Providing Supply to the Badgerys Creek Development Area

Options screening notice
20 December 2022

Endeavour Energy

CONTACT

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1. Introduction

The Western Sydney 'Aerotropolis' 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 Badgerys Creek development area, which is planned to be a hub for commercial and industrial developments. In particular, key infrastructure that the Badgerys Creek development area will need to support is electricity supply for the Elizabeth Enterprise Precinct business park, the Sydney Water Advanced Water Recycling Centre and the Badgerys Creek enterprise area south of Elizabeth Drive. In total, connections in this area are expected to require approximately 60MVA of electricity supply capacity by 2050.

We have already applied the Regulatory Investment Test for Distribution (RIT-D) to determine the most efficient means of providing the foundation supply to the Aerotropolis area – a 132kV backbone feeder.[1] We are now commencing this RIT-D to determine the most efficient means of providing supply to the Badgerys Creek development area. Although we expect there to be significant market benefits associated with providing supply to the Badgerys Creek development area, we consider the need for this investment a 'reliability corrective action' due to our regulatory obligations to connect new load. These regulatory obligations are set out in the box below.

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

We have initiated a Regulatory Investment Test for Distribution (RIT-D) to investigate, and consult on, how to most efficiently provide supply to major new customer connections in the Badgerys Creek development 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 customer demand requiring connection will exceed the existing network capacity. This is currently anticipated to be 2025/26, based on the firm connection enquiries received to date.

This options screening notice sets out the reasons why we consider that there will not be a non-network option, or SAPS option, that could form a potential credible option on a standalone basis, or that could form a significant part of a potential credible option for the Badgerys Creek development area RIT-D, i.e., in accordance with NER clause 5.17.4(c).It represents the first formal stage of the RIT-D assessing how to most efficiently provide supply to major new customers in Badgerys Creek development area.

The second formal stage of this RIT-D is a draft project assessment report (DPAR), which includes a full net present value (NPV) options assessment.

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

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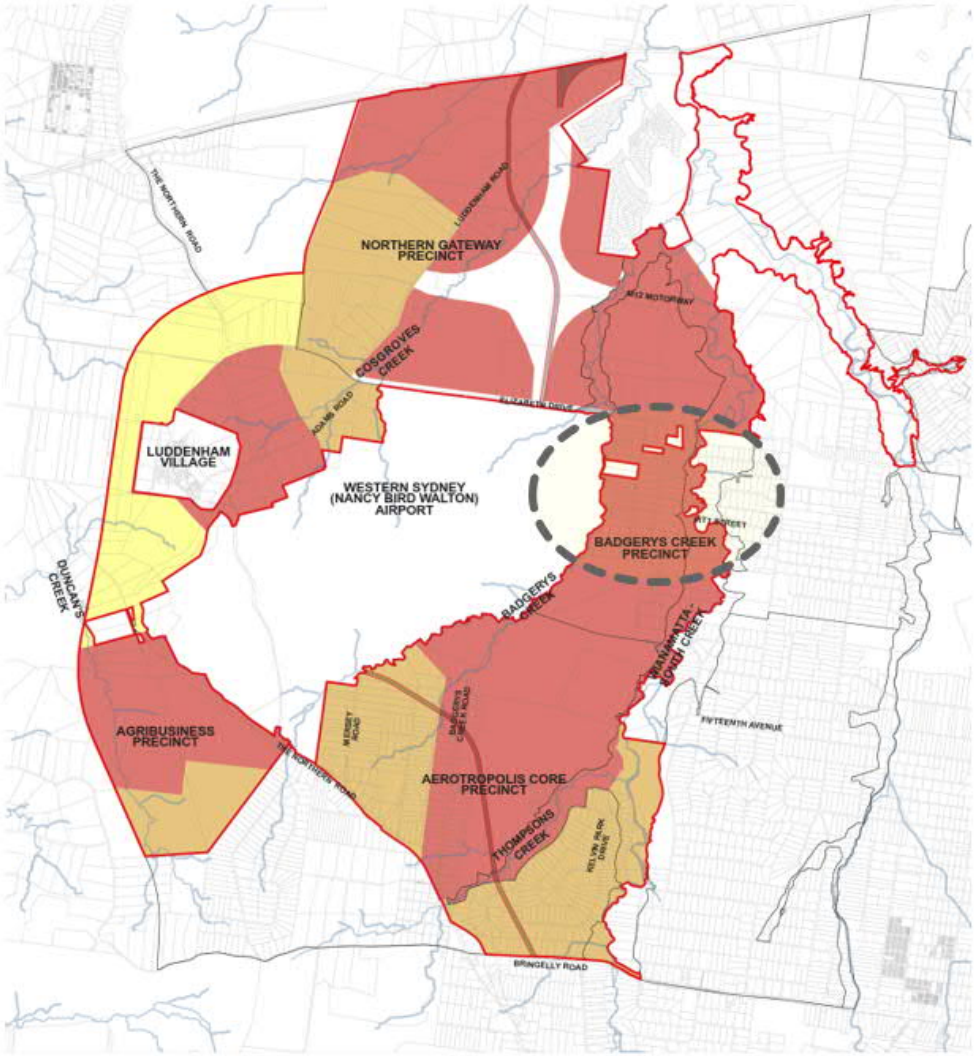
2. Key assumptions underpinning the 'identified need' for this RIT-D

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

2.1 Relevant area of our network

The Badgerys Creek development area sits within the Western Sydney Aerotropolis and is planned to be a hub for commercial and industrial developments. It neighbours the Western Sydney Airport to the west, and the Aerotropolis Core Precinct to the south – figure 1.

Figure 1 – Overview of the location of the Badgerys Creek development area in our supply area



2.2 Load characteristics and demand forecast

The Badgerys Creek development area will principally comprise commercial and industrial customer demand. Key developments in the area include:

- The Elizabeth Enterprise Precinct (EEP), which is expected to grow to a maximum demand of 13 MVA by 2029 and 39 MVA by 2051;
- Sydney Water's Upper South Creek Advanced Water Recycling Centre (AWRC), which is expected to grow to a maximum demand of 5 MVA by 2029 and 17 MVA by 2051; and
- the Badgerys Creek Enterprise Area (south of Elizabeth Drive), which is expected to grow to a maximum demand of 2 MVA maximum load from 2029 and 27 MVA by 2051.

The location of these key developments in the area is illustrated in figure 2. In total, developments in this area are expected to require approximately 20 MVA of capacity by 2031 and 60 MVA by 2050.

Figure 2 – Location of key load developments in the Badgerys Creek development area

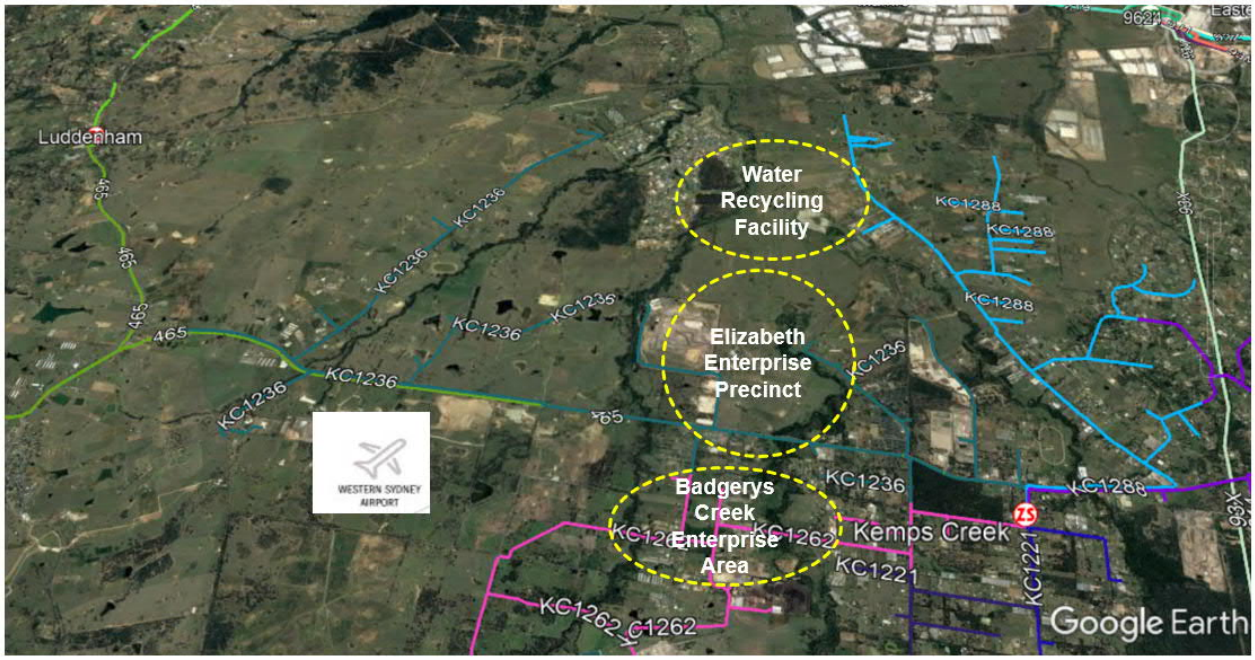
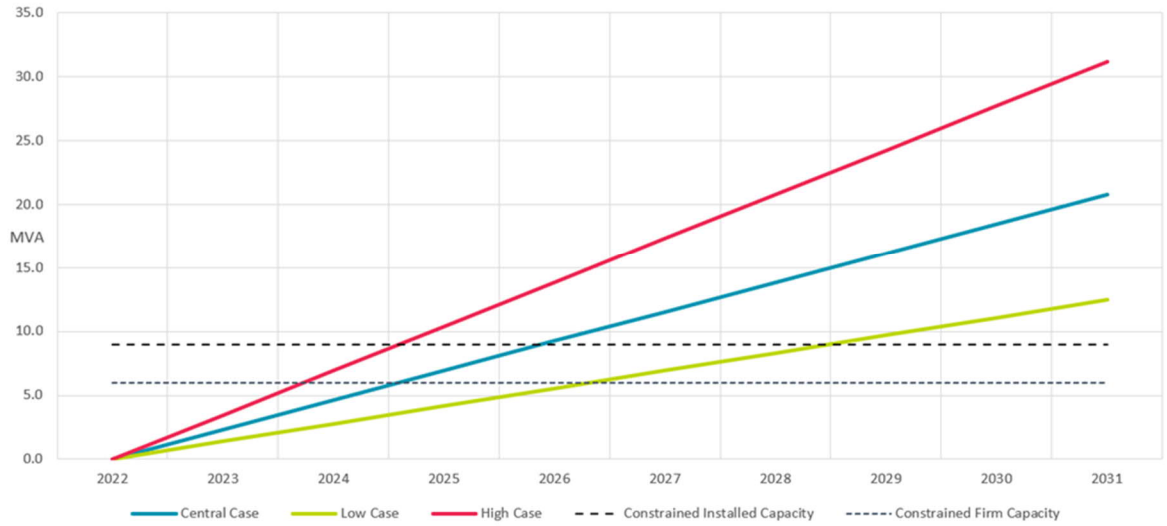


Figure 3 below shows our forecast maximum demand under a central, low and high demand scenario for the Badgerys Creek development area. It also shows the available supply capacity of the existing network infrastructure in the area (the existing network is described in greater detail in section 2.4).

Figure 3 – Badgerys Creek development area maximum demand forecasts from 2022 to 2031



The demand forecasts have been developed to take into account the possible differences in timing of the major developments. In particular, the central scenario demand forecast represents the most likely level of demand expected in the Badgerys Creek development area based on the information provided by the proponents of the developments and their expected timeframes for development. This forecast is moderated and diversified to take into account our knowledge of similar developments in areas such as Erskine Park and Moorebank where there are similar developments of enterprise zoned areas in recent years. The high and low scenario demand forecasts represent respectively accelerated and delayed rates of development for the area.

2.3 Expected pattern of use

Due to the fact that major customers have not yet connected to the network in this greenfield area, we have assessed the identified need using a representative demand profile, which assumes a representative load profile from an existing substation that we expect (at least initially), will have similar demand characteristics as the forecast load (i.e., capturing time and seasonal demand variations).

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

Figure 4 below presents the normalised load duration curve (LDC) assumed based on the representative demand profile, while figure 5 presents the peak load profile for a summer day assumed for the customer connections expected within the Badgerys Creek development area based on the representative demand profile.

Figure 4 – Normalised LDC assumed for customer connections associated with the Badgerys Creek development area

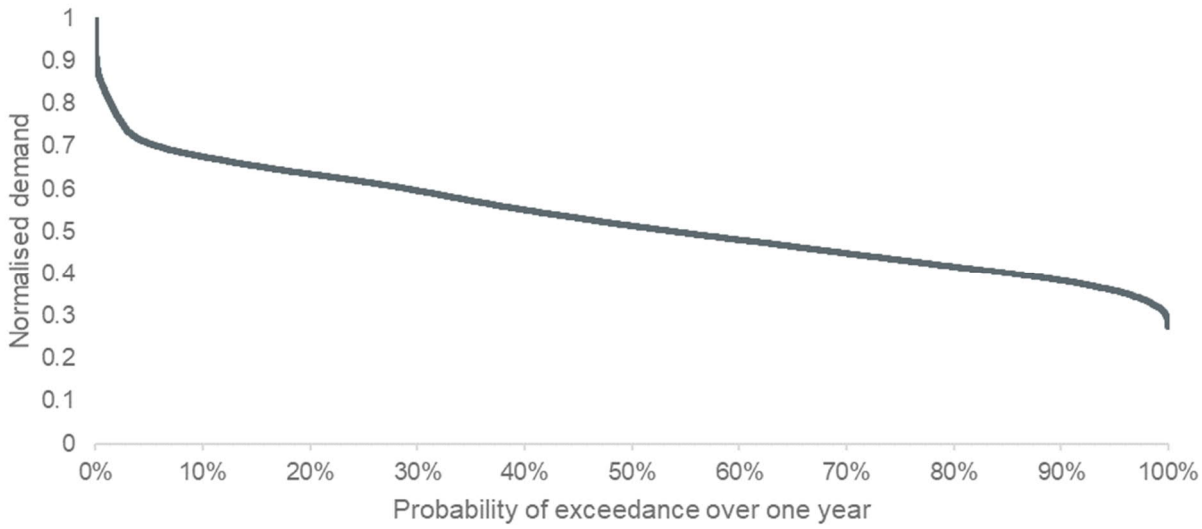
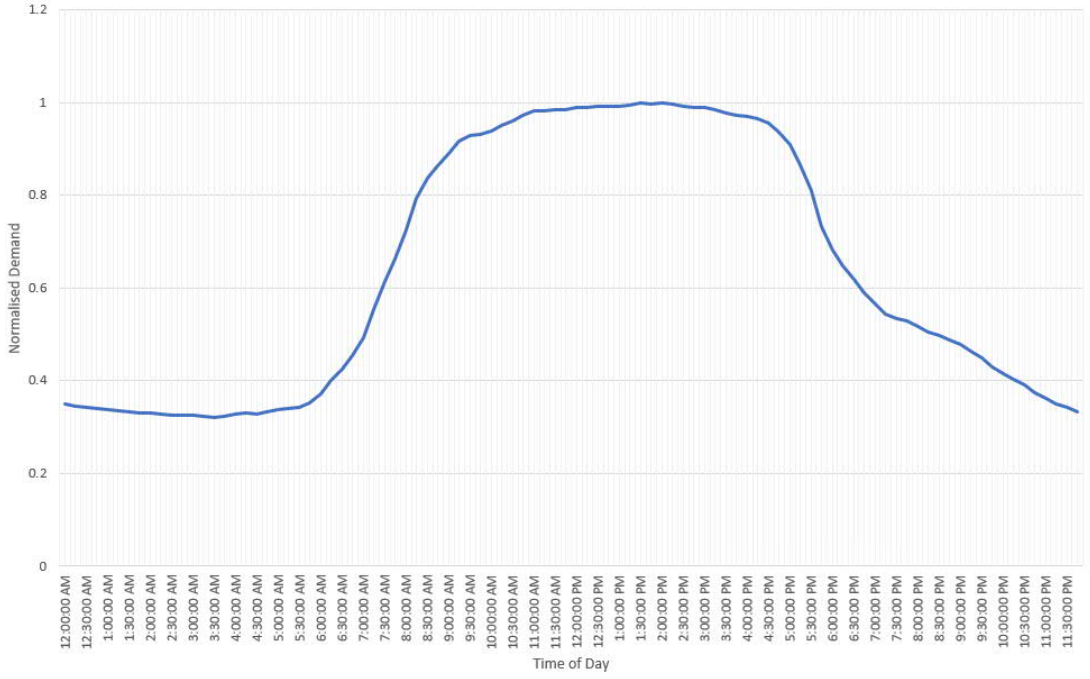


Figure 5 – Peak summer day profile for customer connections associated with the Badgerys Creek development area

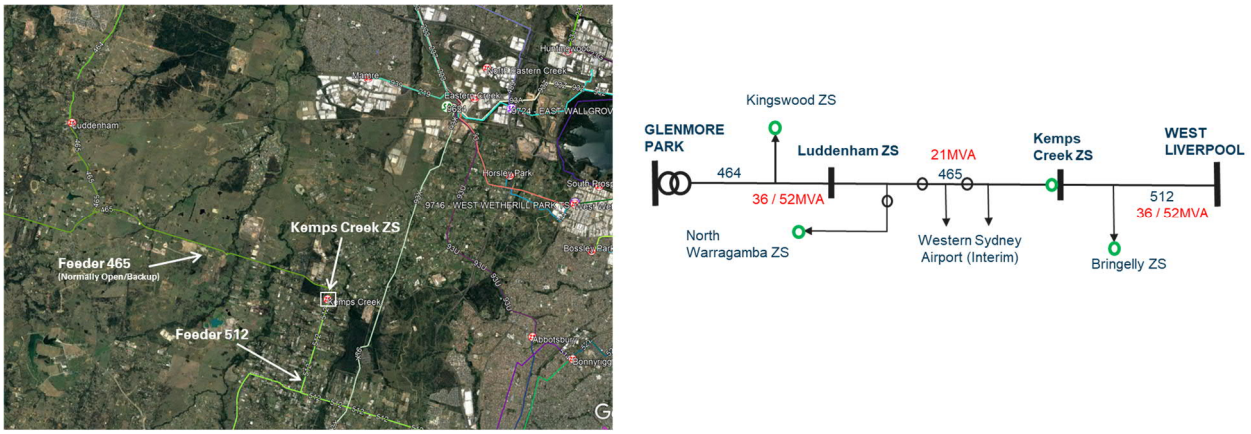


2.4 Existing network

The location of the Badgerys Creek development area is currently served by the Kemps Creek zone substation. The existing network is predominantly an overhead network and was constructed to meet the historical requirements of the area, which was sparsely populated with rural residential demand including agriculture.

Kemps Creek zone substation has two 25MVA transformers and supplies the surrounding area by 11kV feeders. Kemps Creek zone substation is in turn supplied at 33kV from two 33kV feeders. Figure 6 below shows the existing 33kV supply network in the area of Badgerys Creek and Kemps Creek.

Figure 6 – Existing 33kV supply network to the Kemps Creek area



Importantly, the existing network in the area is not capable of servicing the growth in electricity demand. In particular, it is subject to a number of network constraints that inhibit the ability to supply the forecast demand based on the load growth from the major developments in the area. These network constraints are summarised in table 1 below.

Table 1 – Network constraints in the Badgerys Creek development area

Network Constraint	Description
Distribution network capacity from Kemps Creek ZS to the Badgerys Creek development area.	The Badgerys Creek development area is currently supplied from Kemps Creek ZS and the interim supplies for the Elizabeth Enterprise Precinct and the water recycling facility will be supplied by 11kV feeders from Kemps Creek ZS. The interim supplies will be insufficient by mid 2025 due to the lack of available 11kV feeder connections at Kemps Creek ZS and limitations on feeder egress from Kemps Creek ZS to the customer connection locations.
Kemps Creek ZS transformer firm capacity.	The Kemps Creek ZS firm transformer capacity will be exceeded by 2025. This is due to the load growth in the Kemps Creek area, Elizabeth Enterprise Precinct, the Sydney Water Facility, the Badgerys Creek area (south of Elizabeth Drive), the Austral areas, the provision of construction supplies for the WSA and Sydney Metro. Kemps Creek ZS has 2 x 25MVA transformers.
33kV Feeder 512 firm capacity.	The 33kV supply to Kemps Creek ZS will decrease its firm capacity as the demand on Feeder 464 from Glenmore Park ZS will increase due to load

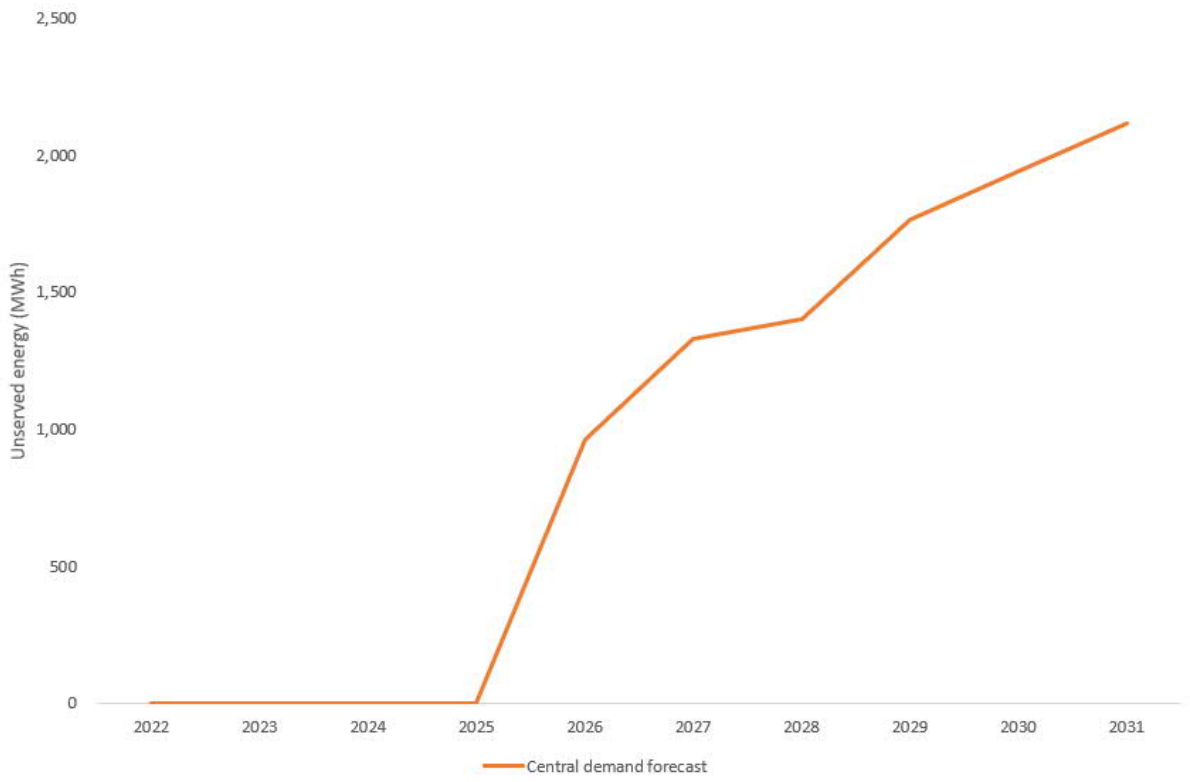
Network Constraint	Description
	growth on Luddenham ZS and the interim supply to Western Sydney Airport. The establishment of the Western Sydney Airport TS in 2024 will provide a strong 33kV source of supply to the Feeder 465 and will alleviate this constraint in the period after 2024.

Figure 3 above illustrates that this existing distribution network is insufficient to meet the supply needs of the Badgerys Creek development area from 2025/26, based on the central demand forecast case.

2.5 Expected unserved energy if action is not taken

If network augmentation is not undertaken, there will be significant unserved energy in our network over the next decade with available capacity being exceeded from 2025/26. Figure 7 presents the expected unserved energy if no action is taken.

Figure 7 – Expected unserved energy for the Badgerys Creek development area based on the central scenario



We propose to cap the expected future unserved energy, in MWh, as part of the DPAR NPV assessment, because the uncapped value of the expected unserved energy will otherwise become unrealistically high (since, in reality, we would undertake investment to avoid widespread customer outages and/or unserved customer connection requests). Using the very large uncapped expected unserved energy values has the potential to distort the comparison of net market benefits between credible options. The approach of

capping expected unserved energy in the base case is in-line with other RIT-Ds (and RIT-Ts) and does not affect the ranking of the overall options.[2,3]

2.6 Proposed scenarios for the forthcoming RIT-D NPV assessment

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

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

A summary of the key variables/framework expected to be used for each scenario is provided in table 2 below.

Table 2 – Proposed scenarios for the forthcoming RIT-D NPV assessment

Parameter/ scenario	Central scenario	High benefits	Low benefits
Capex	Central estimates	-25%	+25%
Demand	Central demand forecast (see section 2.2)	High demand forecast (see section 2.2)	Low demand forecast (see section 2.2)
VCR	Load-weighted AER VCR	+30%	-30%
Discount rate	3.26%	2.22%	4.30%
Maintenance costs	Central estimates	-25%	+25%

The above scenarios have been developed to comprehensively test the range of net benefits that can be expected from the credible options. We consider that this approach allows for a more robust test of the preferred option compared with adopting individual sensitivity tests because multiple inputs are changed together to produce a cumulative scenario.

3. Proposed network options to meet the identified need

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

Each of the credible options involve establishing the Badgerys Creek zone substation (connecting to the 132kV Aerotropolis Foundation Supply backbone feeder) with two 45 MVA transformers and two feeders.

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

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

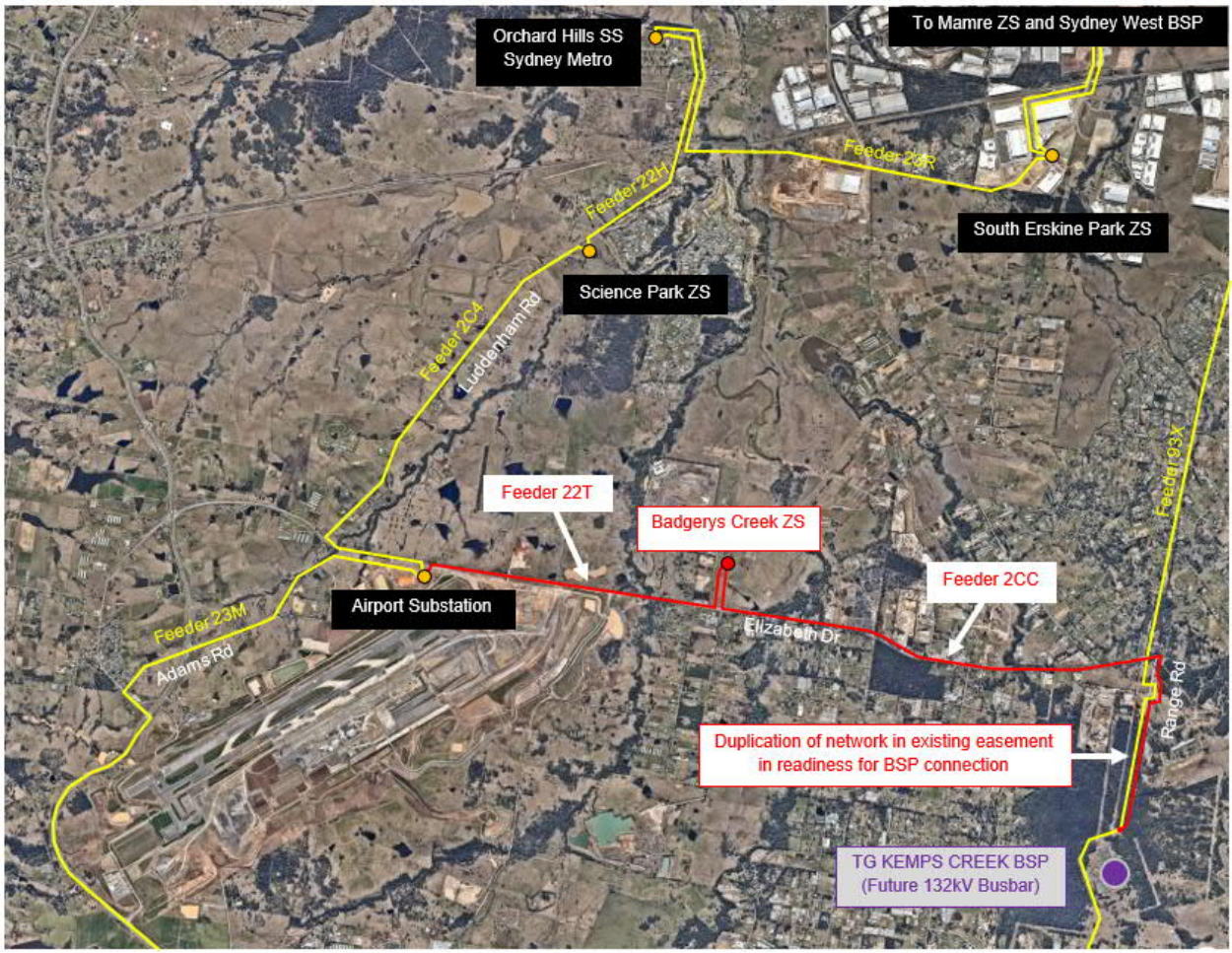
However, these options vary in that the installation of the transformers and feeders are staged, as well as whether both feeders connect to the same transmission substation, or, if one of them connects to another major feeder.

Figure 8 provides an overview of how the proposed Badgerys Creek and existing Kemps Creek zone substations fit into the Aerotropolis structure plan, while

figure 9 provides an aerial view of the development area and proposed network infrastructure.

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

Figure 9 – Development area and proposed network infrastructure for the Badgerys Creek development area

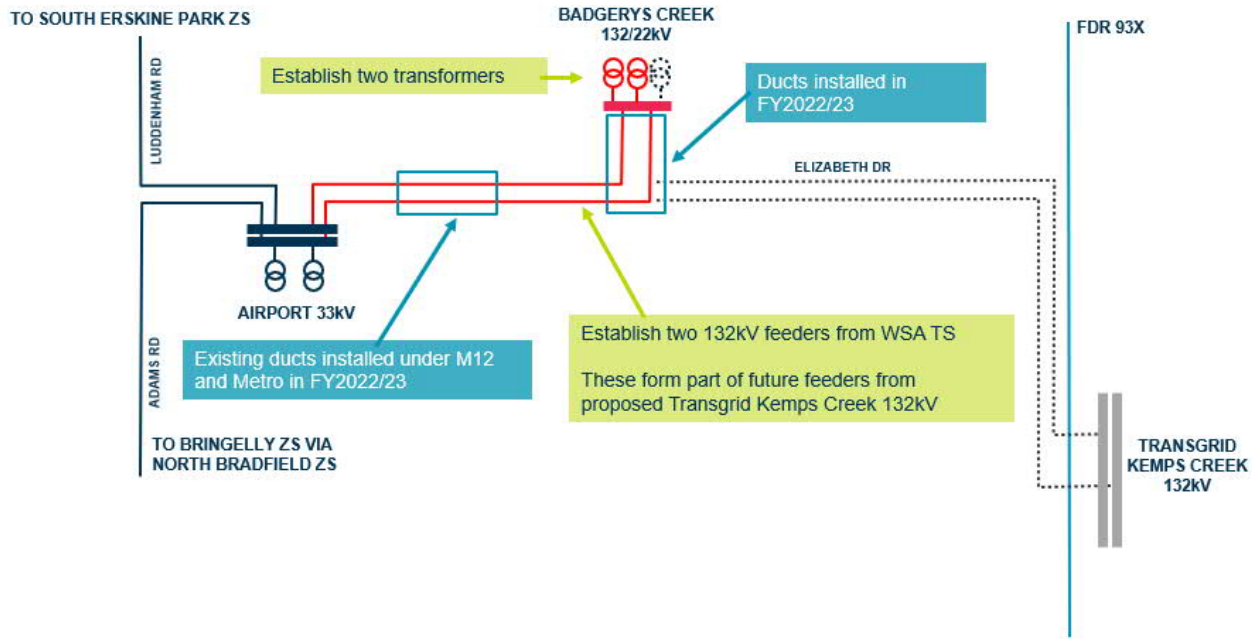


3.1 Option 1 – Establish Badgerys Creek ZS with supply from WSA TS

Option 1 involves establishing the Badgerys Creek zone substation in a single stage. The zone substation would comprise two 45MVA transformers with transmission supply provided by two 132kV feeders from the Western Sydney Airport transmission substation (WSA TS). It would also be designed to have provision for a third future transformer which, based on the current demand forecast, is expected to be required in the period 2035 to 2045. The potential future third transformer would be subject to its own separate investment analysis based on network need and optimal timing.

An overview this option is provided in figure 10.

Figure 10 – Simplified line diagram of Option 1



The total cost of this option is estimated to be $45.2 million and the construction of the Badgerys Creek zone substation would commence in 2022/23 with commissioning in 2025/26. Table 3 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 3 – Scope of works and costs for Option 1

Scope	Description	Cost Estimate ($M)
Mains	Establishment of two 132kV feeders providing supply to Badgerys Creek zone substation: • Two feeders from WSA TS to Badgerys Creek zone substation (underground cables each with 3.6km route length and 275MVA capacity) • Associated protection works and communications fibre	$18.9
Zone substation	Establishment of Badgerys Creek zone substation: • 132/22kV zone substation with two 45MVA transformers • Building(s) to house 22kV switchboards • Building(s) to house protection control equipment and amenities • Spatial provision for future: o Third 45MVA transformer o Third incoming 132kV feeder bay o Additional 22kV switchboard o Grid Battery Energy Storage System	$21.3
Distribution	Construction of seven 22kV distribution feeders: • 2 x 22kV feeders for the Elizabeth Enterprise Precinct. • 2 x 22kV feeders for the major water facility. • 1 x 22kV feeder heading westward towards the Northern Gateway area. • 2 x 22kV feeders and autotransformers for Kemps Creek ZS feeder ties with the location of the ties south of Elizabeth Drive (closer to the Kemps Creek ZS location to allow for beneficial load transfer). • 22kV conversion of network to be transferred to Badgerys Creek ZS. • Implement AFIC, time clock and/or smart meter conversions as required to support hot water heating service to residential areas south of Elizabeth Drive that may require back up supply.	$5.0
Total	Establishment of Badgerys Creek ZS including 132kV supply and distribution works.	**$45.2**

3.2 Option 2A – Establish Badgerys Creek ZS with supply from WSA TS and 93X

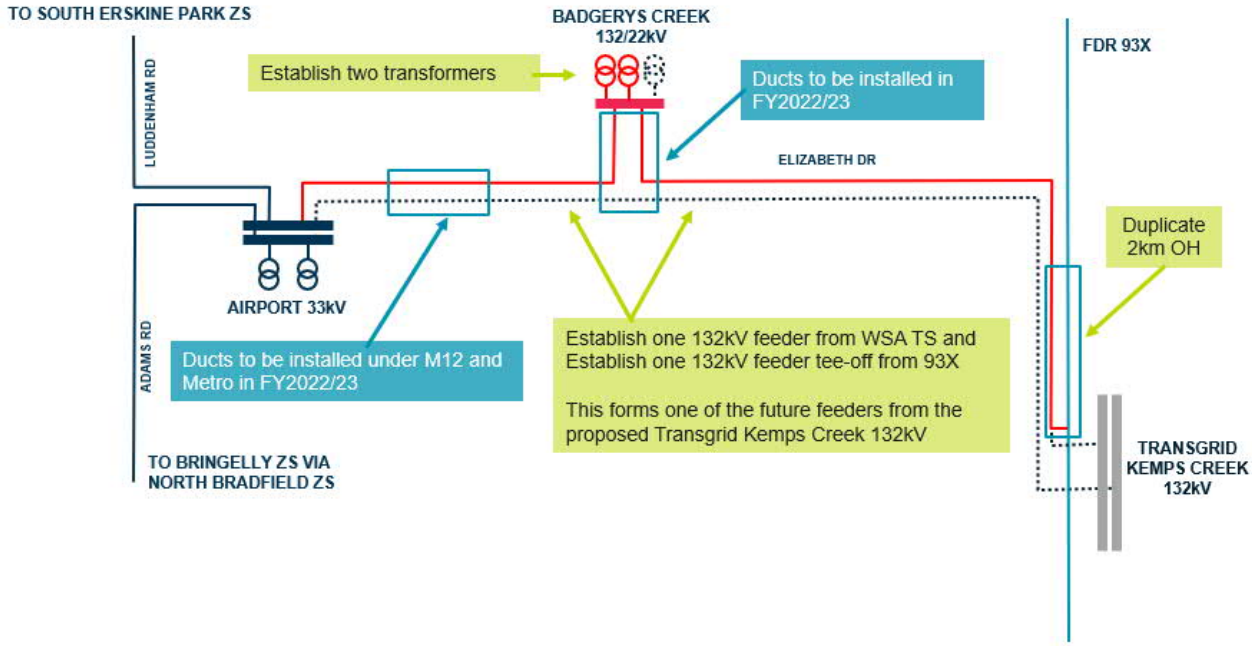
Option 2A involves establishing the Badgerys Creek zone substation in a single stage. The zone substation would comprise two 45MVA transformers with transmission supply provided by two 132kV feeders – one from the Western Sydney Airport TS and the other from a connection to the existing feeder 93X. It would also be designed to have provision for a third future transformer which, based on the current demand forecast, is expected to be required in the period 2035 to 2045.

The main difference between Option 1 and Option 2A is the 132kV supply to the zone substation being from two different sources – one source from the west (the WSA TS) and another from the east (feeder 93X). Connecting to feeder 93X is advantageous because it has significant benefits (included in the market benefits assessment) in terms of diversifying the supply security and reliability of the Aerotropolis area by providing an alternative supply to the area in addition to the Aerotropolis backbone feeder (which will be the primary supply for Western Sydney Airport).

Connecting to feeder 93X also provides a future high-capacity connection to the future augmentation of Transgrid's Kemps Creek Bulk Supply Point (BSP) to provide 132kV supply to the Aerotropolis area, which is expected by 2030 (subject to Joint Planning TNSP & DNSP). This option would therefore facilitate connection to Transgrid's Kemps Creek BSP as soon as it is available. It would also assist in avoiding potential delays associated with construction of the feeder in public roads and environmental and easement considerations for routes from underground to overhead in connecting to the Transgrid site.

An overview of this option is provided in figure 11.

Figure 11 – Simplified line diagram of Option 2A



The total cost of this option is estimated to be $52.4 million and the construction of the Badgerys Creek zone substation would commence in 2022/23 with commissioning in 2025/26. The higher cost relative to Option 1 reflects the increased length of feeder required to connect to feeder 93X. Table 4 provides an overview of the scope of works and capital cost of works for Option 2A, with operating costs assumed to be 0.4 per cent of total capital expenditure.

Table 4 – Scope of works and costs for Option 2A

Scope	Description	Cost Estimate ($M)
Mains	Establishment of two 132kV feeders providing supply to Badgerys Creek zone substation: • One feeder from WSA TS to Badgerys Creek zone substation (underground cable with 3.6km route length and 275MVA capacity) • One feeder from 93X to Badgerys Creek zone substation (underground cable with 6.0km and 275MVA capacity and 2.0km overhead route length in the 93X easement to the location of Transgrid's Kemps Creek BSP). • Associated protection works and communications fibre	$26.1
Zone substation	Establishment of Badgerys Creek zone substation: • 132/22kV zone substation with two 45MVA transformers • Building(s) to house 22kV switchboards • Building(s) to house protection control equipment and amenities • Spatial provision for future: o Third 45MVA transformer o Third incoming 132kV feeder bay o Additional 22kV switchboard o Grid Battery Energy Storage System	$21.3
Distribution	Construction of seven 22kV distribution feeders: • 2 x 22kV feeders for the Elizabeth Enterprise Precinct. • 2 x 22kV feeders for the major water facility. • 1 x 22kV feeder heading westward towards the Northern Gateway area. • 2 x 22kV feeders and autotransformers for Kemps Creek ZS feeder ties with the location of the ties south of Elizabeth Drive (closer to the Kemps Creek ZS location to allow for beneficial load transfer). • 22kV conversion of network to be transferred to Badgerys Creek ZS. • Implement AFIC, time clock and/or smart meter conversions as required to support hot water heating service to residential areas south of Elizabeth Drive that may require back up supply.	$5.0
Total	Establishment of Badgerys Creek ZS including 132kV supply and distribution works.	**$52.4**

3.3 Option 2B – Stage Badgerys Creek ZS with supply from WSA TS and 93X

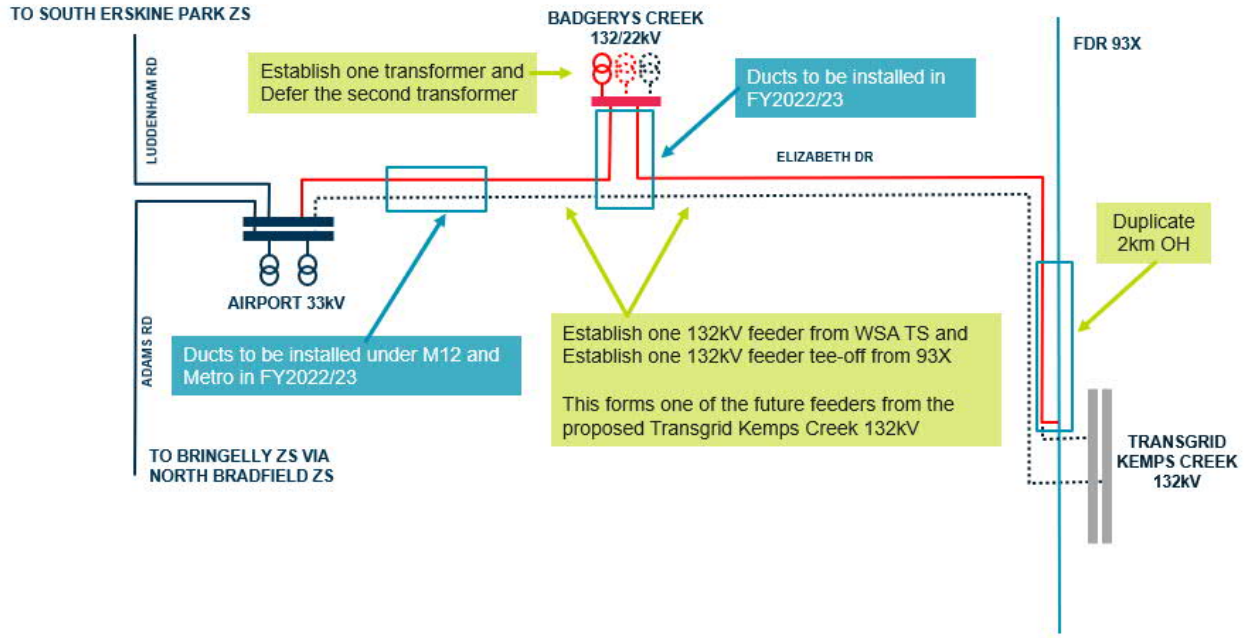
Option 2B would involve establishing the Badgerys Creek zone substation in two stages. In particular, Badgerys Creek zone substation would be established with one 45MVA transformer and with transmission supply provided by two 132kV feeders – one from the WSA TS and other from a connection to the existing feeder 93X.

An overview of this option is provided in figure 12 below.

The key advantages of this option are similar to those described in relation to Option 2A, reflecting its nature as the same technical solution (although with staging). In particular, connecting to feeder 93X has significant benefits in terms of diversifying the supply security and reliability of the Aerotropolis area by providing an alternative supply to the area in addition to the Aerotropolis backbone feeder (which will be the primary supply for Western Sydney Airport). Further, it facilitates connection to Transgrid's Kemps Creek BSP as soon as it is available and assists in avoiding potential delays associated with construction of the feeder in public roads and environmental and easement considerations for routes from underground to overhead in connecting to the Transgrid site.

However, this option would be associated with higher expected unserved energy during the period of the zone substation being supplied by the single transformer. For example, an outage of the single transformer (either planned or unplanned) would require backup through the distribution network and due to the greenfields nature of the development there is limited backup via the distribution network at this time. Following the development of the Northern Gateway and Mamre Road precinct areas there would be additional backup capacity available from the distribution network, however those developments are some years into the future and are unlikely to be available to provide backup capability in the timeframe of FY26 to FY28 which would be the time period that this option would operate on a single transformer.

Figure 12 – Simplified line diagram of Option 2B



The total cost of this option is estimated to be $53.7 million and the construction of the Badgerys Creek zone substation (with a single transformer and supply from two 132kV feeders) would commence in 2022/23 with commissioning in 2025/26. Works to install the second transformer would commence in

2026/27 with commissioning in 2027/28. The increase in costs relative to option 2A reflect the need to demobilise and remobilise works on the site for the installation of the second transformer and include a cost escalation factor for the duration of the deferral due to current increase in costs for materials.

Table 5 provides an overview of the scope of works and capital cost of works for Option 2B, with operating costs assumed to be 0.4 per cent of total capital expenditure.

Table 5 – Scope of works and costs for Option 2B

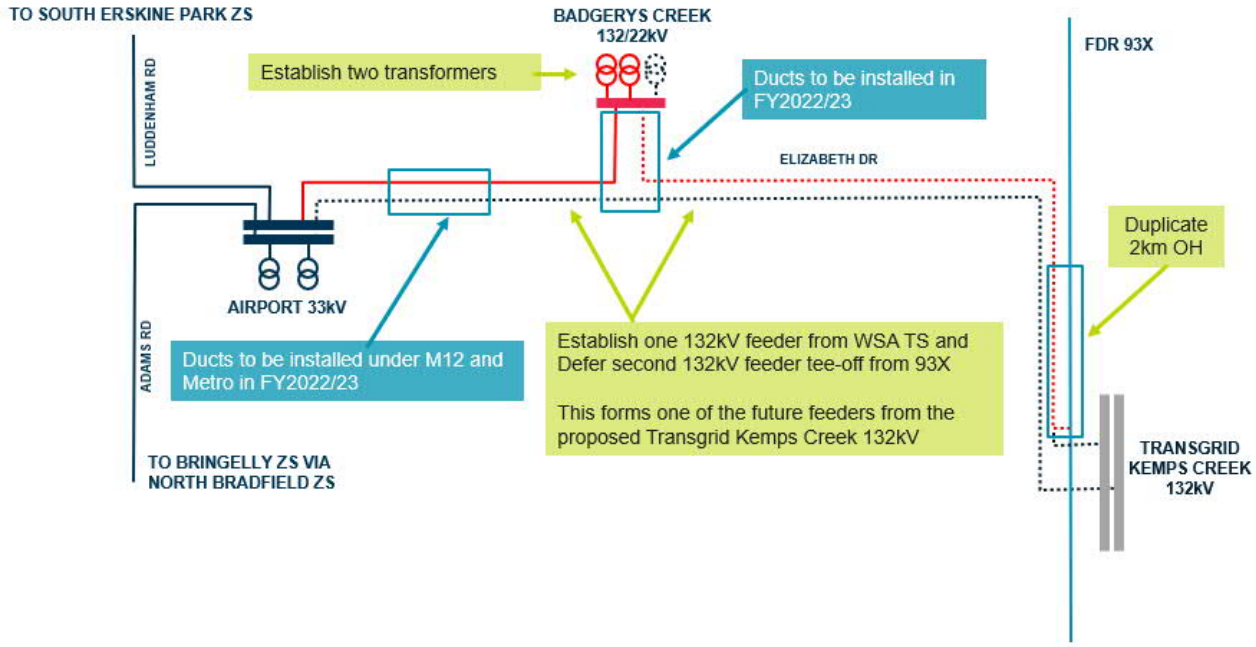
Scope	Description	Cost Estimate ($M)
Mains	Establishment of two 132kV feeders providing supply to Badgerys Creek zone substation: • One feeder from WSA TS to Badgerys Creek zone substation (underground cable with 3.6km route length and 275MVA capacity) • One feeder from 93X to Badgerys Creek zone substation (underground cable with 6.0km and 275MVA capacity and 2.0km overhead route length in the 93X easement to the location of Transgrid's Kemps Creek BSP). • Associated protection works and communications fibre	$26.1
Zone substation	Establishment of Badgerys Creek zone substation: • 132/22kV zone substation with two 45MVA transformers (Staged for commissioning in FY26 and FY28 including demobilisation and remobilisation on the work site for the second transformer installation.) • Building(s) to house 22kV switchboards • Building(s) to house protection control equipment and amenities • Spatial provision for future: o Third 45MVA transformer o Third incoming 132kV feeder bay o Additional 22kV switchboard o Grid Battery Energy Storage System	$22.6
Distribution	Construction of seven 22kV distribution feeders: • 2 x 22kV feeders for the Elizabeth Enterprise Precinct. • 2 x 22kV feeders for the major water facility. • 1 x 22kV feeder heading westward towards the Northern Gateway area. • 2 x 22kV feeders and autotransformers for Kemps Creek ZS feeder ties with the location of the ties south of Elizabeth Drive (closer to the Kemps Creek ZS location to allow for beneficial load transfer). • 22kV conversion of network to be transferred to Badgerys Creek ZS. • Implement AFIC, time clock and/or smart meter conversions as required to support hot water heating service to residential areas south of Elizabeth Drive that may require back up supply.)	$5.0
Total	Establishment of Badgerys Creek ZS including 132kV supply and distribution works.	**$53.7**

3.4 Option 2C – Establish Badgerys Creek ZS and stage 132kV supply

Option 2C would involve establishing the Badgerys Creek zone substation in a single stage, but staging its 132kV supply. In particular, Badgerys Creek zone substation would be established with two 45MVA transformers and with transmission supply from a single 132kV feeder from WSA TS. A feeder that connects to the existing feeder 93X would subsequently be commissioned. The zone substation would also be designed to have provision for a third future transformer which, based on the current demand forecast, is expected to be required in the period 2035 to 2045.

An overview of this option is provided in figure 13.

Figure 13 – Simplified line diagram of Option 2C



The key advantages of this option are similar to those described in relation to Option 2A and 2B, reflecting its nature as the same technical solution (although with a different type of staging). In particular, connecting to feeder 93X has significant benefits in terms of diversifying the supply security and reliability of the Aerotropolis area by providing an alternative supply to the area in addition to the Aerotropolis backbone feeder (which will be the primary supply for Western Sydney Airport). Further, it facilitates connection to Transgrid's Kemps Creek BSP as soon as it is available and assists in avoiding potential delays associated with construction of the feeder in public roads and environmental and easement considerations for routes from underground to overhead in connecting to the Transgrid site.

However, this option would incur higher expected unserved energy during the period of the zone substation being supplied by the single 132kV feeder. Although the single feeder from the WSA TS would have sufficient capacity to supply the zone substation, it would result in a higher level of reliability and security of supply risk due to the dependence on the single transmission feeder. If there were a fault on the single 132kV feeder there would be a long duration outage to customers. A possible but low probability outage scenario could be a cable fault on the 132kV cable from WSA TS to Badgerys Creek and the fault would need to be located and repaired and supply restored to Badgerys Creek to avoid a long duration outage to customers. The distribution network in the area would not be capable of supplying the Badgerys Creek demand via a load transfer at this early stage of development in the area.

The total cost of this option is estimated to be $52.9 million and the construction of the Badgerys Creek zone substation (with two transformers and a single 132kV supply feeder) would commence in 2022/23 with commissioning in 2025/26. Works to construct the second feeder connecting to feeder 93X would commence in 2025/26 with commissioning in 2027/28.

Table 6 provides an overview of the scope of works and capital cost of works for Option 2C, with operating costs assumed to be 0.4 per cent of total capital expenditure.

Table 6 – Scope of works and costs for Option 2C

Scope	Description	Cost Estimate ($M)
Mains	Establishment of two 132kV feeders providing supply to Badgerys Creek zone substation: • FY2026 :- One feeder from WSA TS to Badgerys Creek zone substation (underground cable with 3.6km route length and 275MVA capacity) • FY2028 :- One feeder from 93X to Badgerys Creek zone substation (underground cable with 6.0km and 275MVA capacity and 2.0km overhead route length in the 93X easement to the location of Transgrid's Kemps Creek BSP). • Associated protection works and communications fibre	$26.6
Zone substation	Establishment of Badgerys Creek zone substation: • 132/22kV zone substation with two 45MVA transformers • Building(s) to house 22kV switchboards • Building(s) to house protection control equipment and amenities • Spatial provision for future: o Third 45MVA transformer o Third incoming 132kV feeder bay o Additional 22kV switchboard o Grid Battery Energy Storage System	$21.3
Distribution	Construction of seven 22kV distribution feeders: • 2 x 22kV feeders for the Elizabeth Enterprise Precinct. • 2 x 22kV feeders for the major water facility. • 1 x 22kV feeder heading westward towards the Northern Gateway area. • 2 x 22kV feeders and autotransformers for Kemps Creek ZS feeder ties with the location of the ties south of Elizabeth Drive (closer to the Kemps Creek ZS location to allow for beneficial load transfer). • 22kV conversion of network to be transferred to Badgerys Creek ZS. • Implement AFIC, time clock and/or smart meter conversions as required to support hot water heating service to residential areas south of Elizabeth Drive that may require back up supply.)	$5.0
Total	Establishment of Badgerys Creek ZS including 132kV supply and distribution works.	**$52.9**

3.5 Options considered but not proposed to be progressed in the DPAR

Endeavour Energy has considered a number of options that we propose not to progress to the DPAR. These options, and our reasoning for not progressing them further, are summarised in table 7.

Table 7 – Options considered but not proposed to be progressed in the DPAR

Option	Reason not progressed
Augmentation of existing Kemps Creek zone substation	Possible network options considered were adding a third transformer and augmenting the existing transformers to 35MVA (from 25MVA) and conversion of the Kemps Creek zone substation to 132kV. However, both of these options would require long duration planned outages to the Kemps Creek zone substation during the construction works period to the detriment of customers supplied by the zone substation.
Establish Badgerys Creek zone substation with single transformer and single 132kV supply from WSA TS	This option would be associated with a lack of firm capacity supply from a single transformer and single transmission supply. There would also be insufficient back up capacity from the distribution network to support this option. The Badgerys Creek development area will be a 22kV distribution network and initially there will be no backup at 22kV and will therefore rely on autotransformers to the adjacent 11kV networks. It is estimated that there will not be a widespread 22kV network in adjacent areas until 2030.
Establish Badgerys Creek zone substation with single transformer and single 132kV supply from feeder 93X	This option would be associated with a lack of firm capacity supply from a single transformer and single transmission supply. There would also be insufficient back up capacity from the distribution network to support this option. The Badgerys Creek development area will be a 22kV distribution network and initially there will be no backup at 22kV and will therefore rely on autotransformers to the adjacent 11kV networks. It is estimated that there will not be a widespread 22kV network in adjacent areas until 2030.
Stage Badgerys Creek zone substation with two 132kV feeders from WSA TS	This is a staged variant of Option 1. However, we do not propose to progress staging of this option further because it would not provide full alignment to the Aerotropolis growth servicing strategy that utilises the new Transgrid BSP for the area.

4. Assessment of non-network solutions and SAPS

Following a review of the expected future customer demands of the Badgerys Creek development area and the nature of the existing load and network capability, Endeavour Energy has determined that there is unlikely to be a non-network option, or SAPS option, that could form a potential credible option on a standalone basis, or that could form a significant part of a potential credible option for this RIT-D.

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

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

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

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

A viable non-network option that maintains supply to all customers must be capable of reducing the estimated shortfall on the network from the firm capacity at Kemps Creek zone substation. Under the central scenario, by the end of 2024/25 a shortfall is estimated to exist for 23 days in the year and is at a maximum of about 5 MWh per day in the summer period. By 2027/28, a shortfall is estimated to exist for 338 days in the year and at a maximum of about 76 MWh per day in the summer period under the central scenario. The requirement for support from non-network options is therefore substantive in both the number of days expected to be required and the magnitude of the support needed.

In addition, we note that for any non-network solution to be effective it would need to locate near, and essentially connect to, the new load connection points. We consider that any such co-location would be extremely difficult at the required capacity given the substantial land requirements for many non-network options, the planning approvals, issues with community acceptance and these being in addition to and in competition with the underlying developments expected in these areas. Further, the lack of existing load in the area negates the potential for demand reduction approaches.

Table 8 below summarises the expected network support requirements out to 2027/28 for any non-network solutions to form standalone options under the central scenario. We note that the requirements would increase further beyond 2027/28 as more customers connect.

Table 8 – Network support required for a standalone option under the central scenario

Year	Peak load reduction required (MW)	Days required	Hours required	Total MWh required
FY25	0.9	23	118	32
FY26	3.2	160	1,149	1,036
FY27	5.5	281	2,744	4,339
FY28	7.9	338	3,780	9,231

Table 9 below sets out the requirements for non-network options to defer network expenditure in a cost effective manner, i.e., for them to be coupled with a network option in order to form a combined credible option.

Given that the comprehensive NPV assessment of the network options is yet to be undertaken (and will be part of the DPAR), the deferral assessment has been undertaken in this screening notice using the preliminarily preferred network option, Option 2A.

Table 9 – Network support required to defer a network option under the central scenario

Deferral period	Deferral year	Peak load reduction required (MW)	Days required	Hours required	Total MWh required	Deferral value[4]
1 year	FY25	0.9	23	118	32	$1.71M
2 years	FY25	0.9	23	118	32	$3.42M
	FY26	3.2	160	1,149	1,036	

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

[4] The deferral value is calculated as the net present value of deferring the preliminary preferred network option by one year using the central scenario's discount rate.

4.2 Assessment of specific non-network technologies

In addition to our general assessment of whether non-network options are likely able to form a potential credible option on a standalone basis, or form a significant part of a potential credible option for the Badgerys Creek development area RIT-D, we have considered individual non-network technologies. Our assessment is summarised in table 10.

Table 10 – Assessment of non-network technologies

Non-network technology	Assessment
Grid-scale storage	Not feasible because it would not defer network investment due to the energy storage system itself requiring connection to the network to provide charging supply.
VPP	Not feasible because the Badgerys Creek precinct is a new development. Uptake initially requires customers to connect to the network, which is not feasible with the existing network infrastructure and small existing customer base in the area.
Residential BESS	Not feasible because it does not defer network investment. It also requires customers to connect to the network, which is not feasible with the existing network infrastructure. The early stages of this development area will likely feature enterprise customers with a residential customer base in medium to high density housing coming a few years later.
Commercial direct load control	Not feasible because the Badgerys Creek precinct is a new development. Uptake initially requires customers to connect to the network, which is not feasible with the existing network infrastructure. In the longer term there will be a strong commercial and enterprise customer base in the area that could participate in future demand management programs.
Behaviour demand response	Not feasible because the Badgerys Creek precinct is a new development. Uptake initially requires customers to connect to the network, which is not feasible with the existing network infrastructure. In the long term it is likely that the residential customer base in the area would be able to participate in demand response programs when the planned residential developments are built out.

Endeavour Energy acknowledges that non-network solutions may be able to assist in future as load continues to grow following the establishment of the initial network infrastructure for the Badgerys Creek development area. Indeed, the proposed design of the Badgerys Creek zone substation includes consideration of space for a grid battery in the future.

4.3 Consideration of SAPS options

Recent changes to the NER, RIT-D and RIT-D application guidelines require Endeavour Energy to consider whether a SAPS option can fully or partly address an identified need. In practice, this relates to consideration of whether an identified need could be fully or partly addressed by converting part of our

distribution network forming part of the interconnected national electricity system to a regulated SAPS.[5] Regulated SAPS are set out in section 6B of the National Electricity Law (NEL), which defines a SAPS as a system that:[6]

- generates and distributes electricity; and
- does not form part of the interconnected national electricity system.

We consider that there is not a SAPS option that could form a potential credible option on a standalone basis, or that could form a significant part of the credible option, in this RIT-D. In particular, the load requirements of the greenfield development area are significant and therefore could not be supported by a network that is not part of the interconnected national electricity system with the ability to draw on grid-connected generation sources. In forming this conclusion we have considered both the potential to convert part of our distribution network to a regulated SAPS as well as the potential to build a new SAPS (given the greenfield nature of the network development in this area.

We note that this conclusion does not preclude the development of embedded generation and storage by specific loads to meet part of their supply needs and/or as back-up to their grid connections. Such developments fall outside of the definition of a SAPS and are coupled with those loads continuing to also require their full demand to be able to be met from the grid.

[5] See definition of 'SAPS option' in the NER.

[6] Section 6B(6) of the NEL.

5. Conclusion

The development of the Badgerys Creek development area is associated with the Western Sydney Airport development, which is driving significant investment throughout Sydney's Western Parklands City. Significant customer demand growth owing to the connection of the Badgerys Creek development area requires the establishment of additional connection and supply capability to the network.

Although the existing network capacity may be able service the initial customer connections, as demand continues to grow it will exceed the existing firm capacity meaning there will be a large amount of load at risk and unserved energy in the area. In particular, the Badgerys Creek development area is expected to have a peak demand of 60 MVA by 2050, which will exceed the capacity of the existing 11 kV supply network from Kemps Creek.

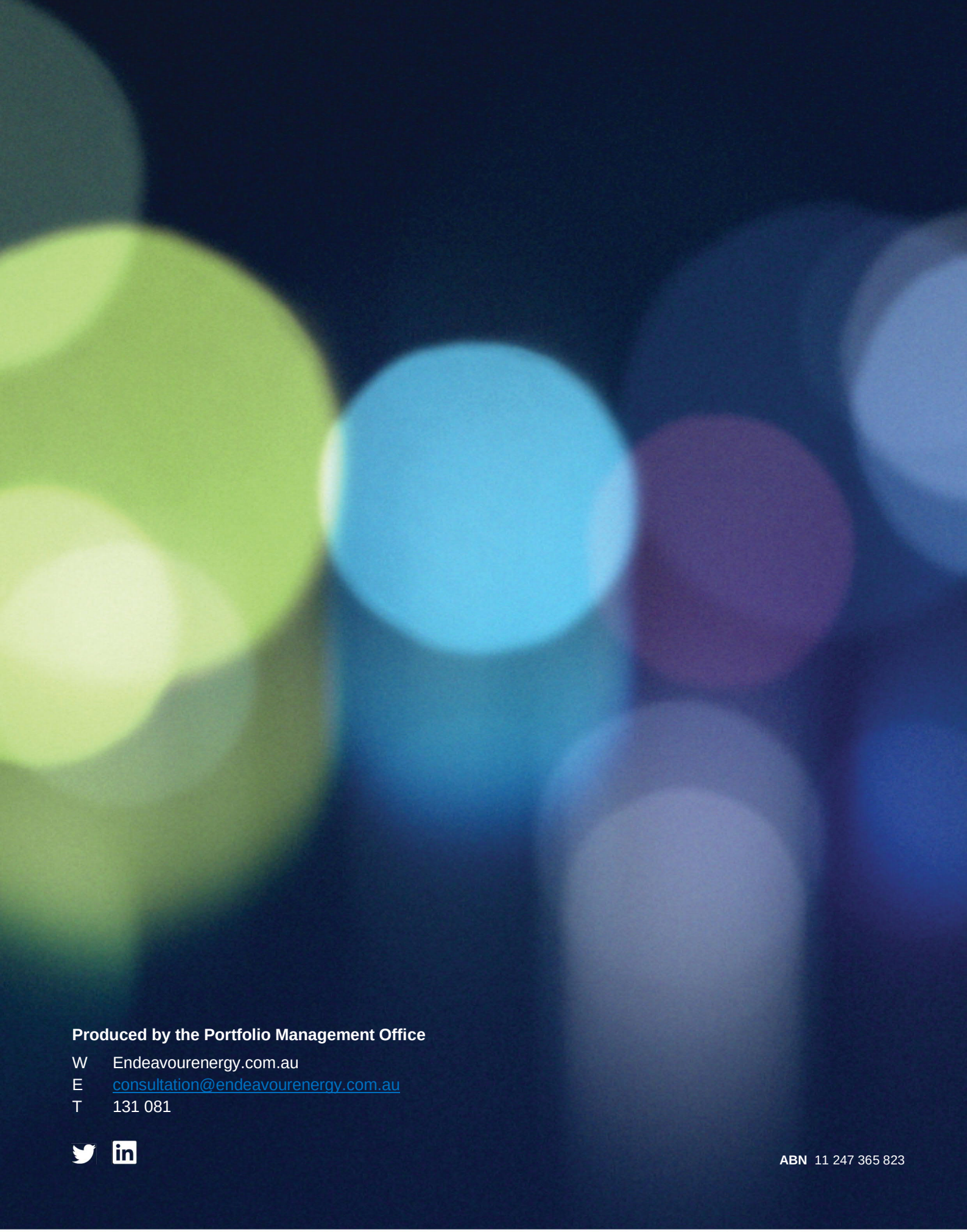
Based on the extent of forecast demand for the Badgerys Creek development area, the expected cost of network options and the capacity of the existing network to facilitate non-network technologies, it is not considered feasible that a non-network solution will form a potential credible option on a standalone basis, or form a significant part of a potential credible option for this RIT-D. Further, SAPS options are unlikely to contribute to meeting the identified need because the size of greenfield development cannot be supported by a network that is not part of the interconnected national electricity system. Consequently, an Options Screening Report is not intended to be prepared for this RIT-D in accordance with clause 5.17.4(c) of the NER.

We consider that non-network solutions may be more likely to be feasible for future developments in the area as the cost of large scale battery storage continues to decrease, the widespread inclusion of solar PV in new commercial and industrial developments continue to increase, and the uptake of electric vehicles, including electric buses offer opportunities for network support.

The load duration curve and peak load profile used in our analysis are based on our best estimate of the expected pattern of use in the area, however given the uptake of EVs, battery storage behind the meter and continued higher penetration of solar PV the load duration curve and the pattern of usage will change.

For example, we expect that the impact of EV charging cycles in both homes and workplaces will change the pattern of usage over time and will then impact the sizing of network infrastructure and potentially the capital investment required. Future changes to energy prices from retailers and network use of system charges are also likely to change the pattern of usage in the area over the long term.

These developments will be closely monitored as the Badgerys Creek precinct develops over the next decade and non network options will be considered as part of future network augmentations. In particular, Endeavour Energy will monitor these changes and assess whether an update to the evaluation in this RIT-D is needed should non-network options be a credible alternative to the subsequent stages of network investment.



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