Providing Supply to Sydney Science Park and the Surrounding Area

Notice on screening for non-network options

29 June 2022

Endeavour Energy

CONTACT

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1. Introduction

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.

The Western Sydney 'Aerotropolis' area is a greenfield development of a new city covering 11,000 hectares of land, which will spearhead Western Sydney's future urbanisation. The proposed development features a precinct-based land use and zoning approach that will require significant development of electricity infrastructure to meet the needs of the area over the long term. This includes the Sydney Science Park development, which is being developed to create an internationally recognised epicentre for research, development, education, commercialisation and innovation. It covers an area of approximately 288 hectares and is expected to have a demand of 45 MVA by 2036.

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 precinct – a 132kV backbone feeder.[1] We are now commencing this RIT-D to determine the most efficient means of providing supply to Sydney Science Park and the surrounding areas from this backbone feeder. Although we expect there to be significant market benefits associated with providing supply to Sydney Science Park and the surrounding areas, 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 loads in Sydney Science Park and the surrounding areas.

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.

This non-network screening notice sets out the reasons why we consider that there will not be a non-network option that could form a potential credible option on a standalone basis, or that could form a significant part of a potential credible option for the Sydney Science Park 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 loads in Sydney Science Park and the surrounding areas.

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

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.

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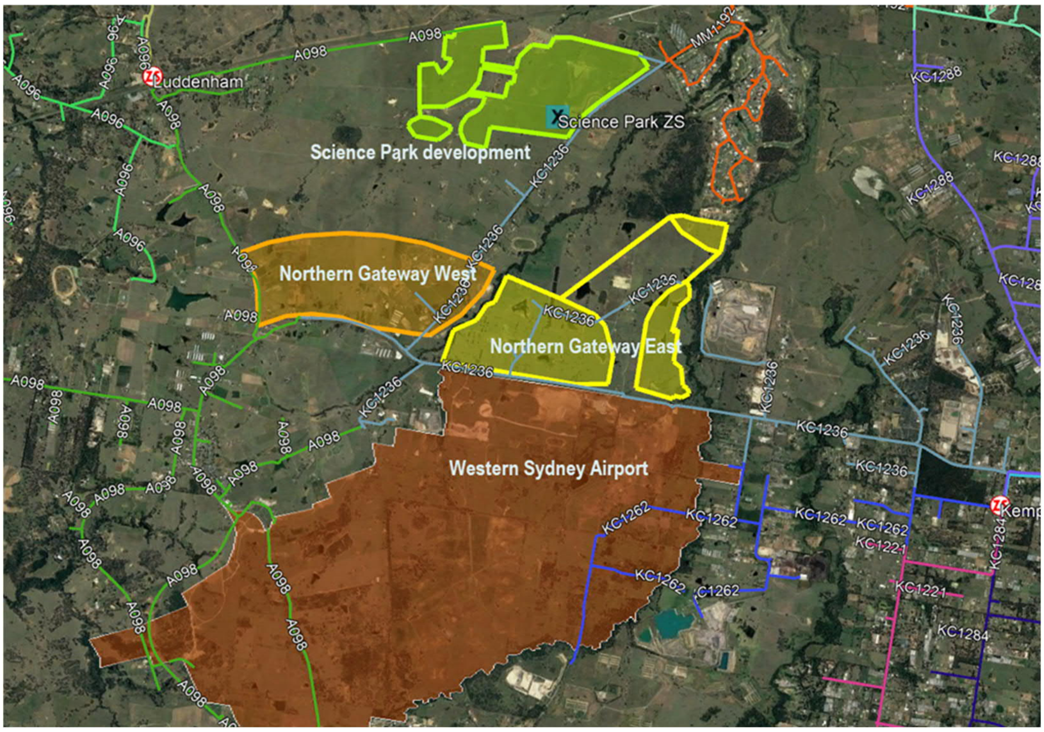
2. Key assumptions underpinning the 'identified need' for this RIT-D

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 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

Sydney Science Park is associated within the Western Sydney Airport growth precinct development. It covers an area of approximately 288 hectares and is bound by the Warragamba to Prospect Water Supply Pipeline to the north, Luddenham Road to the east and existing agricultural land to the south and west. Although distribution network investment at Sydney Science Park will principally be used to supply load in the immediate area, it will also provide supply for a proportion of the Northern Gateway Development, which is located at the eastern corner of Luddenham Road and Eastern Drive.[2] At this stage, the Northern Gateway area (West and East) will require a separate zone substation to service those areas based on separate development needs and timing. Figure 1 provides an overview of the relevant network area.

Figure 1 – Overview of the location of the Sydney Science Park development in our supply area

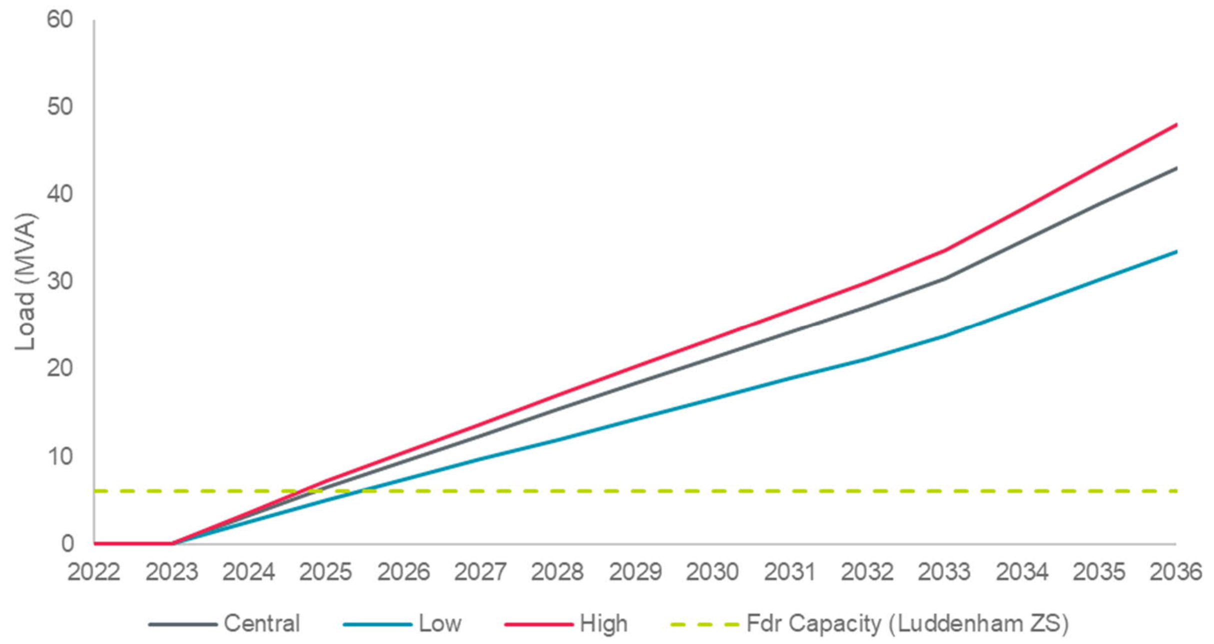


[2] Supply for the Northern Gateway Development will principally be met by a separate Zone Substation in that area. The Northern Gateway Zone Substation is currently in the Endeavour Energy planning process and is likely to be a separate RIT-D process. However, there will be some residual demand in the Northern Gateway area that will be supplied from the Sydney Science Park ZS. The future M12 motorway is planned to be located between the Sydney Science Park and Northern Gateway.

2.2 Load characteristics and demand forecast

Sydney Science Park has been designed as a mixture of commercial, educational, residential and industrial facilities. It is intended to be a recognised centre for research, development, education, commercialisation and innovation. Its development is driven by the development of the future Western Sydney Airport and Metro Western line – from St Marys to the Western Sydney Airport – which passes through this development. It is expected to have a demand of 45 MVA by 2036, which includes approximately 20MVA of expected residual load from the Northern Gateway by 2036. Figure 2 below shows our forecast demand under a central, low and high demand scenario for Sydney Science Park and the surrounding areas. It also shows the spare capacity of the Luddenham zone substation feeder.

Figure 2 – Sydney Science Park demand forecasts from 2022 to 3036



The central scenario has been developed from ongoing discussions over several years that Endeavour Energy has had with the developer. It is based on:

- an ultimate load forecast for the precinct;
- a timeframe to reach that ultimate load (the estimated time for this precinct to reach maturity is 20 years); and
- a load ramp up rate assumption (which is linear in this instance).

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

Sydney Science Park is expected to comprise principally commercial load (73 per cent of forecast load types for major connection points), with the remaining 27 per cent expected to be residential load.

2.3 Expected pattern of use

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

Specifically, the composite demand profile is based on the Aerotropolis load profile, which incorporates Wetherill Park zone substation load profile (an existing commercial/industrial area). The existing supply capacity to the area has been included in our assessment of the identified need.

Figure 3 below presents the normalised load duration curve (LDC) assumed based on the composite demand profile, while figure 4 presents the peak load profile for a summer day assumed for the load from the customer connections associated with Sydney Science park based on the composite demand profile.

Figure 3 – Normalised LDC assumed for customer connections associated with Sydney Science Park

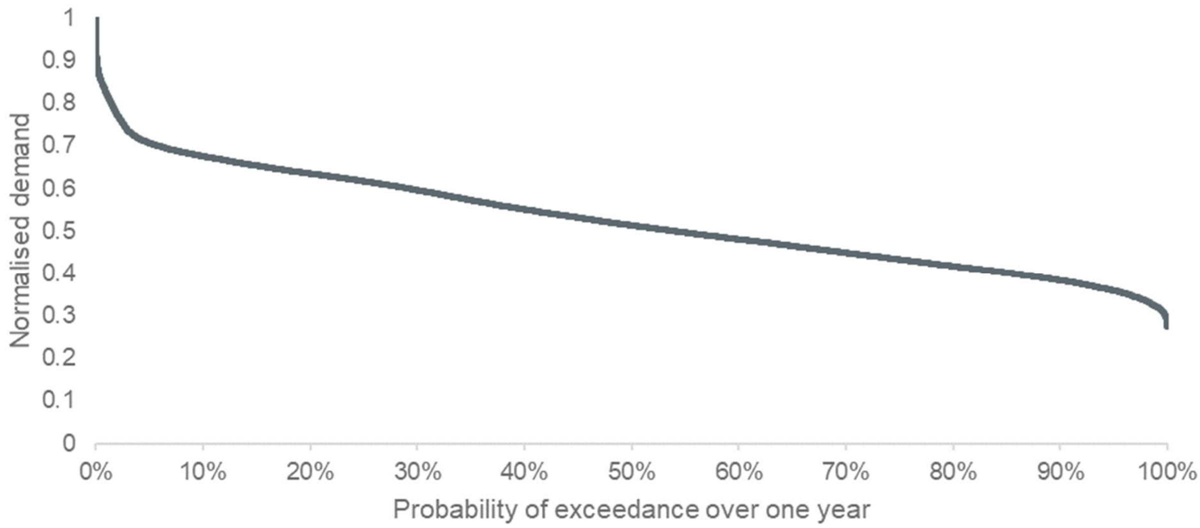
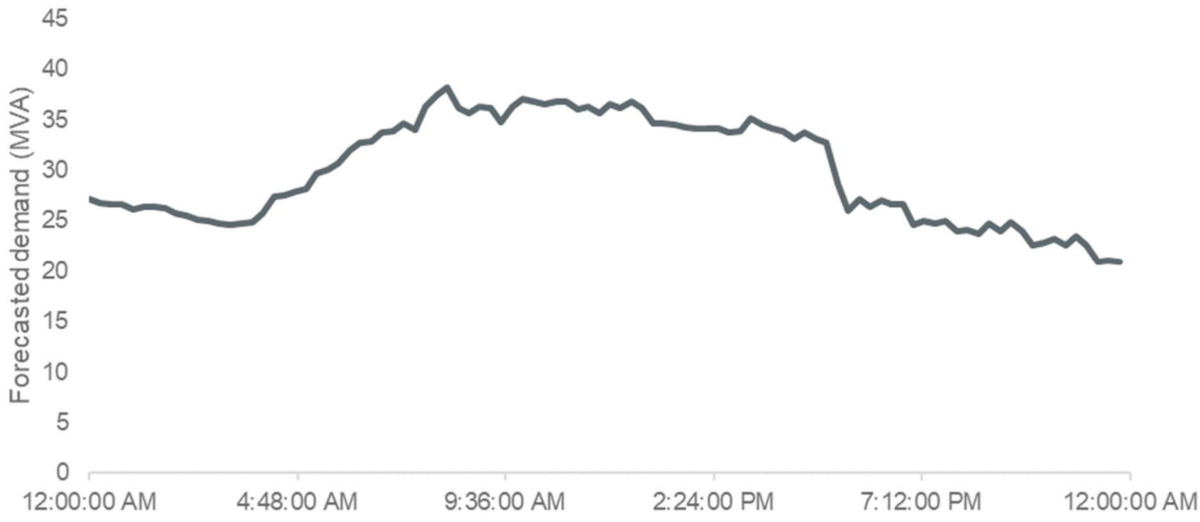


Figure 4 – Peak summer day profile for customer connections associated with Sydney Science Park



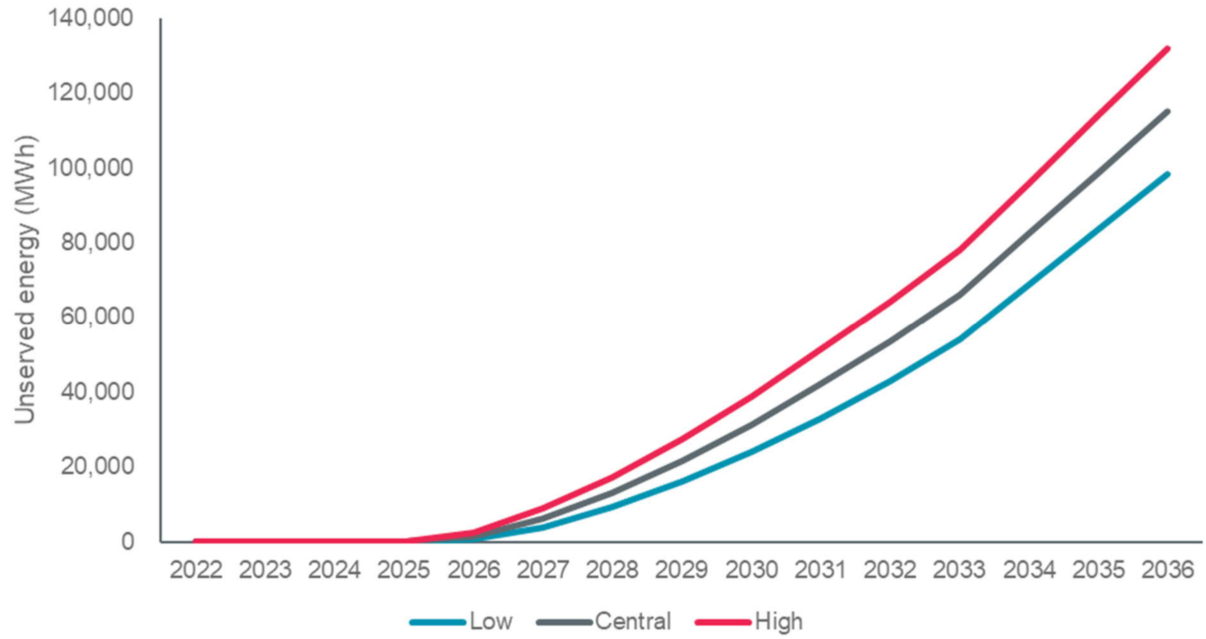
2.4 Existing network

The existing distribution network in the Sydney Science Park development area is insufficient to meet the supply needs of the Sydney Science Park area from 2024/25, even under the low demand scenario outlined above in figure 2. In particular, the initial development can only be serviced by 6MVA of available capacity at Luddenham zone substation. This existing supply capacity to the area has been included in our assessment of the identified need.

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 2024/25. Figure 5 presents the estimated unserved energy if no action is taken.

Figure 5 – Forecast unserved energy for Sydney Science Park under low, central and high scenarios



We propose to cap the expected future unserved energy, in MWh, as part of the DPAR NPV assessment, because the uncapped value of unserved energy will otherwise become unrealistically high (since, in reality, we would undertake investment to avoid widespread customer outages). Using the very large uncapped values has the potential to distort the comparison of net market benefits between credible options. The approach of capping USE in the base case is in-line with other RIT-Ds (and RIT-Ts) and does not affect the ranking of the overall options.[3,4]

[3] 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.

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

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 provide in table 1 below.

Table 1 – 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	+25%	-25%
Discount rate	3.26%	2.22%	4.30%
Maintenance costs	Central estimates	-25%	+25%

3. Proposed network options to meet the identified need

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

3.1 Option 1 – Staged installation of a 132/22kV zone substation with two 45MVA transformers

Option 1 involves construction of a new zone substation for Sydney Science Park with one 45MVA transformer installed in 2024/25, and the installation of a second 45MVA transformer deferred until 2033/34. This substation would connect to the 132kV Aerotropolis backbone feeder, which is due for completion in 2023/24. Although this option would address concerns regarding unserved energy in the short term, installing a single 45MVA transformer is expected to lead to significant load at risk by 2033/34 due to increasing growth in load, which would require the installation of a second transformer at that time.

The total cost of this option is expected to be $27.4 million in 2022/23 dollars and construction is expected to commence in 2022/23 with commissioning of the zone substation and first transformer in 2024/25. The second transformer will be installed in 2033/34. Table 2 provides an overview of the scope of works and cost of works for Option 1, with operating costs assumed to be 0.4 per cent of total capital expenditure.

Table 2 – Scope of works and costs for Option 1

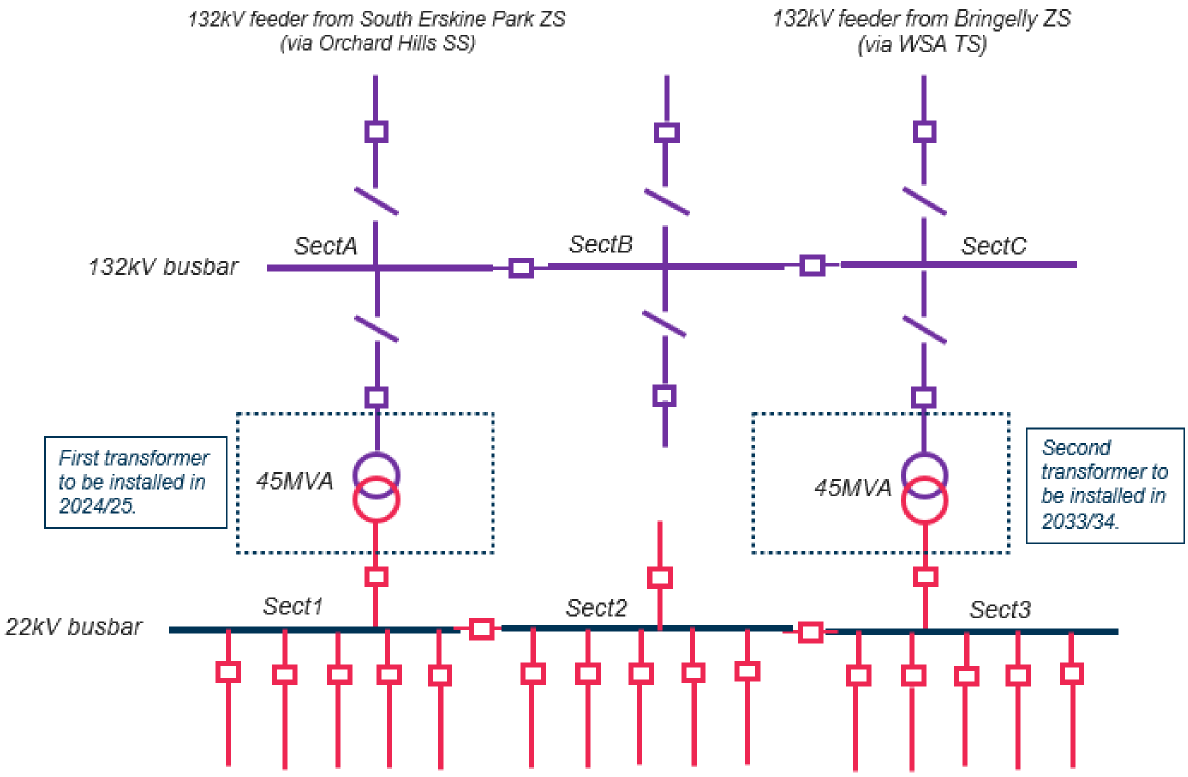
Scope	Description	Cost Estimate ($M)
Zone Substation	Establishment of a zone substation at Sydney Science Park: • Establish a new indoor control building to accommodate 22kV switchboards and other equipment • Single 132/22kV 45MVA transformers at time of commissioning, with a second installed in 2033/34 • 132kV indoor busbar with two 132kV circuit breakers, bus section circuit breakers and two 132kV transmission circuit breakers • 132kV and 22kV protection equipment and communication works • Associated 22kV distribution works • Consideration of rooftop solar panels to offset carbon emissions of the substation building energy consumption • Consideration of space for future incorporation of a grid battery	$20.8
Transmission Connection	Connection of zone substation to transmission network: • Connection to the 132kV Aerotropolis backbone feeder with cables matching the size and type to ensure supply capacity	$1.6
Distribution	Construction of distribution feeders: • Establish ten 22kV distribution feeders • Establish three 22/11kV autotransformers	$5.0
Total	Construction of Sydney Science Park zone substation with 132kV connection to the Aerotropolis backbone feeder and establishment of distribution feeders	**$27.4**

Endeavour Energy notes that additional preliminary design and project management costs associated with the staging of the second transformer have not been included in this cost estimate. These costs are not considered to be material to the outcome of this RIT-D because they are small in context of total project costs.[5]

[5] These costs could be up to $300,000 dollars, or one per cent of total project costs.

An overview of this option is provided in provided in figure 6 below.

Figure 6 – Simplified line diagram of Option 1



3.2 Option 2 – Installation of a 132/22kV zone substation with two 45MVA transformers

Option 2 involves construction of a new zone substation for Sydney Science Park with two 45MVA transformers installed in 2024/25. The scope of works is largely similar to that of Option 1, i.e., the substation would connect to the 132kV Aerotropolis backbone feeder. However, two transformers would be installed at the time of commissioning, as opposed to the staged installation of the transformers in Option 1. Installing the two transformers at the time of commissioning the zone substation is expected to eliminate all load at risk into the foreseeable future.

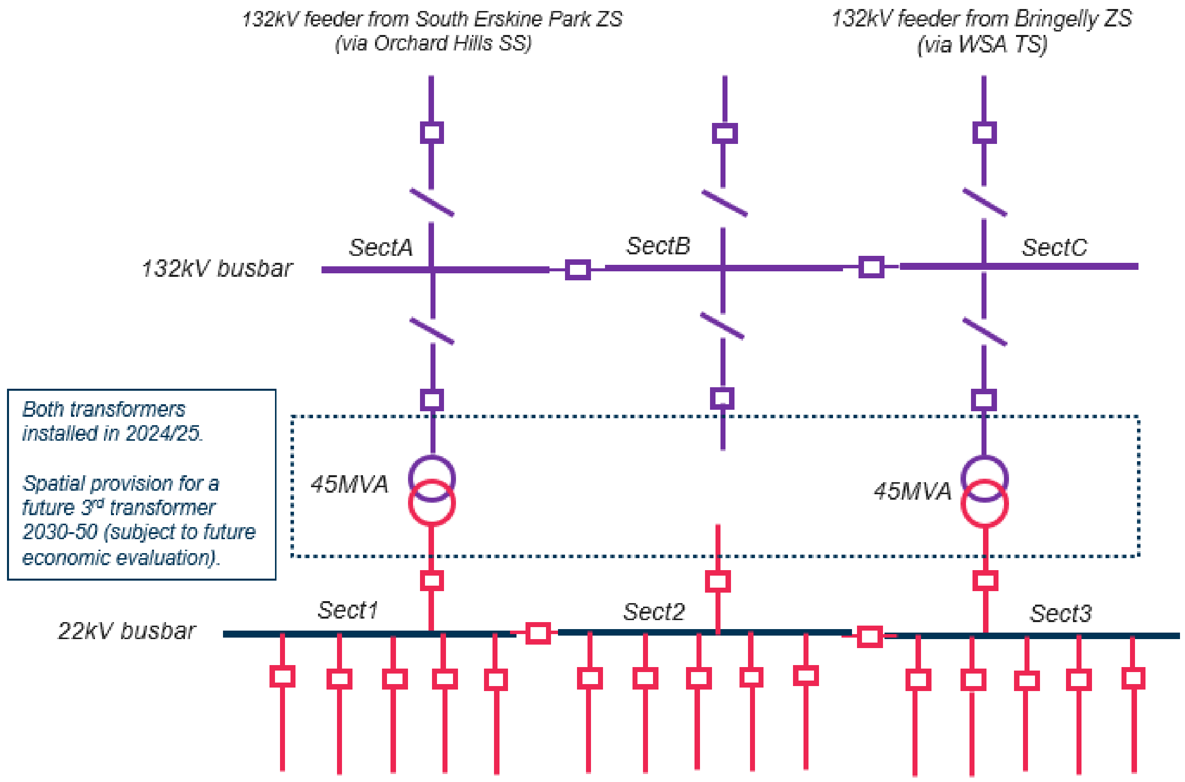
The total cost of this option is expected to be $27.4 million in 2022/23 dollars and construction is expected to commence in 2022/23 with commissioning in 2024/25. Table 3 provides an overview of the scope of works, and the cost of those works, for Option 2. Operating costs are assumed to be 0.4 per cent of total capital expenditure.

Table 3 – Scope of works and costs for Option 2

Scope	Description	Cost Estimate ($M)
Zone Substation	Establishment of a zone substation at Sydney Science Park: • Establish a new indoor control building to accommodate 22kV switchboards and other equipment • Single 132/22kV 45MVA transformers at time of commissioning, with a second installed in 2033/34 • 132kV indoor busbar with two 132kV circuit breakers, bus section circuit breakers and two 132kV transmission circuit breakers • 132kV and 22kV protection equipment and communication works • Associated 22kV distribution works • Consideration of rooftop solar panels to offset carbon emissions of the substation building energy consumption • Consideration of space for future incorporation of a grid battery	$20.8
Transmission Connection	Connection of zone substation to transmission network: • Connection to the 132kV Aerotropolis backbone feeder with cables matching the size and type to ensure supply capacity	$1.6
Distribution	Construction of distribution feeders to provide supply: • Establish ten 22kV distribution feeders • Establish three 22/11kV autotransformers	$5.0
Total	Construction of Sydney Science Park zone substation with cut in and out works to the Aerotropolis backbone feeder and establishment of distribution feeders/transformers	**$27.4**

An overview of this option is provided in provided in Figure 7 below.

Figure 7 – Simplified line diagram of Option 2



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

The initial supply to the Sydney Science Park precinct has been established with the development of two 11kV feeders from Luddenham zone substation (along with the associated 11/22kV autotransformers). These developments have been triggered by applications to connect. However, the magnitude of the Sydney Science Park development is expected to outstrip the supply that will be made available from these additional feeders. Further, the capacity of Luddenham zone substation will become constrained due to the development and load uptake on these feeders.

Endeavour Energy therefore considered augmenting Luddenham zone substation to meet the identified need of establishing supply to the Sydney Science Park precinct. However, this option has not been progressed due to difficulties associated with acquiring additional land around the zone substation. Further, were land available, augmentation of the Luddenham zone substation may not have been viable due to its distance from the Sydney Science Park precinct.

4. Assessment of non-network solutions

Following a review of the expected future load demands of the Sydney Science Park and surrounding 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 that could form a potential credible option on a standalone basis, or that could form a significant part of a potential credible option for this RIT-D.

This section sets out the assessment behind this determination, which draws on the assumptions outlined in the sections above, and considers the required technical characteristics that a non-network option would need to meet 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 spare capacity at the Luddenham zone substation. Under the central scenario, by the end of 2024/25 a shortfall is estimated to exist for 312 days in the year and is at a maximum of about 3,655 MWh per day in the summer period. By 2027/28, a shortfall is estimated to exist for 365 days in the year and at a maximum of about 33,646 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 4 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 load connects.

Table 4 – 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	3.5	312	3,325	3,655
FY26	6.5	365	6,045	11,614
FY27	9.4	365	8,740	22,124
FY28	12.4	365	8,760	33,646

Table 5 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 report using the preliminarily preferred network option, Option 2 (which is only marginally more expensive than Option 1 in present value terms, but eliminates all load at risk into the foreseeable future).

Table 5 – 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[6]
1 year	FY25	3.5	312	3,325	3,655	$0.8M
2 years	FY25	3.5	365	3,325	3,655	$1.6M
	FY26	6.5	365	6,045	11,614	

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 load 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.

Similarly, the amount of load reduction that would be required in order to enable a deferral of network augmentation by one year is also unrealistically high, particularly when considering the low deferral value. We therefore also do not consider it commercially feasible that non-network technologies can be coupled with a network option to form a credible option.

[6] 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 Sydney Science Park RIT-D, we have individually considered zone source and distributed battery solutions.

4.2.1 Zone source and distributed battery solutions

Large scale battery energy storage systems have the potential to be deployed at zone substation sites as a potential alternative to network solutions. Grid batteries can alleviate network constraints by enabling greater capacity headroom through 'peak shaving' – exporting charged capacity in response to peak demand. These functions can similarly be distributed throughout the network as 'shared batteries' or community batteries.

Although Endeavour Energy recognises that a large scale battery energy storage can assist in managing demand in principle, these assets require network infrastructure to be established so that they can connect and operate without constraint. Due to the greenfield nature of the site and the lack of existing network or demand base such an approach is not viable at this time. However, Endeavour Energy acknowledges that batteries may be able to assist in the future as load continues to grow following the establishment of the initial network infrastructure for Sydney Science Park. Indeed, the proposed design of the zone substation includes consideration of space for a grid battery in future.

5. Conclusion

The development of Sydney Science Park is associated with the Western Sydney Airport growth precinct development, which is driving significant cross sector investment throughout Sydney's Western Parklands City. Significant load growth owing to the connection of Sydney Science Park requires the establishment of additional connection and capacity capability to the network in the region.

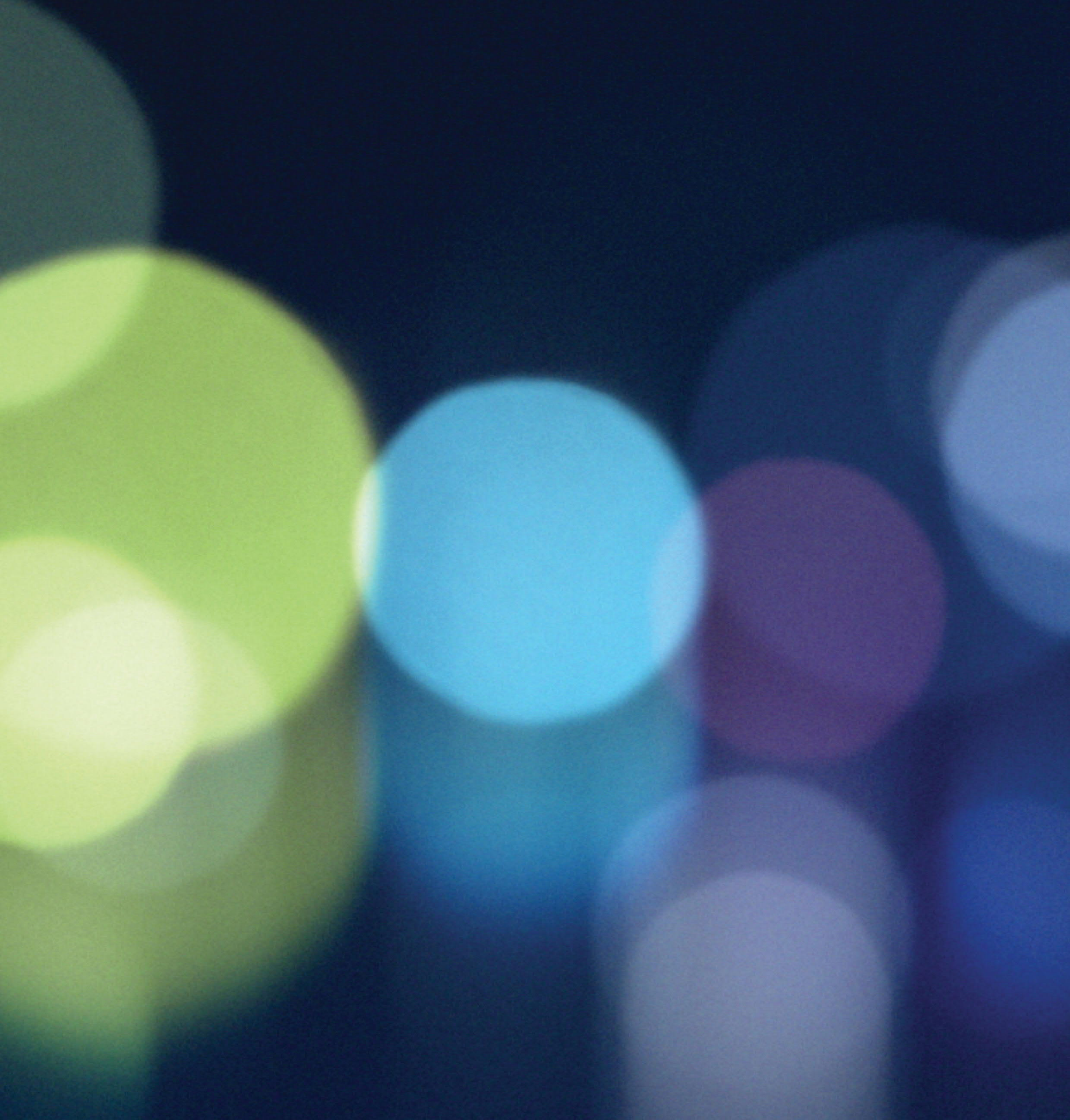
Although the expected load may initially be able to be supplied via spare capacity at the Luddenham zone substation, going forward there is a large amount of load at risk and unserved energy that will result from exceeding capacity in the area. In particular, Sydney Science Park is expected to have a demand of 45MVA by 2036, while the spare capacity of Luddenham zone substation is only capable of supplying 6MVA.

Based on the extent of the forecast load for the Sydney Science Park and surrounding areas, 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. Consequently, a Non-Network Options 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, begins to offer opportunities in the vehicle-to-grid capability for network support.

The load duration curve (LDC) and peak load profile used in our analysis (**2.3 Expected pattern of use**) are based on our best estimate of the expected pattern of use in the area, however given the expected future aspects of EV, battery storage and continued higher penetration of solar/PV the LDC and load profile will continue to change. We expect that EV charging cycles in the household and workplaces will lead to changes of the load profile over time. The continued penetration of solar/PV is likely to continue to decrease network demand in the midday and afternoon periods. The future higher penetration of battery storage will also tend to change the load profile for this area. Future changes to energy prices from retailers and tariffs are also likely to be factors that may change the pattern of use. However, these future changes to the expected pattern of use are not considered material to the analysis of non-network solutions for this area.

These developments will be closely monitored as Sydney Science Park and the surrounding areas develop over the next decade and considered as part of future network augmentations.



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