involves the extension of supply into a greenfield development area which will ultimately 100,000 homes and significant major connections as highlighted in Section 4 .

The 'Do Nothing' approach will result in significant expected unserved energy in the development precincts from 2025 onwards. It also carries with it significant economic development implications and reputational risks of negative press and NSW Government dissatisfaction if Endeavour Energy is unable to meet supply requirements for this area.

In terms of risk cost assessment, the 'Do Nothing' option provides a base case where the risks are valued by applying a Value of Customer Reliability (VCR) to the forecast expected unserved energy. The VCR used by Endeavour Energy in its modelling is based on values published by the AER on its Values of Customer Reliability Report in December 2019. This approach was endorsed by the AER during the determination process. Table 3 shows the annualised risk cost of no proactive intervention.

Table 3 – Risk cost of 'no proactive intervention'

	2025	2026	2027	2028	2029
Risk cost ($M)	59	1,479	5,372	8,601	11,968

6.2 Option 1 – 132 kV option from South Erskine Park ZS to Bringelly ZS, mixed overhead and underground lines following an Endeavour Energy easement

Option 1 involves the construction of a 26.5km 132kV feeder with 275MVA capacity that spans between South Erskine Park zone substation (ZS) to the Bringelly ZS. The feeder will have both overhead sections over a distance of 10.6km and a longer 15.9km section that is underground, using our existing distribution corridor.

An anticipated drawback of Option 1 is that it may require complex environmental assessment and prolonged community consultation due to the overhead portion. The requirement for additional consultation is also likely to be increased because of the need for us to acquire multiple easements. We have direct, recent experience of the community consultation and environmental assessment required for overhead line projects through our recent Grange Avenue project, which has highlighted the potential for extended delays. Several specific features of Option 1 suggest that prolonged community consultation would be required, including that it would be likely to require significantly taller poles being used (due to the 132kV overhead conductor required) and would also require joint use (including the 11kV and low-voltage on the same new poles), resulting in considerably higher visibility of overhead conductor for nearby residents. We have also observed that there is a much higher acceptance of underground cable solutions in community feedback in consultation, with low or negligible opposing feedback (eg, the recent consultation for the transmission supply for Box Hill receiving little or no community feedback opposing the underground solution).

Recent experience with other projects involving overhead lines has demonstrated that the risk that this consultation could lead to delays, risking the ultimate technical feasibility of this option (i.e., its ability to meet the identified need by 2024/25). For the purposes of the DPAR assessment, we assume that this option is technically feasible. However, we note that as per Table 3 a delay of just 12 months would result in unmet demand valued in the order $59 million. This demonstrates the extreme and unacceptably high risk that Option 1 would need to be considered if this option progress.

Option 1 has another disadvantage relating to the overhead line section, in that this section would likely need to be relocated to an underground position in future, as part of the planned widening of Luddenham Road (expected in the next 7 to 10 years). The planned M12 motorway is expected to cross Luddenham Road and lead to the upgrade of the road from its current rural design to an urban road. While it is difficult to determine this cost to a high degree of accuracy at this stage, we estimate this relocation cost could be around $20 million. While the future relocation cost may not be borne directly by Endeavour Energy or other NEM participants (and so would not be captured in the RIT-D analysis), these costs represent an economic cost to the wider community. Moreover, there is a risk that the RMS permitting process and/or Penrith City Council may refuse permits or approvals for overhead lines, due to the complication with future development plans. This would again result in this option being not technically feasible.

Since constructing Option 1 requires impacting joint use poles, there is expected to be substantive outages during construction. This does not apply for Option 2 or Option 3 as they do not involve joint use poles.

Notwithstanding the issues with Option 1 outlined above, we propose to include Option 1 in the DPAR NPV assessment in order to understand its potential net benefit compared to the other options.

The total cost of this option is estimated to be $106.1 million. Assuming no delays arising from consultation processes, construction could start in 2021/22 and be completed in 2024/25, with commissioning of the feeder in the same year as construction is complete.

Table 4 Scope of works for Option 1

Scope	Description	Cost Estimate ($M)
Mains	132kV 275MVA 26.5km overhead-underground hybrid construction from South Erskine Park ZS to Bringelly ZS • 10.6 km overhead line route • 15.9 km underground line route • Including a 4.0km section of the route to provide supply to the Sydney Metro Stabling Facility to be located at Orchard Hills. • Switching station enabling connection of Sydney Metro Stabling Facility. • Using existing cable ducts on The Northern Road and road reserves on line route. • Associated protection and communications fibre. • New easement cost	97
Substation Connection Enablement	South Erskine Park ZS Connection Works • Use feeder bay provided in existing design for connection of the new feeder • Circuit Breaker and Secondary systems (CTs/VTs, SCADA).	0.6
	Bringelly ZS Connection Works • Extend existing 132kV busbar. • Connect the new feeder • Relocate existing 132kV feeders 9L6 (Oran Park ZS) and 2C5 (South Leppington). • Relocate existing 11kV Feeders and Capacitor Banks • Establish new control room	8.5
Total	132 kV option from South Erskine Park ZS to Bringelly ZS, mixed overhead and underground lines following an Endeavour Energy easement	**106.1**

6.3 Option 2 – 132 kV option from Sydney West BSP (TransGrid) to Bringelly ZS, using TransGrid's 330 kV easement and existing distribution corridor

Option 2 involves the construction of a 27km 132kV feeder with 275MVA capacity that spans from South Erskine Park ZS to Bringelly ZS. The feeder uses TransGrid's 330kV easement and existing distribution corridor. This option is a blend of OH and UG.

There are a number of perceived difficulties with this option, namely:

- it may be difficult to obtain a connection point at TransGrid's Sydney West bulk supply point (BSP) for the northern termination of the proposed feeder, due to feeder bay availability.
- the line route follows TransGrid's 330kV transmission corridor, which would pose access issues for Endeavour Energy in carrying out routine inspection and maintenance; and
- there is a need to acquire additional easements for the sections coming out of the TransGrid 330kV easement and into Endeavour Energy's distribution corridor.

Notwithstanding these potential practical difficulties, we included Option 2 in the NPV assessment in order to compare its net benefit with those of the other options.

Option 2 would not suffer from the significant outages during construction that Option 1 does since there are no joint use poles impacted.

The total cost of this option is estimated to be $104.1 million.

Construction could start in 2021/22 and be completed in 2024/25, with commissioning of the feeder in the same year as construction is complete.

Table 5 Scope of works for Option 2

Scope	Description	Cost Estimate ($M)
Mains	132 kV 275 MVA 26.8 km overhead-underground hybrid construction from Sydney West BSP to Bringelly ZS • 12.7 km overhead line route • 14.1 km underground line route • Using existing cable ducts on The Northern Road and road reserves on line route. • Associated protection and communications fibre. • The following have not been included in this cost estimate: • 4.0km section of the route to provide supply to the Sydney Metro Stabling Facility to be located at Orchard Hills. • Switching station enabling connection of Sydney Metro Stabling Facility.	93.6
Substation Connection Enablement	South West Connection Works • Use feeder bay provided in existing design for connection of the new feeder • Circuit Breaker and Secondary systems (CTs/VTs, SCADA).	2.0
	Bringelly ZS Connection Works • Extend existing 132kV busbar. • Connect the new feeder • Relocate existing 132kV feeders 9L6 (Oran Park ZS) and 2C5 (South Leppington). • Relocate existing 11kV Feeders and Capacitor Banks • Establish new control room	8.5
Total	132 kV option from Sydney West BSP (TransGrid) to Bringelly ZS, using TransGrid's 330 kV easement and existing distribution corridor	**104.1**

6.4 Option 3 - 132 kV option from South Erskine Park ZS to Bringelly ZS, underground, mostly in public road reserve with limited need for easements.

Option 3 involves the construction of a 26.5km 132kV feeder with 275MVA capacity that spans the same route as Option 1 between South Erskine Park ZS and the Bringelly ZS. The feeder will be located entirely underground, mostly in public road reserve and have limited need for easements.

This option utilises the same line route as Option 1 but is placed completely underground to avoid the difficulties and risks identified with the overhead portion of Option 1 (as outlined above).

The total cost of this option is estimated to be $66 million. Construction could start in 2021/22 and to be completed in 2024/25, with commissioning of the feeder in the same year as construction is complete.

There is a notable reduction in cost for this option when compared to Option 1 and Option 2 since it is entirely underground. The above ground components of Option 1 and Option 2 add significantly to their estimated easement costs as a result of high land values in the area.

Option 3 would not suffer from the significant outages during construction that Option 1 does since there are no joint use poles impacted.

Table 6 Scope of works for Option 3

Scope	Description	Cost Estimate ($M)
Mains	132kV 275MVA 26.5km Underground construction • 26.5km line route from South Erskine Park ZS to Bringelly ZS using a total underground feeder construction. • Including a 4.0km section of the route to provide supply to the Sydney Metro Stabling Facility to be located at Orchard Hills. • Switching station enabling connection of Sydney Metro Stabling Facility. • Using existing cable ducts on The Northern Road and road reserves on line route. • Associated protection and communications fibre.	57.0
Substation Connection Enablement	South Erskine Park ZS Connection Works • Use feeder bay provided in existing design for connection of the new feeder • Circuit Breaker and Secondary systems (CTs/VTs, SCADA).	0.6
	Bringelly ZS Connection Works • Extend existing 132kV busbar. • Connect the new feeder • Relocate existing 132kV feeders 9L6 (Oran Park ZS) and 2C5 (South Leppington). • Relocate existing 11kV Feeders and Capacitor Banks • Establish new control room	8.5
Total	132 kV option from South Erskine Park ZS to Bringelly ZS, underground, mostly in public road reserve with limited need for easements.	**66.1**

6.5 Options not considered

As highlighted in the screening report it is not considered feasible that a non-network solution will form a potential credible option on a standalone basis, or form a significant part of a potential credible option for the Aerotropolis RIT-D. This is due to the extent of forecast load for the Aerotropolis area, the expected cost of network options and the capacity of the existing network to facilitate non-network technologies (refer to Section 3.4 and 4 of the Screening Report). The screening report also explains why staged and 33kV options were not progress to the DPAR.

7. Modelling & 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 state of the system with 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.

Endeavour Energy is currently seeking further engagement with the AER on matters to support new technology solutions under the RIT-D framework. Particularly, we are seeking advice to consider new classes of market benefits and guidance on the method to quantify these benefits.

The time period chosen for the NPV analysis was 20 years. In the central case this covers 15 years of asset operation.

7.1 Assumptions

7.1.1 Energy at risk and expected unserved energy

A core justification for this project is based on load at risk and energy not able to be supplied to customers waiting to connect. This is different to a situation where already connected customers risk losing supply. The same VCR value has been applied as a default position to the energy at risk values established from the proposals 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 quickly rise to extremely large amounts.

The Energy at Risk (EAR) has been estimated from the annual peak demand forecasts and load duration curves. Energy at Risk was capped at a constant value based on 2030 levels (as shown in the Appendix's Figure 9)

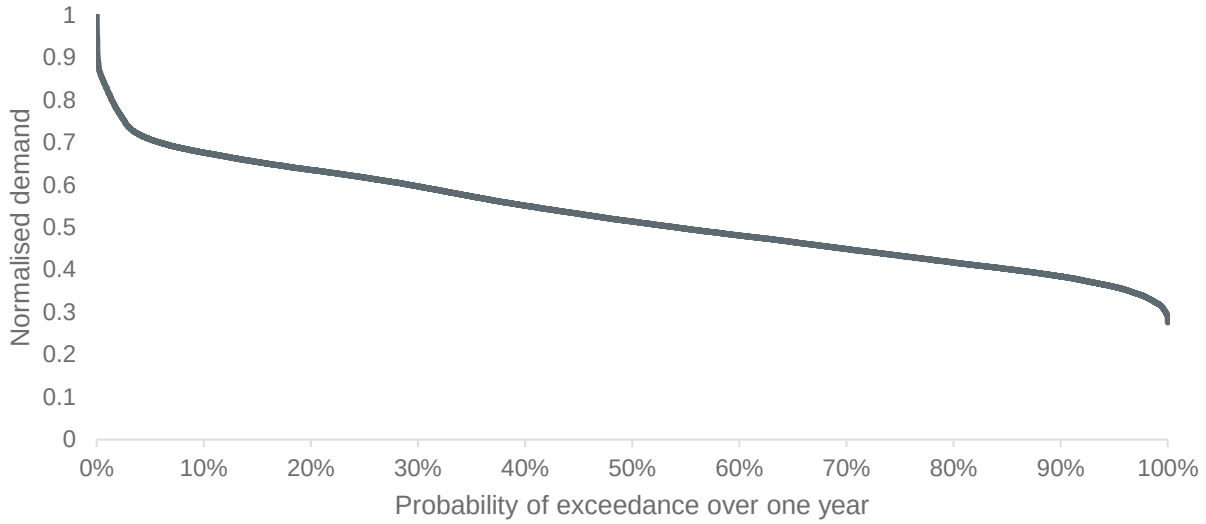
7.1.2 Load profile characteristics

Since the forecast loads are yet to connect, we have assessed the identified need using a composite demand profile, created by scaling existing load profiles that we expect will have similar demand characteristics as the forecast load (e.g. time and seasonal demand variations).

Specifically, the composite demand profile is comprised of a North West Metro load profile for the metro forecasted load, and a Wetherill Park zone substation load profile (an existing commercial/industrial site) for the remaining loads. The existing supply capacity to the area has been included in our assessment of the identified need, particularly covering the interim supply capacity to the Metro, Science Park and Western Sydney Airport (outlined line Section 10 below).

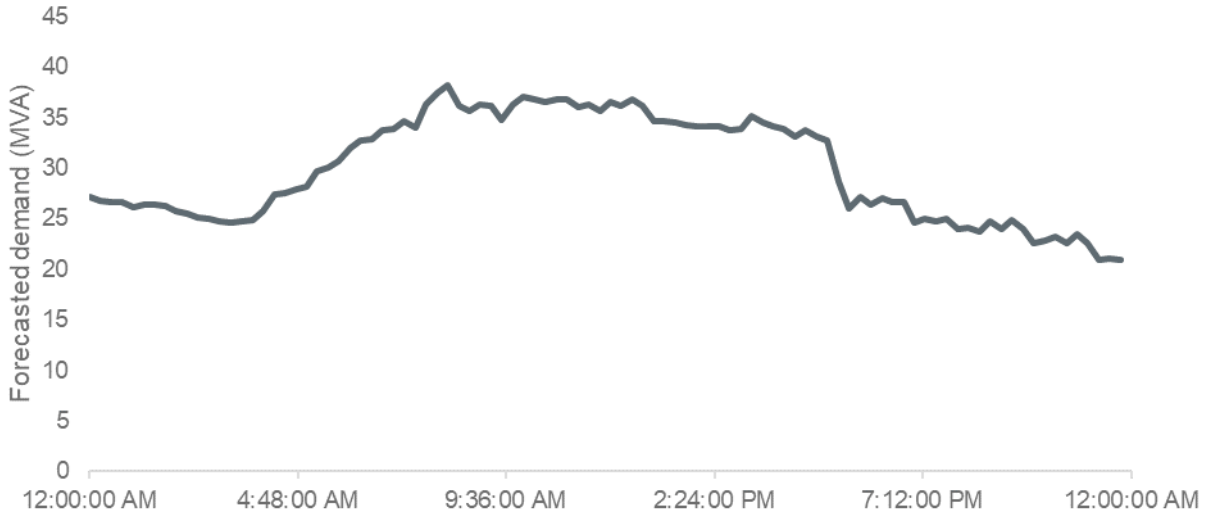
Figure 6 presents the normalised load duration curve (LDC) assumed for the Aerotropolis load based on the composite demand profile.

Figure 6 – Normalised LDC assumed for Aerotropolis



Similarly, Figure 7 presents the peak load profile for summer assumed for the Aerotropolis load based on the composite demand profile.

Figure 7 – Peak summer day profile assumed for Aerotropolis



7.1.3 Plant failure rates

To understand the comparison between overhead and underground, the analysis considered the failure rate of the 132kV feeders. The failure rate assumptions shown in Table 7 are based on Endeavour Energy's operational experience.

As the feeders will be operating as ring mains the duration of the outages is expected to be relatively short and equivalent between the two options.

Table 7 - 132kV Feeder Failure Rates

	Overhead	Underground
132kV Feeder Failure Rate (faults/km/annum)	0.002	0.001
Duration of outage	1 Hour	1 Hour

7.1.4 Plant Ratings

Endeavour Energy's standard ratings have been employed for the purposes of this evaluation.

7.1.5 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 $45.90 per kWh in the evaluation which is based on the 2019 VCR values provided by the AER, weighted in accordance with the composition of the commercial, industrial and residential load within the constituent connections.

This reflects a high level of commercial and industrial loads that will be served in the development area. A breakdown of these assumptions is provided in the table below:

Table 8 Forecasted load types for the major connection points

Connection Points	Commercial	Industrial	Residential
Sydney Science Park	80%		20%
Northern Gateway & USyd Employment Lands	80%	20%	
Adams Rd Precinct	40%	60%	
Western Sydney Airport	100%		
Sydney Metro	100%		

Using this composition, a VCR was then calculated based on each load component parts and weighted based on the forecast contribution of each load point. This is shown in Table 9.

Table 9 - VCR Weightings and Derivation

Connection Points	Forecast MVA	VCR
Sydney Science Park	75	40,142
Northern Gateway & USyd Employment Lands	90	48,710
Adams Rd Precinct	25	56,470
Western Sydney Airport	34	44,830
Metro	46	44,830
Weighted Average		**45,899**

7.2 Classes of market benefit considered

The classes of market benefits that are considered material and have been quantified in this RIT-D assessment are:

- Changes in involuntary load shedding and customer interruptions caused by network outages; and
- Differences in the timing of expenditure

7.2.1 Changes in involuntary load shedding

Increasing the supply capability in the Aerotropolis Development Area increases the supply available to meet the growth in demand within these areas. This will provide greater reliability for this region 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 residential development area where potential customers would otherwise have to go without supply is therefore captured using changes in involuntary load shedding.

Although relatively small, the impacts of line outages during construction and in operation were also calculated and included to better demonstrate the impacts of OH and UG options.

7.2.2 Differences in timing of expenditure

The difference in the timing of expenditure for the options considered is shown in Table 10 below. Option 1 has a larger upfront component over the build period, relative to total costs. Note there are no major differences in project staging between the options.

Table 10 - Comparison of Option Capital Cost Schedules.

Option	Description	2022	2023	2024	2025
1	132kV South Erskine Park ZS to Bringelly ZS (Mixed OH & UG)	31.5	40.5	23.5	10.6
2	132kV Sydney West BSP to Bringelly ZS (Mixed OH & UG)	15.0	43.0	44.0	2.1
3	132kV South Erskine Park ZS to Bringelly ZS (UG only)	15.0	24.0	25.0	2.1

7.3 Classes of market benefit not considered to be material

The classes of market benefits that are not considered material are listed below:

- Differences in Timing of Expenditure
- Changes in Voluntary Load Curtailment
- Option Value
- Changes in load transfer capacity.
- Changes in costs to other parties
- Changes in electrical losses.

7.3.1 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 could lead to a reduction in involuntary load shedding, that is, increase in voluntary load reduction.

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 (predominantly residential) to deliver sufficient voluntary demand reduction.

7.3.2 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 committed connections there is little uncertainty about the need and use of the assets and each option is considered equivalent in that respect. Option Value has therefore not been considered in the economic analysis.

7.3.3 Changes in load transfer capability

Each of the Options 1, 2 and 3 allows for alternate supply from both ends of the feeder to ensure secure and reliable supply. This alternate supply from both ends of the feeders common to all 3 options identified provides operational flexibility for Endeavour Energy. They each also support the future growth of the Aerotropolis area with high reliability and will make connection of additional Endeavour Energy and customer funded substations both economic and timely. The operational flexibility provided by alternate supply from either end of the proposed feeders also enhances the ability of the network to accept embedded generation within the Aerotropolis area, particularly large-scale PV solar farms and other renewable energy projects that may develop in the area based on stated intentions of connecting customers to pursue net zero and potentially carbon negative solutions.

As these benefits were considered broadly equivalent between each of the options, this was not considered to be material aspect of comparison.

7.3.4 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.

7.3.5 Changes in electrical losses

Endeavour Energy recognises that there would be small changes in the loss profile for customers serviced out via the options considered but given they are all 132kV feeders that these are negligibly small in each case. Changes in electrical losses have not been modelled.

7.4 Scenarios and sensitivities

The capital and operating cost assumptions for each credible option are summarised in Table 9.

Table 11 Base Case Capital and Operating Cost Assumptions

Variables	Values
Maximum demand forecasts	Base (expected) growth scenario presented in Section 4
Capital costs	Estimates provided in Section 0
O&M costs	0.4% of capital spend unless otherwise stated. The analysis also included a specific difference between options in cost of repairs due to reliability between UG and OH options (7.2.1)
Value of customer reliability	Base estimates provided in Section 7.1.5

7.4.1 Demand forecasts

The maximum demand forecasts have been derived from a projection of the connection and growth of new loads as **Figure 3**. Notionally, this is on an approximate 50% probability of exceedance basis. For sensitivity analysis, the base forecast has been varied by ± 20% and included variable customer growth rate assumptions, as shown in the earlier figure.

7.4.2 Capital costs

Capital cost estimates have been based on standard planning cost estimates of the detailed scope of work including a high-level scope of work. For sensitivity analysis, these estimates have been varied by ± 25%.

7.4.3 Value of customer reliability

This analysis adopts the value of customer reliability values published by 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 volume weighted VCR value of $45.899 per kWh has been derived and used in the RIT-D analysis. A variation of ±30% has been used for sensitivity testing in accordance with AER guidelines.

7.4.4 Discount Rate

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

Table 12 below describes the variations in input parameters used for the purpose of defining various scenarios.

Table 12 - Variables for Sensitivity Testing

Parameter/ scenario	Central scenario	High benefits	Low benefits
Capex	Central estimates	-25%	+25%
Demand	Central demand forecast (see section 0)	High demand forecast (see section 0)	Low demand forecast (see section 0)
VCR	Load-weighted AER VCR	+30%	-30%
Discount rate	3.26%	2.22%	4.30%

8. Results of analysis

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

8.1 Central case results

The economic analysis of the options under the Central case scenario is shown in Table 13. This shows Option 3 is considered the preferred option. The present value of comparable benefits are split in the table to show USE in the Base case (do nothing), separate from the attributable differences in reliability,

outages during construction and outage restoration costs (PV of other factors). Of notable difference is that Option 1 will involve outages during construction, which Option 2 & 3 will not. Additionally, the results reflect underground transmissions marginal benefit when compared to overhead options.

Table 13 - Central Case Results

Option	Description	Project capex nominal ($M)	PV of USE ($m)	PV of other factors (Reliability etc) ($m)	PV of Costs ($M)	NPV ($M)	Rank
1	132kV South Erskine Park ZS to Bringelly ZS (Mixed OH & UG)	106.1	141,644	-11.1	-58.9	141,579	3
2	132kV Sydney West BSP to Bringelly ZS (Mixed OH & UG)	104.1	141,644	-5.8	-57.5	141,585	2
3	132kV South Erskine Park ZS to Bringelly ZS (UG only)	66.1	141,644	-3.7	-42.8	141,600	1

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 changes in relation to:

- Forecast demand, and hence quantity of involuntary load shedding
- Value of Customer reliability
- Investment costs
- Discount Rate

Detailed in

Figure 8 are the scenarios used in sensitivity testing and their relative weightings.

Figure 8 – Summary of Scenarios used in sensitivity testing

User Interface

Scenarios	
Scenario selection	
Scenario	Scenario 1

Scenario weighting	Scenario 1	Scenario 2	Scenario 3
Weighting	0.33	0.33	0.33

General inputs							
General	Unit	Value	Selection	Scenario 1	Scenario 2	Scenario 3	User defined
Commercial discount rate	Percent	3.26%	Base	Base	High	Low	Base

Cost inputs							
Cost	Unit	Value	Selection	Scenario 1	Scenario 2	Scenario 3	User defined
Capital cost	Percent	100%	Base	Base	High	Low	Base
Planned routine maintenance and refurbishment	Percent	100%	Base	Base	Low	High	Base
Unplanned corrective maintenance	Percent	100%	Base	Base	Low	High	Base
Decommissioning costs	Percent	100%	Base	Base	Base	Base	Base
Safety risk costs	Percent	100%	Base	Base	High	Low	Base
Bushfire risk costs	Percent	100%	Base	Base	Base	Base	Base
Non-network option provider costs	Percent	100%	Base	Base	Base	Base	Base

Benefit inputs							
Benefit	Unit	Value	Selection	Scenario 1	Scenario 2	Scenario 3	User defined
Involuntary load shedding - VCR	$/MWh	45,899	Base	Base	Low	High	Base
Involuntary load shedding - MWh	Scenario	NA	Base	Base	Low	High	Base
Difference in timing of unrelated expenditure	Scenario	NA	Base	Base	Low	High	Base
Difference in timing of unrelated expenditure	Percent	100%	Base	Base	Low	High	Base
Voluntary load curtailment - VCR	$/MWh	45,899	Base	Base	Low	High	Base
Voluntary load curtailment - MWh	Scenario	NA	Base	Base	Low	High	Base
Outages During Construction Period	Percent	100%	Base	Base	Base	Base	Base
Not Used	$/MWh	100	Base	Base	Base	Base	Base
Unplanned Corrective Maintenance (Cost of Repairs)	Percent	100%	Base	Base	Base	Base	Base
Unplanned Outage Reliability Cost of Unserved Energy	Percent	100%	Base	Base	Base	Base	Base

Detailed in Table 14 are the results of the sensitivity analysis.

Table 14 Sensitivity and Scenario Assessment

Option	Description	Scenario 1 Rank	Scenario 2 Rank	Scenario 3 Rank	Weighted Scenario Rank
1	132kV South Erskine Park ZS to Bringelly ZS (Mixed OH & UG)	3	3	3	3
2	132kV Sydney West BSP to Bringelly ZS	2	2	2	2
3	132kV South Erskine Park ZS to Bringelly ZS (UG only)	1	1	1	1

The results show that Option 3 maximises the net market benefit in the base case as well as the weighted scenarios considered for sensitivity analysis.

8.3 Economic timing

The economic timing of the proposed preferred option may be taken to be the point where network capacity is insufficient to connect new customers.

The Aerotropolis Foundation Supply requires connection capacity to be made available as soon as the existing available capacity in the network is exhausted. Based on current demand forecast, this is expected to occur in FY25. Consequently, this date is seen as the economic timing for this project.

9. Conclusion

The development of a third city in Western Sydney, including the new Western Sydney Airport as well as the development of the Sydney Metro-Western Sydney Airport line and other key developments, is forecast to add significantly to electricity demand in Endeavour Energy's distribution network in the short- to -medium-term. Currently, there are at least five major loads that are exploring connection to our network and whose load directly affects the identified need for this RIT-D, of which Western Sydney Airport, Sydney Metro and Sydney Science Park have already Submitted formal connection applications. Under our central forecasts, these new loads connecting are expected to add more than 50 MVA in aggregate by 2025/26 and rise to over 240 MVA by 2039/40.

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

This DPAR has identified 3 credible network-based options that can technically meet the required network demand. Each consisted of 132kV supply options with 275MVA capacity with different routing options with advantages and disadvantages explain for each. Each was considered in an economic evaluation, and Option 3 was selected as the best case. Option 3 involves a foundation supply between South Erskine Park ZS to Bringelly ZS, which is underground following an Endeavour Energy easement. The overwhelming market benefit was attributable to reducing the forecast unserved energy. Comparably there was only a relatively small variation in market benefit when comparing between the different options and these were due to the outages during construction and small differences in reliability. The major factor in choosing between the alternatives was therefore capital cost, and Option 3 was significantly cheaper than Option 1 & 2 once accounting for above ground easement land costs. It is further noted that pursuing an underground approach also fits with community expectations for the development of area, reduces risk of delays and the need to relocate lines in future and will reduce the footprint of land required.

Sensitivity Analysis was conducted and found there to be no change to the Central scenario results, which provides a high degree of certainty that this option can best meet the future requirements of customers in the area and provides the best value for customers in the EE franchise.

10. Appendix – Further Details on Network need

10.1 Existing Network Overview

The existing distribution network in the Aerotropolis area is insufficient to meet the supply needs of the Aerotropolis area from 2024/25, even under the low demand scenario outlined above (which we consider to be an extreme lower bound).

The existing network is a low capacity 33kV network that was originally designed to meet the existing and historical rural and residential load base. The current network is also predominantly overhead construction and will likely require future replacement or relocation due to the road widening development throughout the area to cater for the increased transport requirements of the Aerotropolis.

The new load connections require high capacity 132kV connection to customer locations and so it is not possible to use the existing 33kV zone substations to supply these connections via the existing distribution systems.

To cater for the early construction period of the major customers in Aerotropolis, the following supply arrangements are currently in-place as interim supplies until a permanent solution is able to be commissioned:

- Metro rail line construction phase supply (including for their tunnel boring requirements) with interim supply from Claremont Meadows, Kemps Creek and Bringelly zone substations;
- Sydney Science Park initial supply from Luddenham zone substation (ZS), including an 11kV feeder re-arrangement to ensure secure interim supply; and
- Western Sydney International airport initial supply from the 33kV network via connection to Feeder 465 at Elizabeth Drive.
- The existing supply capacity to the area has been included in our assessment of the identified need, including these interim supply capacities.

10.2 Load forecast

In the body of the report **Figure 3** shows the forecast peak summer load forecasts under a central, low and high demand scenario for the Aerotropolis area.

Each scenario reflects different assumptions regarding the timing and quantity assumed for future load connections. In particular, we have considered different growth rates and different eventual load requirements for the five key loads outlined earlier:[12]

- Sydney Science Park;
- Northern Gateway and University of Sydney Employment Lands;
- Western Sydney Airport;

[12] In addition, there are a range of other significant related loads expected to connect to other feeders in the same area in the next few years – namely: (1) Mirvac Enterprise Precinct and Sydney Water Factory in 2022/23; (2) new agribusiness load stemming from a new large government-designated agricultural precinct in 2024/25; and (3) Aerotropolis core (Airport CBD and Western Parklands City Centre) in 2024/25. These three loads are presented here for additional context only and have not been included in any of the demand forecasts in this report, since they are expected to connect to different feeders than the one to be covered by the RIT-D for the Aerotropolis foundation supply.

- Adams Rd precinct; and
- Sydney Metro – Western Sydney Airport line.

The aggregate new loads across the three scenarios can be summarised as follows:

- the central scenario assumes that these five key customer connections eventually total 243 MVA in 2039/40;
- the low scenario assumes the same five key customer connections as under the central scenario, albeit at lower growth rates and with only 80 per cent of the total load assumed in the central scenario eventually connecting (i.e. under the low scenario, demand reaches 194 MVA in 2039/40); and
- the high scenario assumes the same five key customer connections as under the central scenario, but with higher growth rates and with 120 per cent of the total load assumed in the central scenario eventually connecting (i.e. under the high scenario, demand reaches 292 MVA in 2039/40).
- The range of demand reflected across the three scenarios is considered to represent the extreme of the lower and upper bounds of future demand in the Aerotropolis area. The variation between scenarios can also be considered to capture some of these loads going ahead as currently anticipated, where others have a slower or faster trajectory, as well as contributions to overall load growth from other smaller loads that is anticipated in the area. Noting that we have received formal connection applications for Western Sydney Airport, Sydney Metro and Science Park, and the potential portfolios effects, we consider the central scenario is the most likely.

While all customer connections are assumed to occur between 2022/23 and 2024/25, load drawn for each customer continues to increase for a number of years after before becoming constant. Specifically, the five key loads remain constant from the following years:

- Sydney Science Park from 2040/41;
- Northern Gateway (multiple developers) from 2040/41;
- Adams Rd precinct from 2030/31;
- Western Sydney Airport from 2026/27 before a step-up in 2031/32 (and constant from then); and
- Sydney Metro – Western Sydney Airport line from 2033/34.
- Due to the confidentiality of these forecast loads, we are not able to present a further breakdown of the composition of demand under each scenario.

The combined demand forecasts shown above are based on currently available information derived from the plans of NSW government planning groups, infrastructure providers and private developers. There is a degree of uncertainty with regards to the demand requirements, as they are dependent upon individual commercial decisions of the development proponents, which has been reflected in the different load scenarios shown above.

As outlined there is no capacity to connect these loads to the existing distribution network after 2024/25. All existing loads in the area will remain supplied by the existing zone substations.

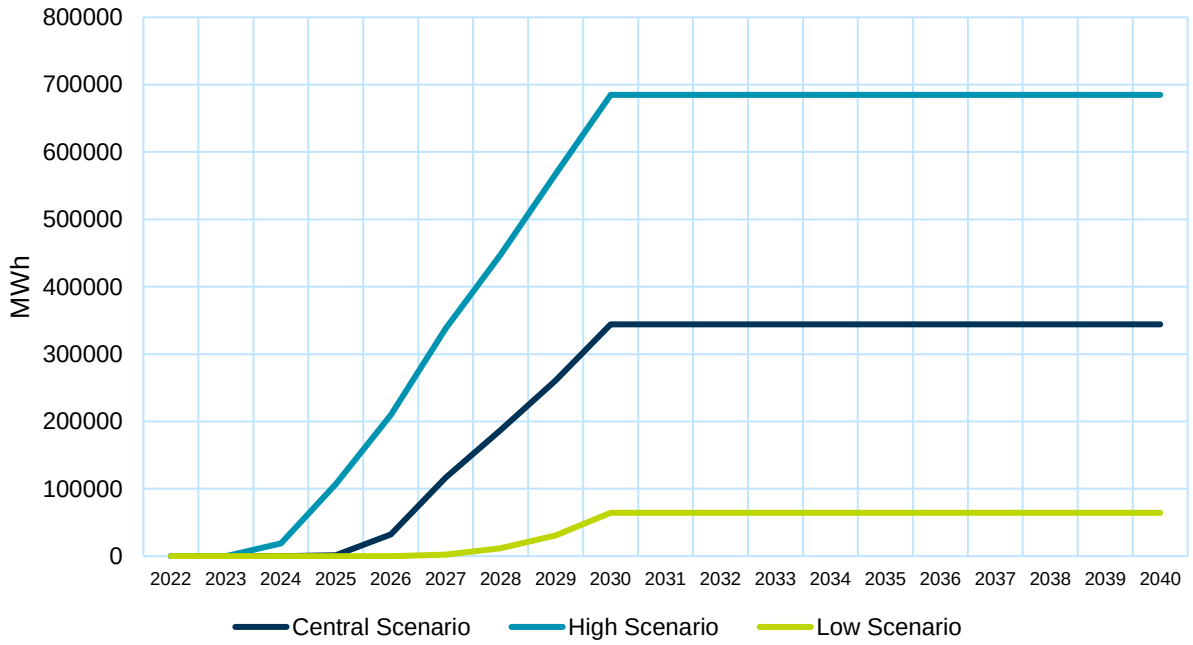
The table below presents a breakdown of load types for the spot load connections under the central demand forecast based on connections analysis undertaken by our capacity planning team, using information provided in the network connection enquiry/application and what we know about the load being considered for connection. Due to confidentiality, we have aggregated loads to broad types of customers.

Table 15 Breakdown of load types for spot load connections[13]

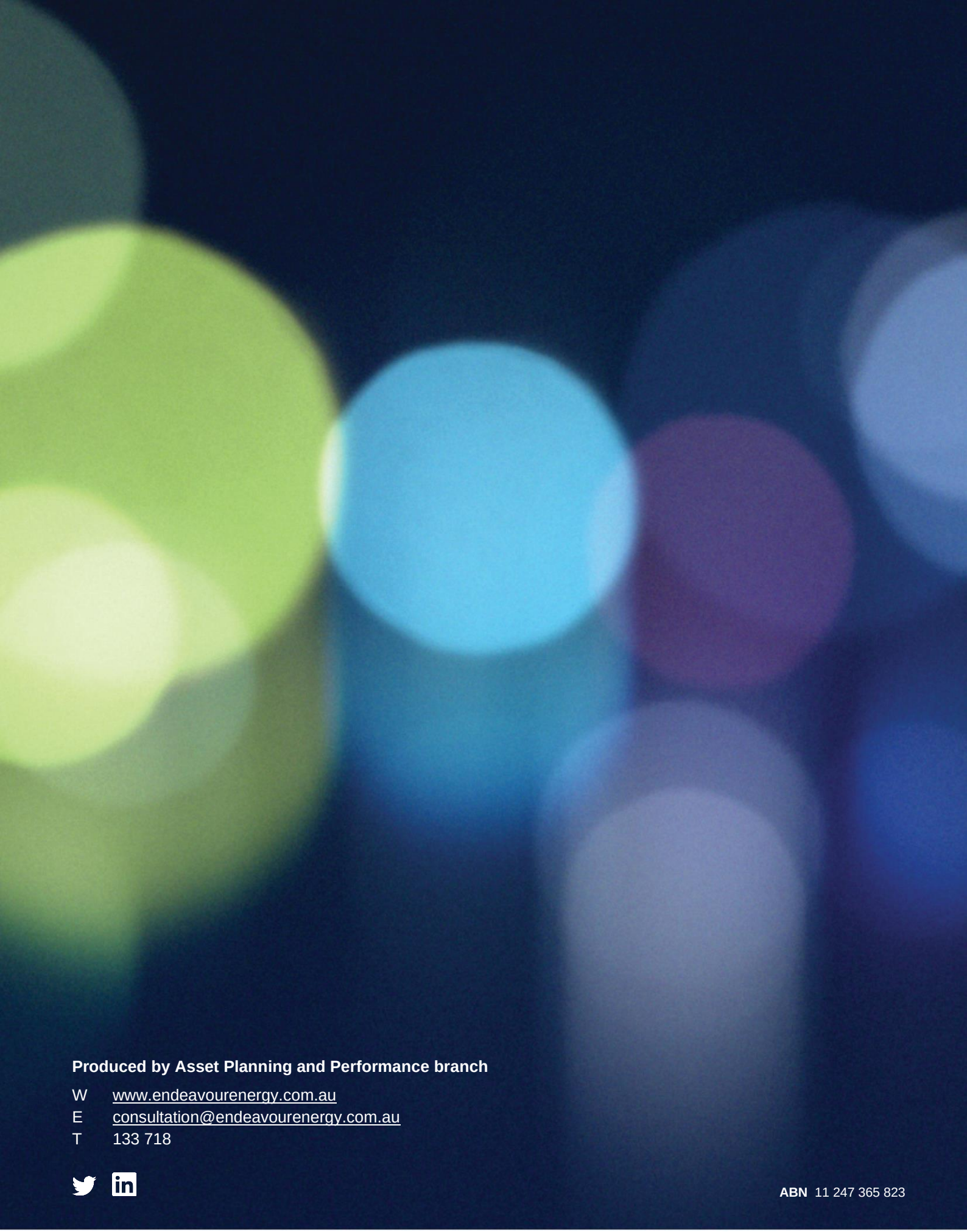
Load	Commercial	Industrial	Residential	Total
MVA	222	33	15	270

For the economic analysis, unserved energy was capped on a MWh basis as show in Figure 9 below.

Figure 9 - Unserved energy assumptions, capped at 2030 levels



[13] Table 15 sets out a breakdown of load types for undiversified spot load, which is the maximum system load. The applicable diversity factor for the spot loads is 90 per cent, which translates to a diversified spot load of 243 MVA.



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