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CASE FOR INVESTMENT (CFI): NPR-000060 BERRIMA JUNCTION EMPLOYMENT LANDS

August 2022

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Prepared by:



Parth Dave

Engineer – System Investment Partner

Date: 17/8/2022

Endorsed by:

Endorsed by:

Matthew Lee

Engineer – Forecasting & Planning

Date:

Endorsed by:

Gavin de Hosson

Network Planning Manager

Date:

Peter Langdon

Head of Asset Planning and Performance

Date:

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1. Executive Summary

This Executive Summary sets out an overview of the proposed investment including the underlying need, our recommended solution, a discussion of the key drivers, and the options considered to address the need. These aspects are covered in detail in the body of the Case for Investment (CFI).

1.1 Need / Background

This CFI addresses the planned developments of a data centre and industrial subdivision surrounding Berrima Junction Zone Substation (ZS) in which Endeavour Energy has received customer applications in recent years.

The key drivers for this investment are the customer applications that have been received by Endeavour Energy for the following developments:

- Data Centre (NCL1699¹) with a total demand of 15 MVA.
 - For this CFI, a conservative load actualisation factor of 80% was assumed which results in a maximum demand of 12 MVA. This was used for the economic and technical analysis of the options.
- Industrial precincts (UIS058 & UIS0863²) with a maximum combined demand of 5.4 MVA

Currently, the temporary Berrima Junction ZS has a single 20 MVA 33/11 kV transformer and is supplied via a tee-off from Fairfax Lane 33 kV Feeder 7905. Based on the demand forecast, the current network infrastructure will have load at risk from 2023 with the total capacity of Berrima Junction ZS exceeded in 2030. From then, there will be a large amount of load at risk and ultimately sustained involuntary load shedding, resulting in considerable unserved energy. This will result in customers not being able to connect to the network, which contravenes Endeavour Energy's obligation to provide connection services. A project is required to service future customers in the areas surrounding the temporary substation.

Figure 1 describes the decision rule from Endeavour Energy's growth servicing strategy to determine the approach required to address the trigger and need. Based on the decision rule, the identified need is such that it is sub-optimal for Endeavour Energy to do nothing because:

- Based on characteristics of growth, this investment is classified as **greenfield**.
- Identified need based on consequence of no action for the greenfield development is that customers are not able to connect which the proposed investment is a **reliability corrective action**³.

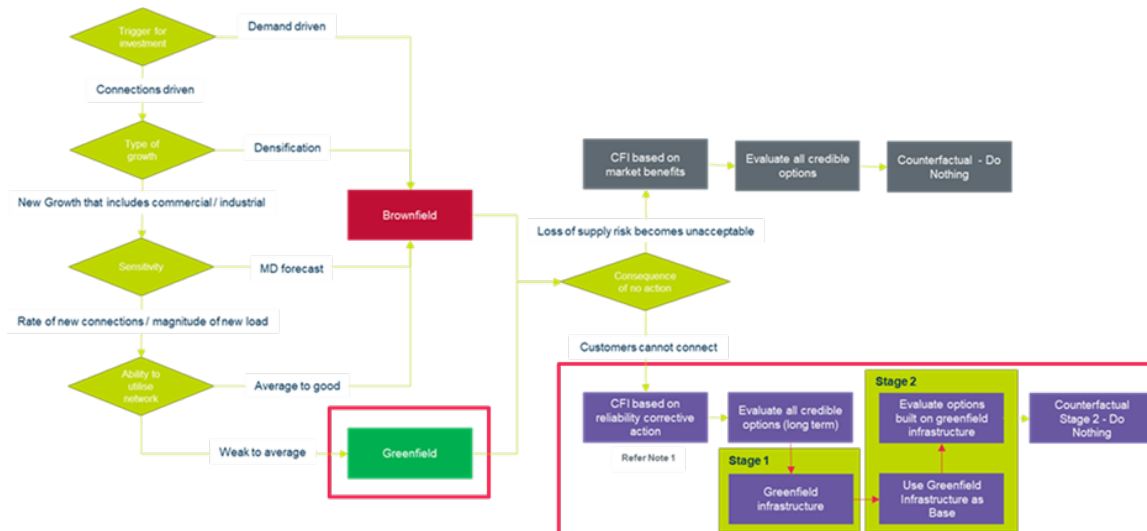


Figure 1: Decision Framework from Endeavour's Growth Service Strategy

¹ The internal identifier for this connection application.

² The connection application number has used to deidentify the relevant developers.

³ Refer to Growth Servicing Strategy for definitions of greenfield and brownfield sites.

1.2 Options Considered

1.2.1 Long Term Network Options

Table 1 outlines the long-term options that were considered to address the identified need of supplying the new connections in this area. The table shows that Option 2B has the most significant economic benefit being Net Present Value (NPV) positive \$125.3 million. However, we note that Option 2C has a marginally lower NPV of \$123.9 million (1% difference). **Option 2B** is still preferred over Option 2C as this option has a lower CAPEX during the FY25-29 regulatory cycle (\$1.7 million), while providing the same net benefits. Hence, **Option 2B** is the preferred long term credible network configuration as it is the least cost and technically feasible option which will allow Endeavour Energy to connect the most of customers in this area.

Table 1 - List of Long-Term Network Options

Option	Description	Solution Type	NPV ¹ \$M	Rank	Assessment Description
2A	Establish a 35 MVA firm Berrima Junction ZS, commissioned by FY26	Network solution	100.0	3	Technically feasible, lower net benefits
2B	Establish a 35 MVA firm Berrima Junction ZS with a new feeder from Moss Vale ZS to Berrima Junction ZS, commissioned by FY26	Network Solution	125.3	1	Greatest Net Benefits, Preferred Long Term option
2C	Establish a 35 MVA firm Berrima Junction ZS with a tee-off from Feeder 7906 to Berrima Junction ZS, , commissioned by FY26	Network Solution	123.9	2	Technically feasible, lower net benefits

Notes:

1: The NPV is based on the central scenario.

1.2.2 Non-Network Options

The NTMP tool and the subsequent qualitative analysis found at least two credible non-network options (Commercial Direct Load Control & Behavioural Demand Response). These options need to be further evaluated using the screening test in the RIT-D process. As part of the RIT-D process, Endeavour Energy will issue a non-network options report before progressing with the Draft Project Assessment Report (DPAR).

1.3 Recommendation/ Next Steps

This CFI recommends the establishment of a permanent 35 MVA firm 33/11 kV Berrima Junction ZS to replace the existing temporary zone sub, and the establishment of a new 33 kV Feeder from Berrima Junction ZS to Moss Vale ZS (**Option 2B**). Minor augments at Moss Vale ZS are also required to facilitate the new 33 kV feeder. This will allow Endeavour Energy to connect the proposed data centre and industrial subdivision.

Based on the Endeavour Energy's RIT-D process (**Figure 2**), it is recommended that:

- A Non-Network Options Report be issued seeking submissions for non-network options, given that credible non-network options are available.
- If a feasible and cost-effective non network option is not received, proceed with the recommended network solution which is the establishment of a new a permanent substation (Berrima Junction ZS) with a firm capacity of 35 MVA by 2026 with a new transmission feeder from Moss Vale VS to Berrima Junction ZS. This option is estimated to cost **\$14.9 Million** with a contingency of **\$1.5 Million** to be spread over two year from 2024-25.
- It is recommended that the project value of **\$16.4 Million** (inclusive of contingency) be approved for consideration in the FY23 Portfolio Investment Plan.
- The CFI will be finalised at the completion of the RIT-D process and a final approval will then be submitted to the confirm if the scope will include a non-network option and if the recommended timing of investment of the preferred network option will change.

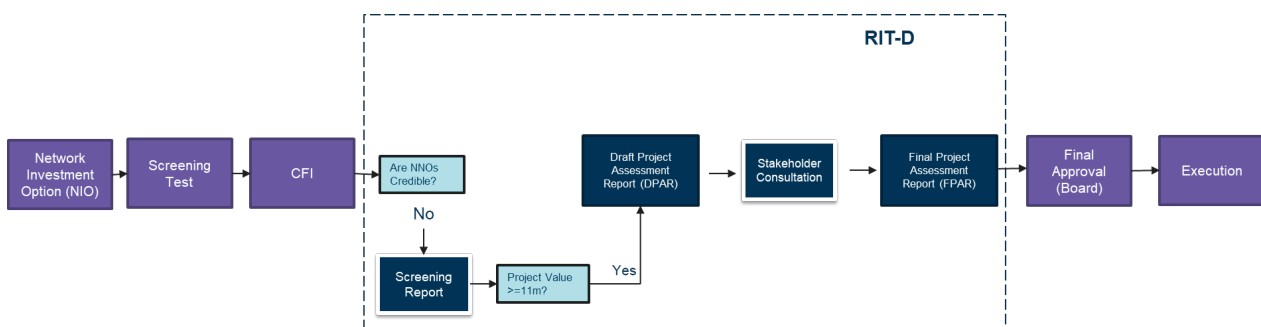


Figure 2 - Endeavour Energy's RIT-D Process for this Project

2. Project Proposal

2.1 Identified Need or Opportunity

Berrima Junction Zone Substation (ZS) was built in 2010 on Douglas Rd, Moss Vale under PR546 as a temporary solution to supply a 5 MVA load application from Australian Film and Pipe Manufacturers.

In recent years, Endeavour Energy has received a data centre and two industrial subdivision customer applications in the areas surrounding Berrima Junction ZS. The data centre has applied for 15 MVA N-1 (at the 11 kV feeder level) load to be supplied by Berrima Junction ZS 11 kV. The load of the industrial subdivisions is estimated to be around 5.4 MVA based on the customer applications in the subdivisions, and on maximum demand calculations done by Planning using lot sizes and appropriate load densities (VA/m²).

Additionally, there has been a connection enquiry (ENL4142) to connect a 16.5 MVA load at one of two lots near Berrima Junction ZS. This enquiry was only used in the high forecast scenario as the customer was also interested in a lot in Kembla Grange.

Geographical representation of Berrima Junction ZS and surrounding areas is given on Figure 3.

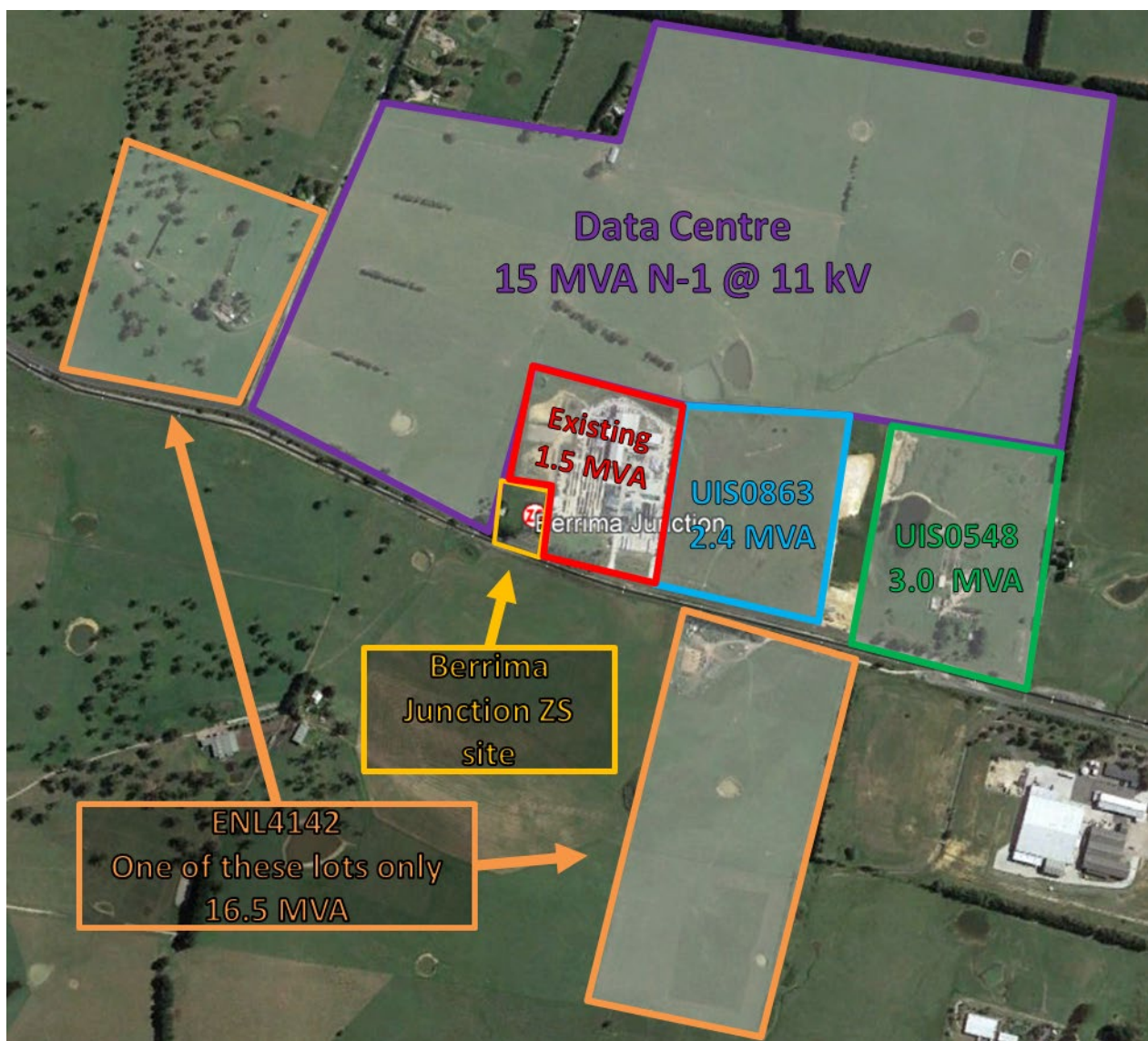


Figure 3 – Berrima Junction ZS and the customer load applications in the surrounding area.

2.2 Existing Infrastructure not capable to service the growth

2.2.1 Existing Infrastructure

Berrima Junction ZS has a single 20 MVA 33/11 kV transformer and is supplied via a tee-off from Fairfax Lane 33 kV Feeder 7905. Feeder 7905 also supplies the Boral Cement Works Berrima HVC (BCW Berrima), formerly Blue Circle Southern Cement Berrima. 33 kV Feeder 7908 from Moss Vale ZS to BCW Berrima. A Single line diagram (SLD) of Berrima Junction ZS including relevant surrounding network is presented on Figure 4.

Since Berrima Junction ZS was commissioned in 2010, it has only supplied Australian Film and Pipe Manufacturers in normal configuration. The peak load at Berrima Junction ZS has varied between 1.3 and 1.9 MVA over the past five years.

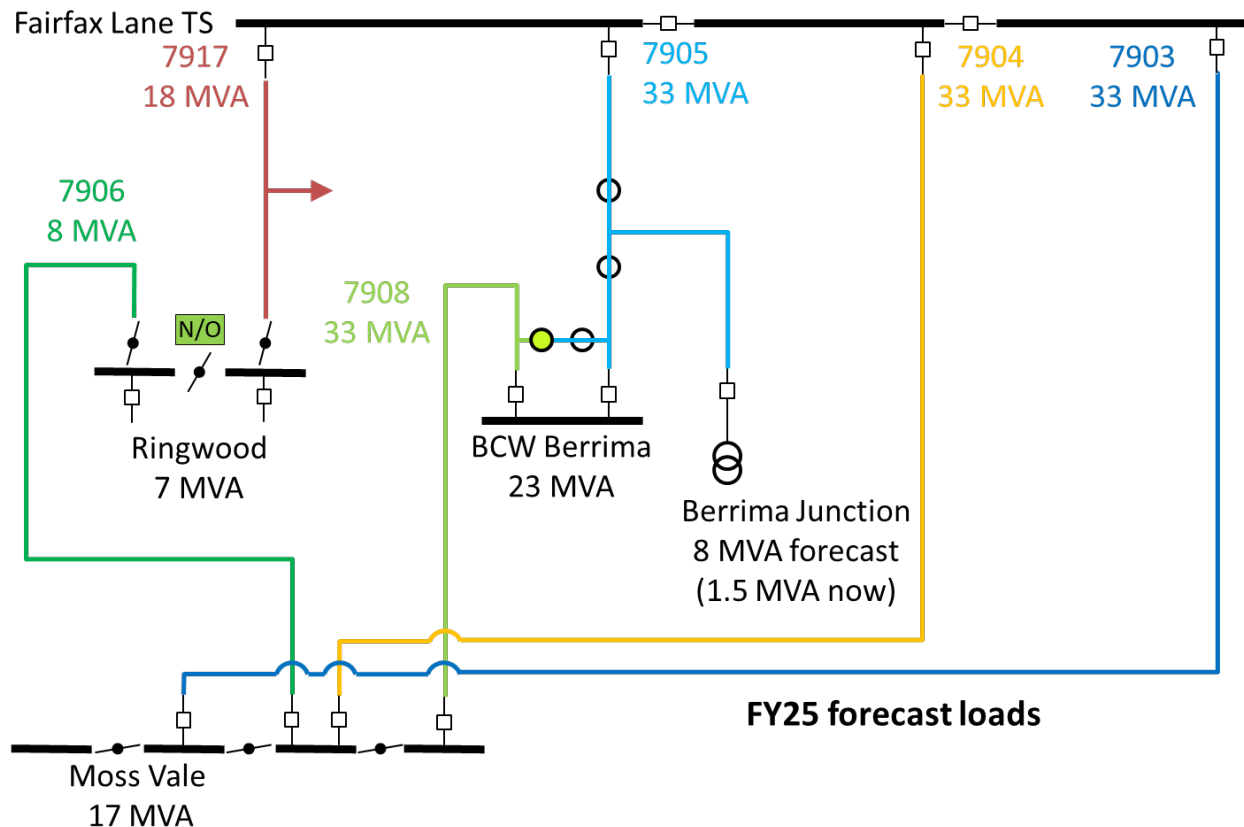


Figure 4 – Single line diagram of Berrima Junction ZS and relevant Fairfax Lane TS network with FY25 forecast loads and feeder ratings.

2.2.2 Limitations of existing infrastructure

There are three contingency scenarios identified that will result in unserved energy due to the insufficient load transfer potential from neighbouring zone substation and feeders:

- I. Contingency scenario 1: Total loss of Berrima Junction ZS caused by a fault on:
 - a. Transmission Feeder 7905 between the ABS's used to isolate Berrima Junction ZS;
 - b. The Berrima Junction ZS 20 MVA 33/11 kV transformer; or,
 - c. The ABS's used to isolate the tee-off to Berrima Junction;
- II. Contingency scenario 2: Loss of Feeder 7905 between Fairfax Lane TS and the ABS's used to isolate Berrima Junction ZS; and,
- III. Contingency scenario 3: Loss of Feeder 7908.

Under the first contingency scenario, all load at Berrima Junction ZS will be lost until the adjacent Moss Vale ZS 11 kV feeders are switched to back up Berrima Junction ZS. The maximum spare 11 kV backup capacity during industrial hours (06:00 – 18:00) is approximately **3.14 MVA** in FY21.

In the second and third contingency scenarios, Feeder 7905 or Feeder 7908 will be required to supply Berrima Junction ZS and BCW Berrima. Feeder 7905 and Feeder 7908 are both rated at 33 MVA total capacity (66 MVA before switching) with 0 MVA firm capacity.

Analysis found that out of these three contingencies, most of the unserved energy is due to:

- Total loss of Berrima Junction ZS
- Loss of Feeder 7905 between Fairfax Lane TS and the ABS's used to isolate Berrima Junction ZS

2.2.3 Load Growth

The load growth can be summarised into the following developments:

- Data Centre with a total demand of 15 MVA based on a customer connection application that was received by Endeavour Energy
 - The data centre was assumed to grow by 2.4 MVA per annum., starting in FY23 to a maximum of 12 MVA based on 80% load actualisation factor for the purpose of the demand forecast
- Industrial precincts (UIS0548 & UIS0863) with a maximum combined demand of 5.4 MVA
- There were two customer applications in the UIS0548 subdivision. These loads were used instead of a lot size-based estimate. A 60% load actualisation factor was applied for these loads for the demand forecast, a lower load actualisation factor as AS3000 maximum demand estimates are conservative
- For the remaining lots, the loads were assumed to draw 40 VA/m² at each lot with an 80% load actualisation factor for the purpose of the demand forecast
- ENL4142 to establish a 16.5 MVA industrial facility at one of two locations near Berrima Junction, and one location in Kembla Grange. Planning has applied a 60% load actualisation to this load for the demand forecast (9.9 MVA load). A 60% load actualisation factor was applied for these loads for the demand forecast, a lower load actualisation factor as AS3000 maximum demand estimates are conservative. As this load could eventuate in Kembla Grange, this load was only applied to the high forecast scenario.

2.2.4 Demand forecast

The demand forecast for the Berrima Junction area, considering the major new connections and network constraints listed above, is presented on Figure 5 and detailed in for central, high and low forecast cases.

- The Central case represents a scenario where there 12 MVA data centre has load growth over five years in addition to the industrial subdivision loads
- The Low case is when there is a 12 MVA data centre load growth over 10 years in addition to the industrial subdivision loads
- The High case is the Central case with the addition of the forecasted load from ENL4142.

A diversity of 80% was used when summing all loads. Endeavour Energy believes this forecast is a conservative forecast to strengthen the case for this CFI. Based on the load forecast as shown in Table 2 and on Figure 5, Berrima Junction ZS will have load at risk from 2023 with the total capacity of Berrima Junction ZS exceeded in 2030 which will result in involuntary load shedding, resulting in considerable unserved energy. This will result in customers not being able to connect to the network, which contravenes Endeavour Energy's obligation to provide connection services. An investment into additional electrical capacity in this area is required to meet these requirements. Consequently, this investment is considered a reliability corrective action under Section 5.10 of the NER.

Table 2: Berrima Junction ZS Load Forecast in detail

Demand Forecast (MVA)	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2036	2041
November 2021 Summer Demand Forecast	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
UIS0548 (Central)	0.0	0.6	1.2	1.8	2.4	3.0	3.0	3.0	3.0	3.0	3.0	3.0
UIS0863 (Central)	0.0	0.0	0.0	0.5	1.0	1.4	1.9	2.4	2.4	2.4	2.4	2.4
Data Centre (Central)	0.0	2.4	4.8	7.2	9.6	12.0	12.0	12.0	12.0	12.0	12.0	12.0
Data Centre (Low)		1.2	2.4	3.6	4.8	6.0	7.2	8.4	9.6	10.8	12.0	12.0
ENL4142 (High)	0.0	0.0	0.0	1.0	2.0	3.0	4.0	5.0	5.9	6.9	9.9	9.9
	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2036	2041
High Forecast	1.5	3.9	6.3	9.9	13.4	17.0	18.2	19.4	20.2	21.0	23.8	25.0
Central Forecast	1.5	3.9	6.3	9.1	11.9	14.6	15.0	15.4	15.6	15.7	16.5	17.4
Low Forecast	1.5	2.9	4.4	6.2	8.0	9.8	11.2	12.5	13.5	14.5	16.0	16.9
	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2036	2041
Berrima Junction ZS (Total Capacity)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Berrima Junction ZS (Firm Capacity)	3.14	3.14	3.14	3.14	3.14	3.14	3.14	3.14	3.14	3.14	3.14	3.14
Feeder 7905 (Total Capacity)	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0
Feeder 7905 (Firm) Capacity	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Load at Risk - Central (Due to Failure of Transformer)	0.0	0.8	3.2	5.9	8.7	11.5	11.9	12.3	12.4	12.6	13.4	14.2
Load at Risk - Central (Due to Failure of Feeder)	1.5	3.9	6.3	9.1	11.9	14.6	15.0	15.4	15.6	15.7	16.5	17.4

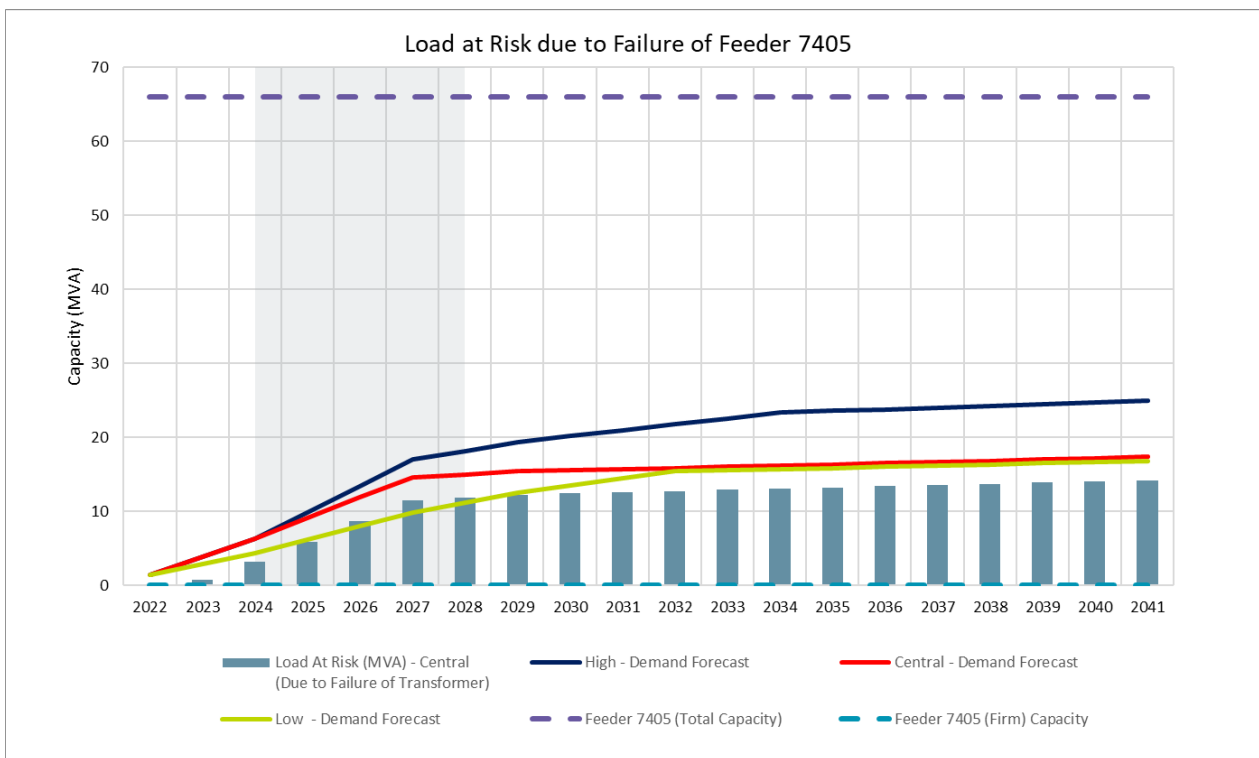
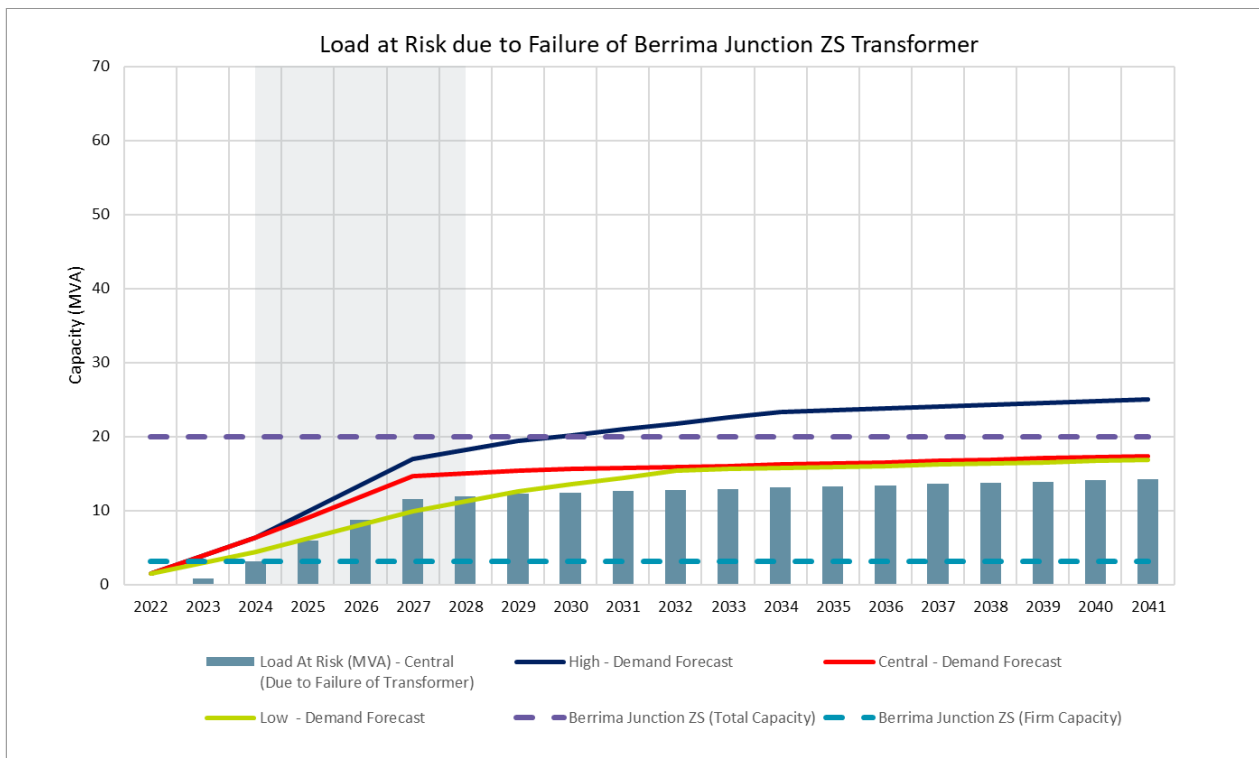


Figure 5 - Berrima Junction ZS Load Forecast & Load at Risk.

2.2.5 Related Projects

There are no projects related to NPR-000060 (PR778) Berrima Junction Employment Lands.

3. Options Considered

Based on the decision rule outlined in the Growth Servicing Strategy, the following are the characteristics of the area:

- Investment is classified as **greenfield**.
- Identified need based on consequence of no action for the greenfield development is **reliability corrective action**⁴.

Figure 6 below (subset of the decision rule included in the Growth Servicing Strategy) has been utilised to outline the options.

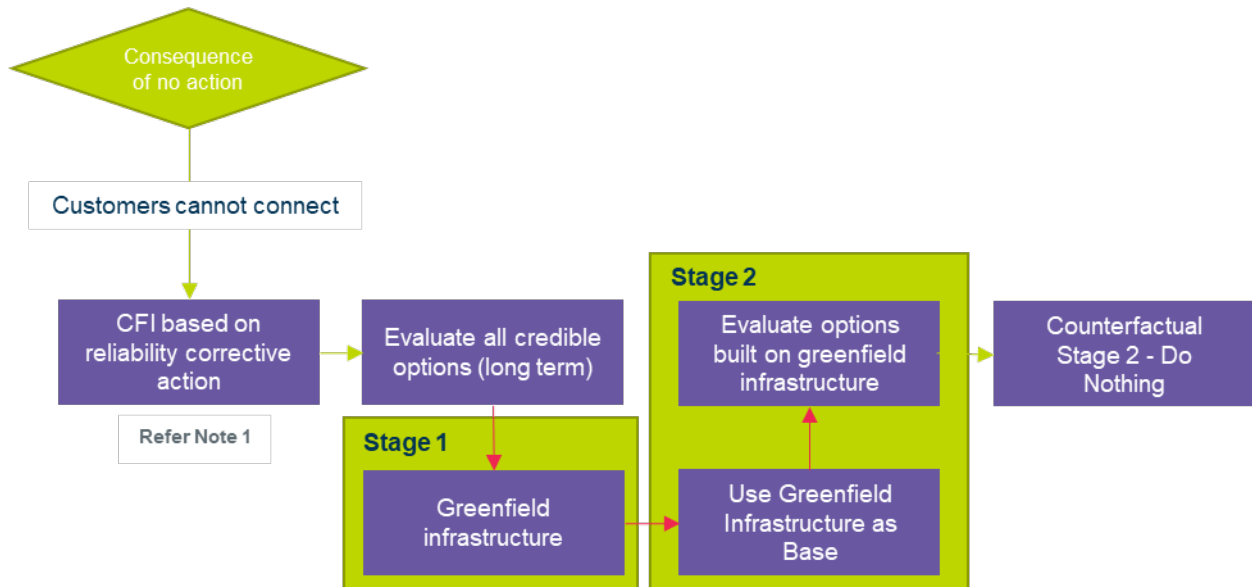


Figure 6: Decision Rule from Endeavour Energy's Growth Servicing Strategy

3.1 BAU Base Case - 'No proactive intervention'

This chapter examines the risks and benefits of undertaking a non-proactive intervention. The consequence of not proceeding with any investment in a network option for the Berrima Junction Employment Lands will result in significant unserved energy due to the existing supply network being constrained and incapable of supplying the forecast demand for the area. Most of the expected unserved energy (EUE) is due to the failure of the transformer at the existing Berrima Junction substation or the failure of feeder 7905.

Without proactive intervention, a risk of unserved energy will remain as shown on Figure 7 and Table 3, and Endeavour Energy may be unable to provide supply security for future developments in the growth area.

In terms of Risk Cost assessment, the "No Proactive Intervention" option provides a base case, business as usual (BAU) case, where the risks are valued by applying a VCR to the forecast expected unserved energy. A composite VCR of \$47,240 was used in the analyses comprised of 95% commercial and 5% industrial, which is believed to be conservatively representative of the future load at Berrima Junction ZS in FY25. The 2022 calendar year (CY22) adjusted VCRs were used. Network Planning believes this composite VCR satisfies the AER requirement to use a VCR reflective of customer composition.

⁴ Refer Growth Servicing Strategy for definitions of greenfield and brownfield sites

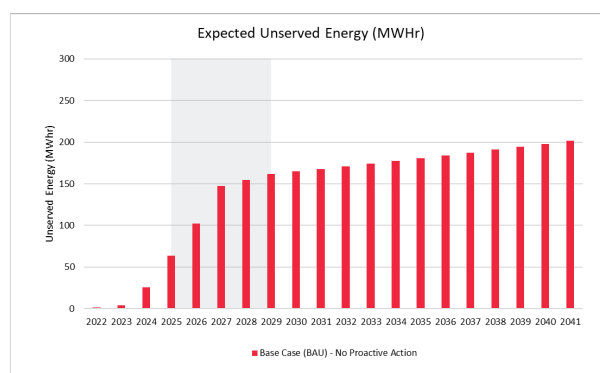
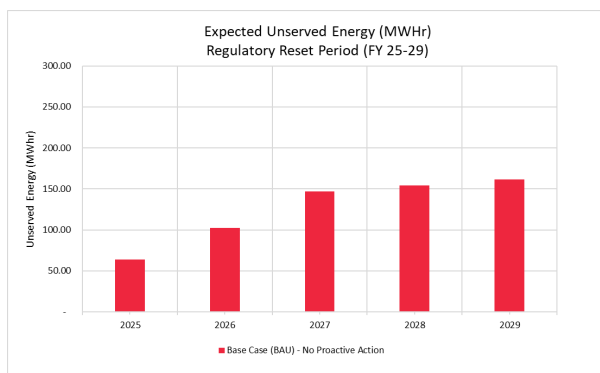


Figure 7 - Expected Unserved Energy as a result of “no proactive intervention”

Table 3: Value of Expected Unserved Energy as a result of “no proactive intervention”

	2025	2026	2027	2028	2029	2030	2031	2036	2041
Expected Unserved Energy (MWh)	64	103	147	154	162	165	168	184	202
Value of Unserved Energy (\$M)	1.6	2.5	3.6	3.8	4.0	4.0	4.1	4.5	5.0

3.2 Credible Network Options

The National Electricity Objectives (NEO) as stated in the National Electricity Law (NEL) require Endeavour Energy to operate the networks in the long-term interests of consumers. The options comparison table below (Table 14) sets out the **credible options** that were considered, together with a counterfactual option: “*no proactive intervention*” to assist the overall comparison. These include all substantially differing commercially and technically credible options, including non-network solutions. Credible options (or a group of options) are those that meet the following criteria:

- addresses the identified need
- is (or are) commercially and technically feasible
- can be implemented in sufficient time to meet the identified need

Each credible network option is further elaborated in the subsequent chapter.

3.2.1 Option 2A – Establish a 35 MVA firm Berrima Junction ZS

3.2.1.1 Scope

This option proposes to establish Berrima Junction ZS with 2x 35 MVA transformers which provides a firm substation capacity of 35 MVA by FY26. While this alleviates the first network constraint of the single transformer at the temporary substation, it does not resolve the failure of feeder 7905.

This option proposes following equipment to be installed on the site of the existing temporary zone substation:

- 2 x 35 MVA 33/11 kV transformers,
- 2 x transmission feeder bays,
- 2 x 33 kV bus sections and
- 2 x 11 kV switchboards.

Substation Design has previously advised that construction of the permanent zone sub is possible without first de-commissioning the existing temporary zone substation.

This option involves the establishment of the Berrima Junction ZS with 2 x 35MVA transformers, with both transformers commissioned in 2026. Figure 8 presents how this option will reduce the unserved energy when compared to the base case (“no proactive intervention”). While this option reduces the unserved energy when compared to the base case, unserved energy is still expected from 2027 onwards as the feeder 7905 has not been resolved with this option. A high level SLD of this option can be found in on Figure 9.

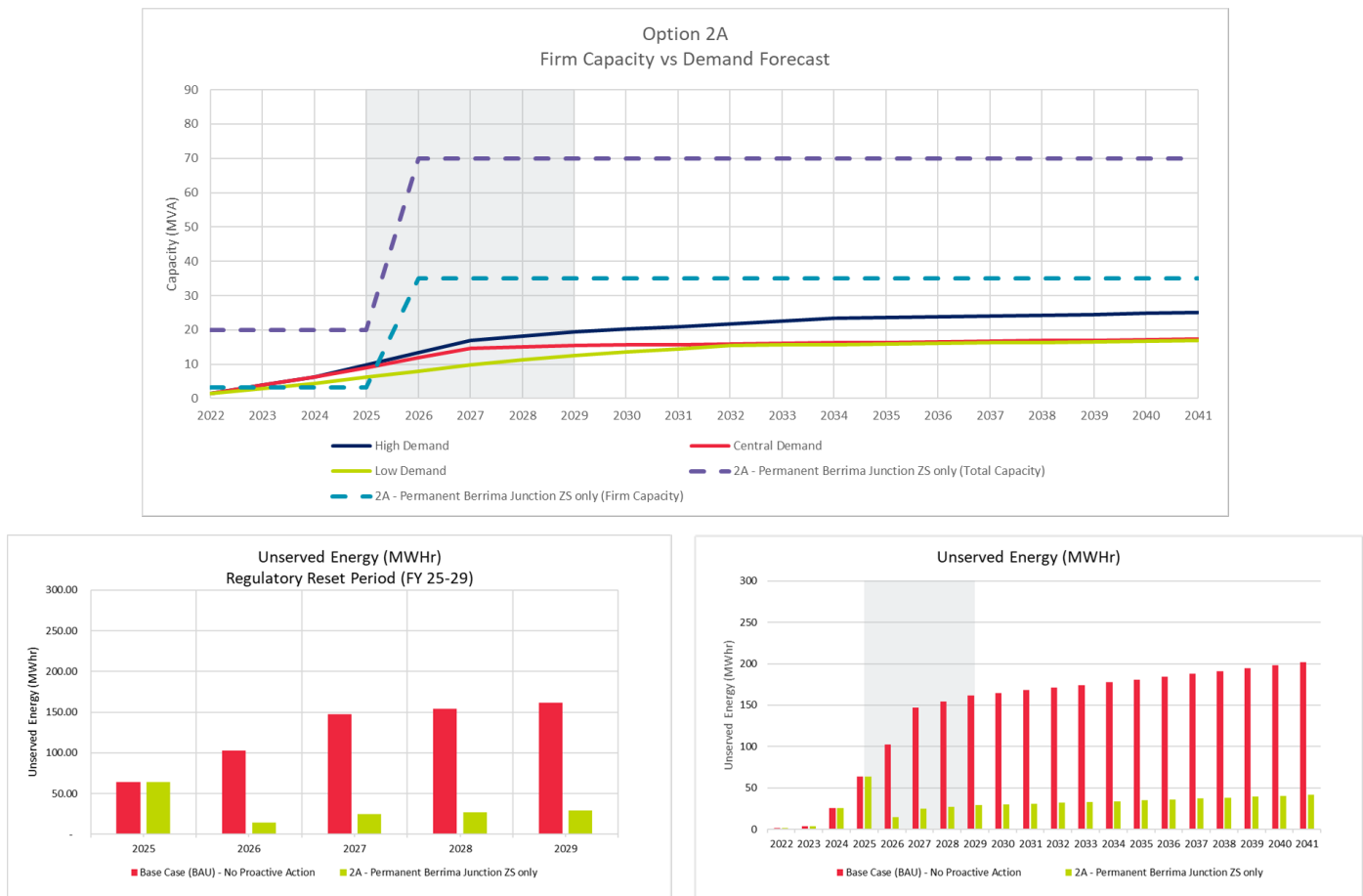


Figure 8: Summary of Option 2A. Expected Unserved Energy based on central case demand forecast

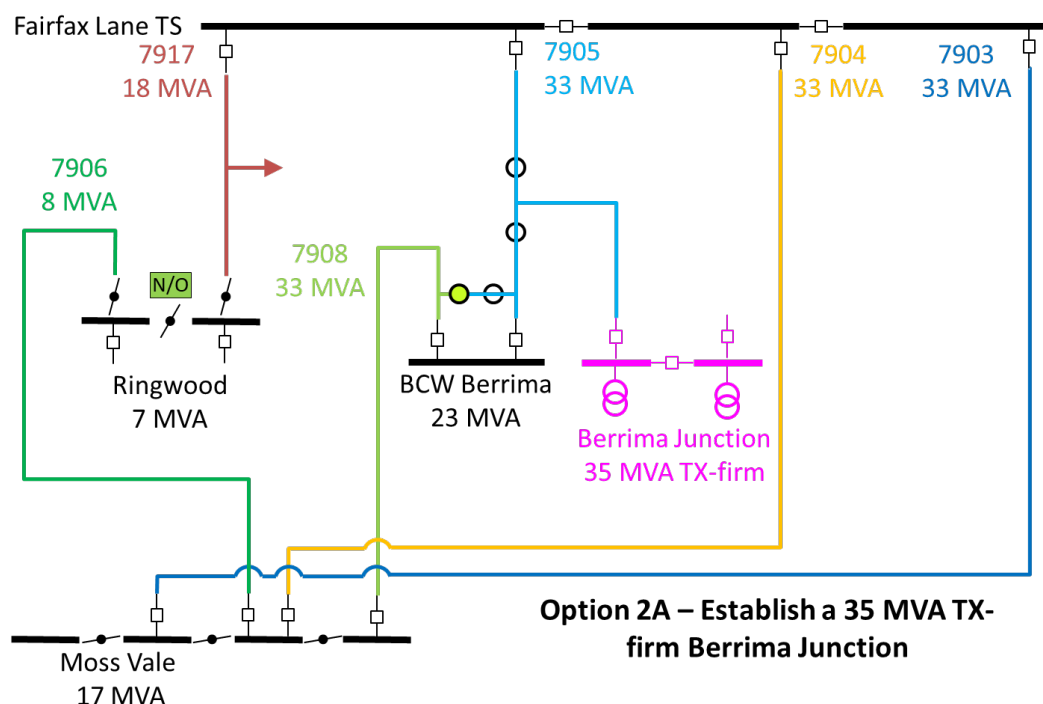


Figure 9 - High Level SLD for Option 2A. New assets in magenta.

3.2.1.2 Cost

Total estimated capital cost of Option 2A is \$13.0M. The cost is spread over two years to align with construction timelines, and it is based on estimates provided by Endeavour Energy's estimating team. Commissioning of new equipment from Option 2A is planned for FY26. A summary of the capital cost can be found in Table 4.

The total present value of costs for Option 2A is \$10.0M.

Table 4 - Option 2A - Capital cost summary

Option	2024	2025
2A	\$7.78M	\$5.19M

3.2.1.3 Benefits & NPV

The NER states that quantifiable economic market benefits (needs) include changes in involuntary load shedding. The costs and benefits analysis described in the following section included this benefit in determining the best option. Endeavour Energy's Unserved Energy Template was used to estimate the involuntary load shedding that can be prevented as a result of proactive action. The HK model utilised the involuntary load shedding along with a Value of Customer Reliability to calculate a market benefit. There were no other identified risks that were included in the costs and benefits analysis.

The assumptions used in the HK model are stated below, and the NPV summary is provided in Table 5 below.

- A study period of 30 years;
- The commercial discount rate was set to 3.26% based on the pre-tax real WACC for the 2025-29 determination period and $\pm 1.04\%$ for low and high sensitivities.
- A composite VCR of \$47,240 was used based on 95% commercial and 5% industrial, which is a conservative estimate of the load profile in this area
- A maintenance cost estimate based on 0.4% of the project cost, commencing the year after commissioning; and
- The benefits of options are based on the avoided unserved energy.
- NPV based on the central scenario

Table 5 – Summary of Option 2A

Option	PV “Market Benefits” (\$M)	PV Costs (\$M)	NPV (\$M)
2A	\$110.1	\$10.0	\$100.0

3.2.2 Option 2B – Establish a 35 MVA firm Berrima Junction ZS with a new feeder from Moss Vale ZS to Berrima Junction ZS

3.2.2.1 Scope

This option proposes to establish Berrima Junction ZS with 2x 35 MVA transformers which provides a firm substation capacity of 35 MVA by FY26. Additionally, this option will establish a new feeder from Moss Vale ZS to Berrima Junction ZS. This option resolves the key network constraints which is the single transformer at the temporary substation and the failure of Feeder 7905.

The Mains Design team has suggested rebuilding Moss Vale ZS 11 kV Feeder MVC2 Medway as a joint-use 33/11 kV feeder to reduce costs. The proposed route is shown above in Figure 10. The new transmission feeder will be rated with a minimum N-1 contingency rating of 70 MVA to support a future upgrade of Berrima Junction ZS to 70 MVA firm.. A 70 MVA firm Berrima Junction ZS will also require an extension of the new feeder to Fairfax Lane TS and the augment of Feeder 7905 to 70 MVA. An aerial route of the proposed feeder can be found in the figure below.

In addition to the new feeder, a 33 kV feeder bay will need to be installed at Moss Vale ZS for the new feeder, and a new 33 kV bus section circuit breaker bay will be required to prevent a 33 kV busbar fault from tripping the entire Moss Vale ZS 33 kV busbar. Due to space constraints, it is proposed to extend the Moss Vale ZS 33 kV busbar and install a second new 33 kV feeder bay to relocate Feeder 7906. After the relocation, the ex-Feeder 7906 feeder bay (CB MV32) will be removed and replaced by a new 33 kV bus section circuit breaker bay.



Figure 10 – The proposed route for the new 33 kV feeder between Moss Vale ZS and Berrima Junction ZS (Option B) and the proposed route for the new 33 kV tee-off Feeder 7906 to Berrima Junction ZS (Option C).

This option proposes following equipment to be installed:

- Berrima Junction ZS:
 - 2 x 35 MVA 33/11 kV transformers,
 - 2 x transmission feeder bays,
 - 2 x 33 kV bus sections and
 - 2 x 11 kV switchboards.
- 1 x 33 kV feeder from Moss Vale ZS
- Moss Vale ZS:
 - 2 x 33 kV feeder bay
 - 33 kV bus section extension
 - 1 x 33 kV bus section circuit breaker bay
 - Feeder 7906 relocation to one of the new 33 kV feeder bays

This option involves the establishment of the Berrima Junction ZS with 2 x 35MVA transformers, with both transformers commissioned in 2026. Figure 11 presents how this option will reduce the unserved energy when compared to the base case (“no proactive intervention”). This option can meet the forecasted central demand of the development with N-1 capacity until 2041. With both network constraints resolved, there is minimal expected unserved energy to 2041 with the central scenario. A high level SLD of this option can be found in on Figure 12.

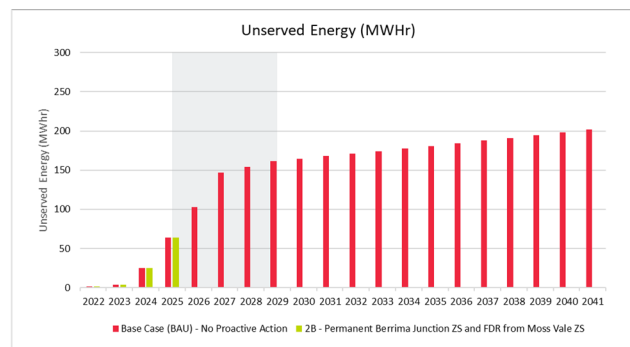
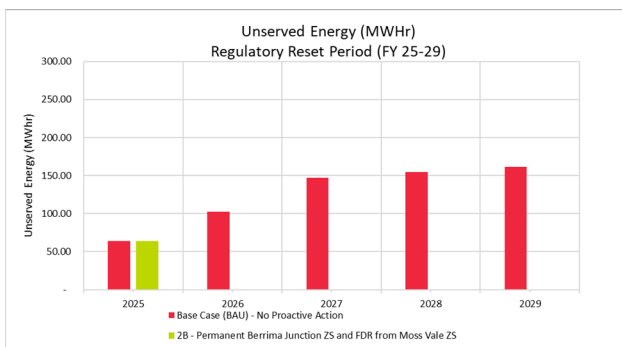
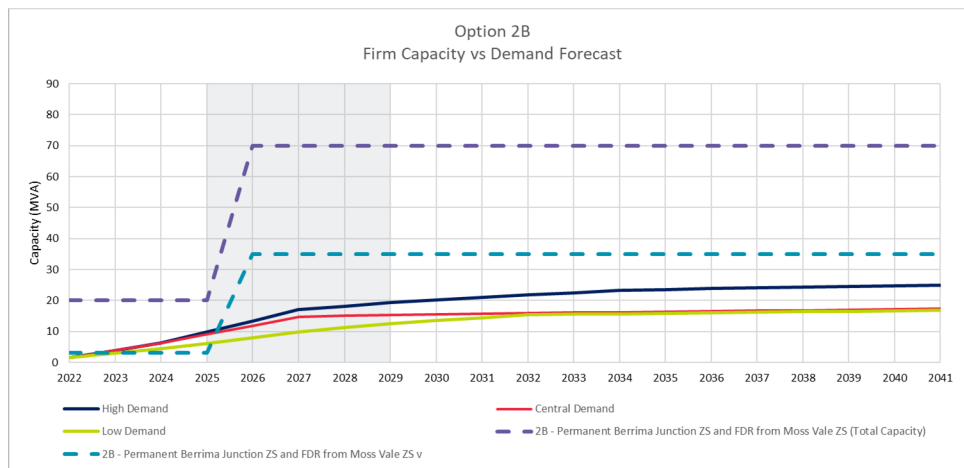


Figure 11 - Summary of Option 2B. Expected Unserved Energy based on central case demand forecast

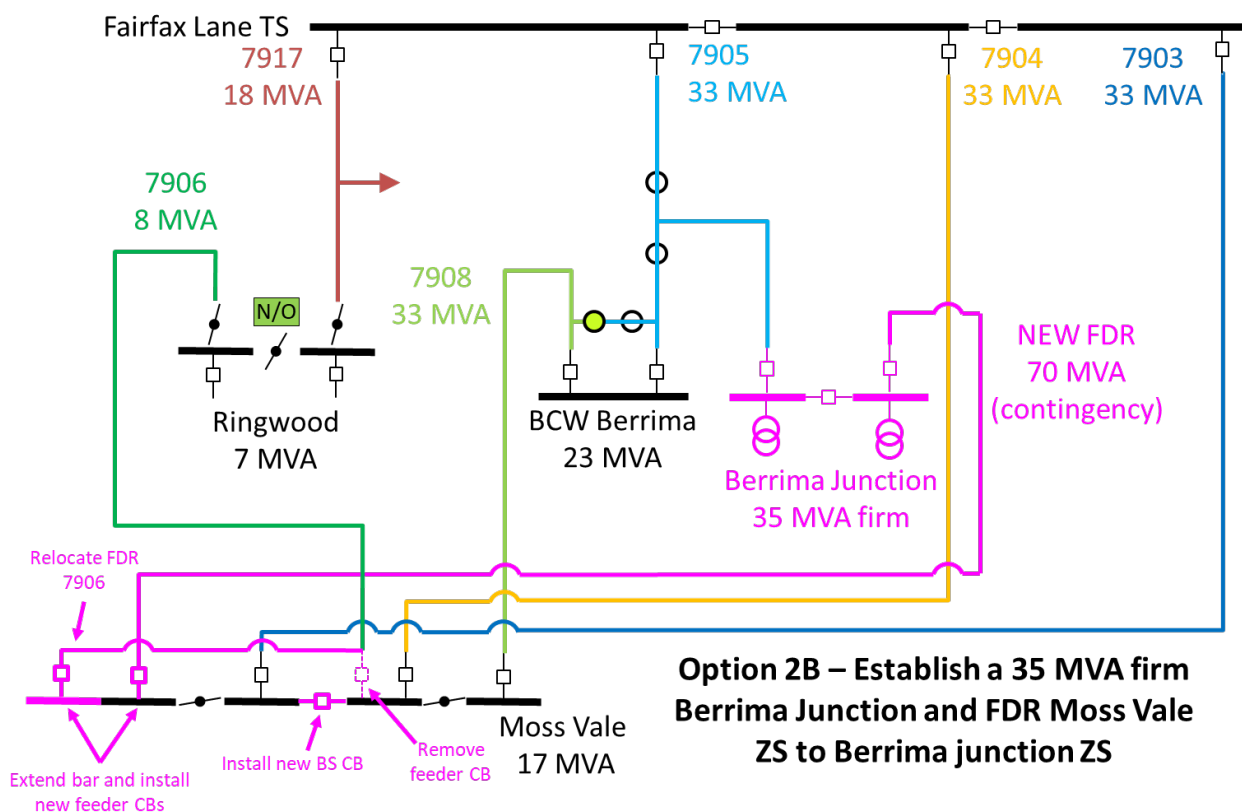


Figure 12 – High Level SLD for Option 2B. New assets in magenta.

3.2.2.2 Cost

The total estimated capital cost of Option 2B is \$14.9M. The cost is spread over two years to align with construction timelines, and it is based on estimates provided by Endeavour Energy's estimating team. Commissioning of the substation is planned for FY26. A summary of the capital cost can be found in Table 6.

The total present value of costs for Option 2B is \$11.6 M.

Table 6 - Option 2B - Capital cost summary

Option	2024	2025
2B	\$8.92M	\$5.95M

3.2.2.3 Benefits & NPV

The NER states that quantifiable economic market benefits (needs) include changes in involuntary load shedding. The costs and benefits analysis described in the following section included this benefit in determining the best option. Endeavour Energy's Unserved Energy Template was used to estimate the involuntary load shedding that can be prevented as a result of proactive action. The HK model utilised the involuntary load shedding along with a Value of Customer Reliability to calculate a market benefit. There were no other identified risks that were included in the costs and benefits analysis.

The assumptions used in the HK model are stated in Section 3.2.1.3. The NPV summary is provided in the Table 7 below.

Table 7 - Summary of Option 2B (Central Scenario)

Option	PV "Market Benefits" (\$M)	PV Costs (\$M)	NPV (\$M)
2B	\$136.9	\$11.6	\$125.3

3.2.3 Option 2C – Establish a 35 MVA firm Berrima Junction ZS with a tee-off from Feeder 7906 to Berrima Junction ZS

3.2.3.1 Scope

This option proposes to establish Berrima Junction ZS with 2x 35 MVA transformers which provides a firm substation capacity of 35 MVA by FY26. Additionally, this option tee-off Feeder 7906 Moss Vale ZS to Berrima Junction ZS. This option resolves the key network constraints which is the single transformer at the temporary substation and the failure of Feeder 7905.

The route of the tee-off is proposed to utilise "paper" roads from Douglas Rd to Beaconsfield Rd, and Beaconsfield Rd to Suttor Rd. Overhead construction is preferred, especially in the "paper" roads, which may need to be relocated in the future, but underground is assumed to be required through the residential areas, along Douglas Rd and across the railway line. The proposed route is shown above in Figure 9.

The tee-off will be rated with a minimum N-1 contingency rating of 70 MVA to support a future upgrade of Berrima Junction ZS to 70 MVA firm. A 70 MVA firm Berrima Junction ZS will also require the separation and extension of the tee-off to Fairfax Lane TS and the augment of Feeder 7905 to 70 MVA N-1 capacity. To support the tee-off, Feeder 7906 will need to be augmented with OPGW to implement three-way differential protection.

In addition to the tee-off, a new 33 kV bus section circuit breaker bay will be required at Moss Vale ZS and Ringwood ZS 33 kV disconnecter RW3711 will need to be replaced by a 33 kV bus section circuit breaker bay. The former will prevent a Moss Vale ZS 33 kV busbar fault from tripping the entire busbar, and the later is proposed to provide both Ringwood ZS busbar protection and Feeder 7906 protection.

Due to space constraints at Moss Vale ZS, it is proposed to install a new 33 kV feeder bay to relocate Feeder 7906. After the relocation, the ex-Feeder 7906 feeder bay (CB MV32) will be removed and replaced by a new 33 kV bus section circuit breaker bay.

This option proposes following equipment to be installed:

- Berrima Junction ZS:
 - 2 x 35 MVA 33/11 kV transformers,
 - 2 x transmission feeder bays,
 - 2 x 33 kV bus sections and
 - 2 x 11 kV switchboards.
- 1 x 33 kV tee-off feeder from Moss Vale ZS
- Augment Feeder 7906 with OPGW
- Moss Vale ZS:
 - 1 x 33 kV feeder bay
 - 1 x 33 kV bus section circuit breaker bay
 - Feeder 7906 relocation to the new 33 kV feeder bay
- Ringwood ZS:
 - 1 x 33 kV bus section circuit breaker bay

This option involves the establishment of the Berrima Junction ZS with 2 x 35MVA transformers, with both transformers commissioned in 2026. Figure 13 presents how this option will reduce the unserved energy when compared to the base case (“no proactive intervention”). This option can meet the forecasted central demand of the development with N-1 capacity until 2041. With both network constraints resolved, there is minimal expected unserved energy to 2041 with the central scenario. A high level SLD of this option can be found in Figure 14.

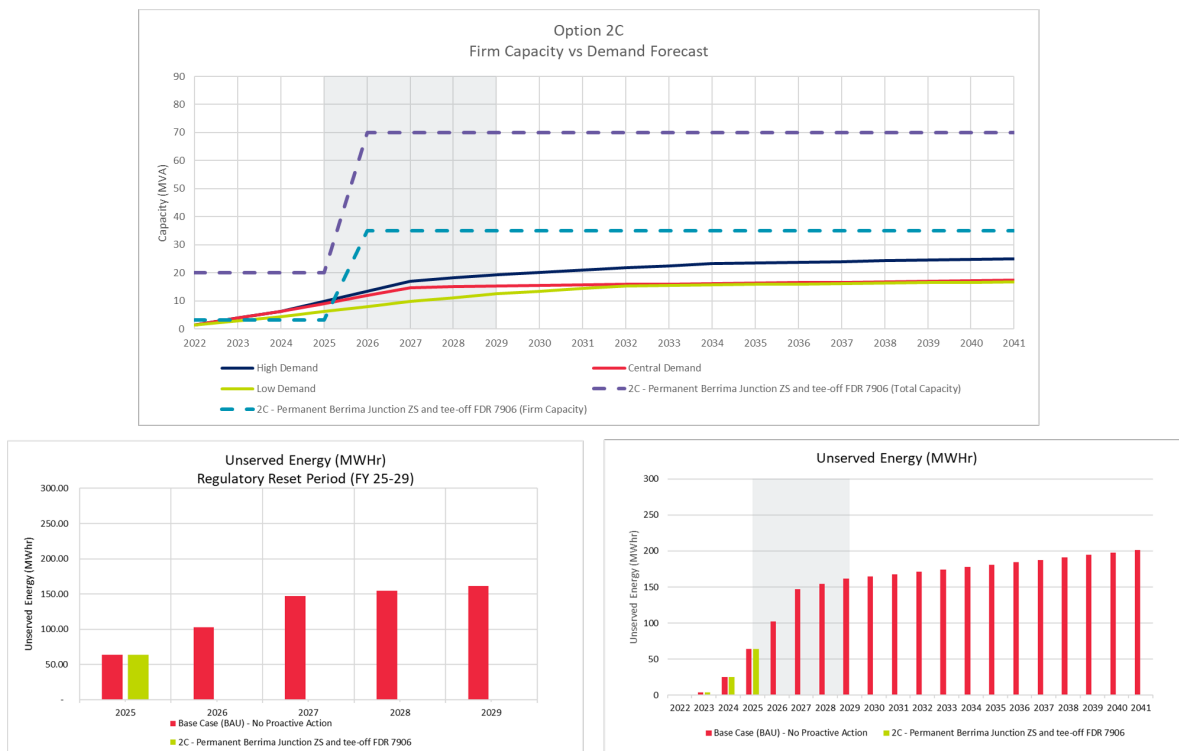


Figure 13 - Summary of Option 2C. Expected Unserved Energy based on central case demand forecast

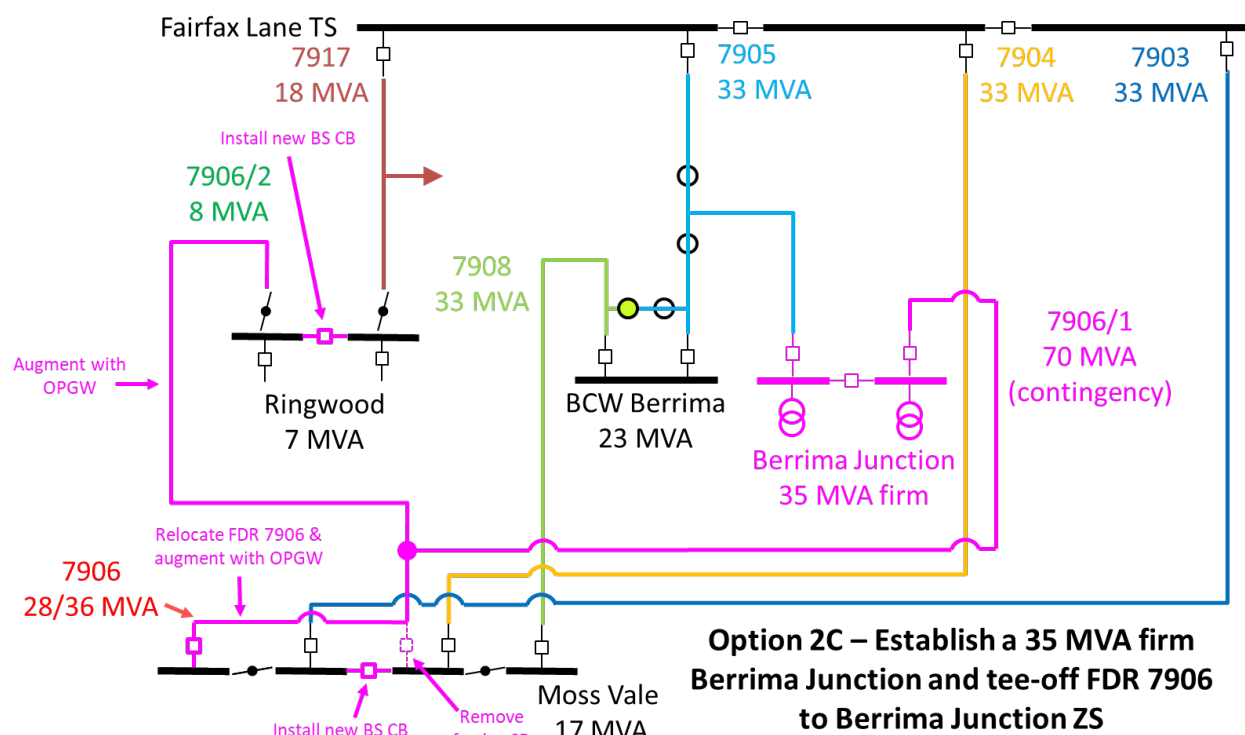


Figure 14 – Visual representation of the scope of works proposed under Option 2C. New assets in magenta.

3.2.3.2 Cost

The total estimated capital cost of Option 2C is \$16.6M. The cost is spread over two years to align with construction timelines, and it is based on estimates provided by Endeavour Energy's estimating team. Commissioning of new equipment from Option 2C is planned for FY26. A summary of the capital cost can be found in Table 6.

The total present value of costs for Option 2C is \$13.0M.

Table 8 - Option 2C - Capital cost summary

Option	2024	2025
2B	\$9.94M	\$6.63

3.2.3.3 Benefits & NPV

The NER states that quantifiable economic market benefits (needs) include changes in involuntary load shedding. The costs and benefits analysis described in the following section included this benefit in determining the best option. Endeavour Energy's Unserved Energy Template was used to estimate the involuntary load shedding that can be prevented as a result of proactive action. The HK model utilised the involuntary load shedding along with a Value of Customer Reliability to calculate a market benefit. There were no other identified risks that were included in the costs and benefits analysis.

The assumptions used in the HK model are stated in Section 3.2.1.3. The NPV summary is provided in the Table 9 below.

Table 9: Summary of Option 2C (Central Scenario)

Option	PV "Market Benefits" (\$M)	PV Costs (\$M)	NPV (\$M)
2C	\$136.9	\$13.0	\$123.9

3.2.4 Other Options Considered

3.2.4.1 Option C – Establish a 2 x 25 MVA transformer Berrima Junction ZS

One option considered is to establish a permanent Berrima Junction ZS with 2 x 25 MVA transformers instead of 2 x 35 MVA transformers presented under preferred Option 2B. Under this option, a third 25 MVA transformer can be installed as the load grows, creating a 50 MVA firm zone substation.

This option was not progressed as Option 2 is only \$0.4M more and provides an additional 10 MVA of firm capacity. As a result, Option 2 will be more NPV positive than Option 3 for most scenarios.

If the load exceeds the 35 MVA firm capacity installed under preferred Option 2B, a third 35 MVA transformer can be installed at an additional cost of approximately \$3.4M, which is only \$0.6M more while provided an additional 20 MVA firm capacity over Option 3. Additionally, as the third 35 MVA transformer would be installed significantly later than the third 25 MVA transformer, the NPV of the 35 MVA transformers option will be greater than the 25 MVA transformers option.

3.2.4.2 Option D – Establish a new feeder from Fairfax Lane TS to Berrima Junction ZS

Another option considered is to establish a permanent 2 x 25 MVA or 2 x 35 MVA transformers Berrima Junction ZS and establish a new feeder from Fairfax TS to Berrima Junction ZS. The new transmission feeder would be rated with a minimum N-1 contingency rating of 50/70 MVA to support a maximum capacity of 50/70 MVA at Berrima Junction ZS. This would also require the augment of Feeder 7905 to 50/70 MVA contingency. The new feeder is proposed to be connected to Fairfax Lane TS BS1 and BS3 to prevent an outage of either bus sections causing unserved energy.

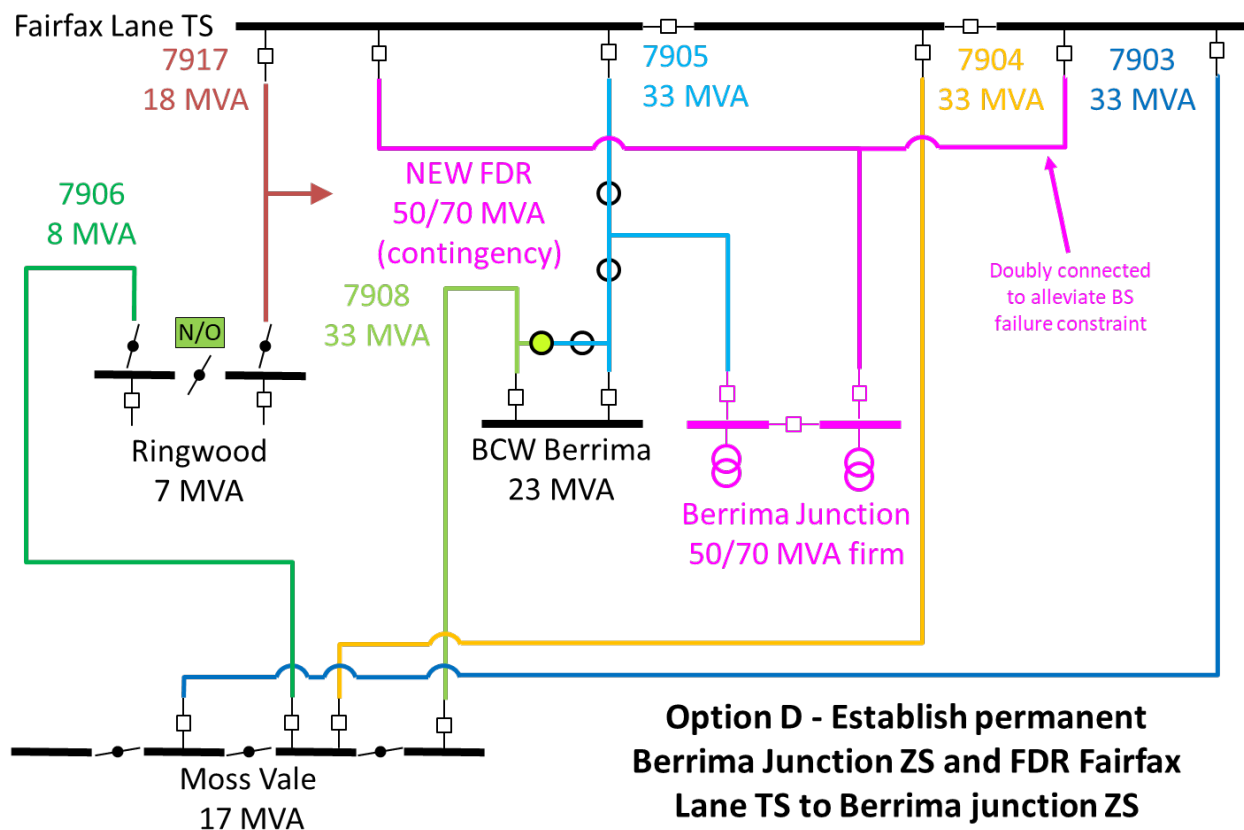


Figure 15 – Visual representation of the scope of works considered under Option D.

If implemented, this option will alleviate the unserved energy caused by a loss of the single 20 MVA transformer at the existing Berrima Junction ZS. This option will also alleviate all the unserved energy caused by transmission feeder faults on Feeders 7903, 7904, 7905 and 7908 that will eventuate when the load at Berrima Junction ZS matures.

This option was not progressed as it is estimated to cost an additional \$2.0M – \$4.4M to extend the new feeder from Moss Vale ZS to Fairfax Lane TS while providing minimal additional benefit. This option can

- also be implemented in the future when the unserved energy caused by transmission feeder faults can justify the expenditure.

3.2.4.3 Option E - Establish Berrima Junction as a staged 35 MVA firm substation with new feeder from Moss Vale ZS to Berrima Junction ZS

This option considered the staged establishment of Berrima Junction ZS. The first stage would establish the substation with 1x 35 MVA transformer by FY26. Additionally, the existing transformer and 11 kV switchboard from the mobile substation will remain which will result in 20 MVA of firm capacity at Berrima Junction ZS. The first stage will also establish a new feeder from Moss Vale ZS to Berrima Junction ZS similar to Option 2B. The 2nd stage of the project would install a 2nd 35 MVA transformer at Berrima Junction ZS in FY35, which would replace the 20 MVA transformer. The 2nd stage would also replace the existing 33 kV and 11 kV switchgear. This would result in a 35 MVA firm capacity substation by FY35. The initial analysis found that this option had a similar economic benefit (i.e., NPV) as Option 2B.

This option did not progress further due to the following issues with the use of the existing transformer and associated electrical switchgear:

- The existing transformer was manufactured in 1965 and is reaching end of life. Endeavour Energy's Regional Field Crew has also reported that the existing transformer has various oil leaks, and the tap changer will need to be replaced.
 - Discussion with Endeavour Energy's Asset Performance team has also indicated that if NPR-000060 did not proceed, this transformer would likely require replacement as part of REPEX in FY26.
- During high demand, it is expected that both transformers would need to be switched in. This would likely result in the 11 kV busbar being operated in a split configuration due to the mismatched impedances of having different transformers. A split configuration has the following consequences:
 - Momentary outages in the event of a fault on one of the 33 kV feeders or one of the transformers until changeover schemes operate or manual switching is conducted
 - The successful operation of restoration schemes is likely to be lower due to the requirement of nested protection schemes, which will affect customer reliability
 - Potentially impose operational constraints on the proposed data centre which requires multiple feeders to Berrima Junction ZS
 - Endeavour have observed similar issues at Claremont Meadows where operational constraints have limited future customer connections in the area
- Option E also has lower total and firm capacities compared to the non-staged Option 2B. This option limits the spare capacity available for future industrial and commercial customer applications.
- The existing 11kV switchgear (Circuit Transformer's, Voltage Transformers etc.) are unlikely to be suitable for transformer differential protection and deployment of underfrequency load shedding schemes.
 - Retrofitting of this equipment may either not be possible or result in a cost blowout on the project.

3.3 Recommended Network Options

The options table below sets out the **long-term credible options** considered together with the option: *BAU Base Case - "no proactive intervention"* to assist the overall comparison. Table 10 shows that Option 2B represents the highest value (economic benefit), being NPV positive of \$125 Million compared to other options, even with the sensitivity & scenarios considered in Section 3.4. However, we note that Option 2C has a marginally lower NPV of \$124 million (1% difference). **Option 2B** is still preferred over Option 2C as this option has a lower CAPEX during the FY25-29 regulatory cycle (\$1.7 million), while providing the same net benefits. Hence, **Option 2B** is the preferred long term credible network configuration as it is the

least cost and technically feasible option which will allow Endeavour Energy to connect the greatest number of customers in the area.

Table 10: Summary of credible options

Option	Description	Solution Type	PV residual risk ¹ \$M	PV Cost ² \$M	PV Benefits ³	NPV ⁴ \$M	Rank	Assessment Description
N / A	No proactive intervention	Base case / counterfactual	-141.3	-	-	-141.3	4	Non-preferred as will lead to unacceptable risk or higher cost for customers if opportunity not captured
2A	Establish a 35 MVA firm Berrima Junction ZS	Network solution	-	10.0	110.1	100.0	3	Technically feasible, lower net benefits
2B	Establish a 35 MVA firm Berrima Junction ZS with a new feeder from Moss Vale ZS to Berrima Junction ZS	Network Solution	-	11.6	136.9	125.3	1	Greatest Net Benefits, Preferred Long Term option
2C	Establish a 35 MVA firm Berrima Junction ZS with a tee-off from Feeder 7906 to Berrima Junction ZS	Network Solution	-	13.0	136.9	123.9	2	Technically feasible, lower net benefits

Notes:

1: PV residual risk cost (or savings for opportunities) post the investment. Further details on the risks considered can be found in Appendix A.

2: PV of total costs, both Capex and Opex..

3: PV of total quantified benefits, both risk mitigated, and any forecast decrease in Capex or Opex arising as a result of undertaking the investment (opportunities).

4: PV Benefits less PV Investment Costs

5. The breakdown of PV is based on the central demand forecast scenario

3.4 Sensitivity and Scenario Analysis

3.4.1 Sensitivity Analysis

Sensitivity tests have been applied to the economic evaluation in the Houston Kemp model and results are shown below. The following sensitivities were tested:

- Discount rates from 2.22% to 4.3% (advice provided by HK);
- Maintenance costs \pm 25%;
- Capital costs \pm 25%; and,
- VCR \pm 25%.

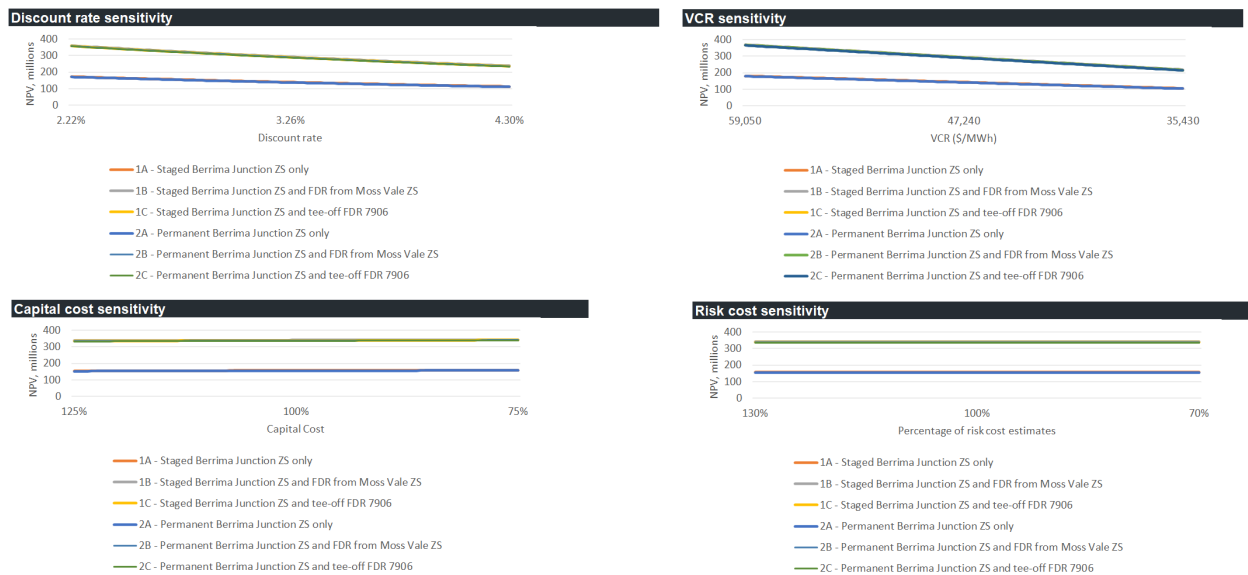


Figure 16 – Sensitivity testing completed using the HK model.

3.4.2 Scenario Analysis: Weighted NPV Scenarios

The model has carried out scenario analysis considering the parameters below.

Scenario settings						
Parameters		S1	S2	S3	S4	
General parameters		Central	High	Low	[Extra]	Notes
Commercial discount rate	Percent	3.26%	2.22%	4.30%	3.26%	
VCR for involuntary load shedding	\$/MWh	47,240	59,050	35,430	47,240	
VCR for voluntary load curtailment	\$/MWh	47,240	59,050	35,430	47,240	
Cost parameters		Central	High	Low	[Extra]	Notes
Capital cost	Factor	1.00	0.75	1.25	1.00	
Planned routine maintenance and refurbishment	Factor	1.00	0.75	1.25	1.00	
Unplanned corrective maintenance	Factor	1.00	1.25	0.75	1.00	
Decommissioning costs	Factor	1.00	1.25	0.75	1.00	
NNO proponent charges	Factor	1.00	0.75	1.25	1.00	
Cost X	Factor	1.00	1.00	1.00	1.00	
Risk cost parameters		Central	High	Low	[Extra]	Notes
Reliability and security risk costs	Factor	1.00	1.30	0.70	1.00	
Safety and health risk costs	Factor	1.00	1.30	0.70	1.00	
Environmental risk costs	Factor	1.00	1.30	0.70	1.00	
Legal/regulatory compliance risk costs	Factor	1.00	1.30	0.70	1.00	
Financial risk costs	Factor	1.00	1.30	0.70	1.00	
Benefit parameters		Central	High	Low	[Extra]	Notes
Avoided involuntary load shedding	Factor	1.00	1.00	1.00	1.00	
Avoided voluntary load curtailment	Factor	1.00	1.00	1.00	1.00	
Avoided costs for non-RIT-D proponent parties	Factor	1.00	1.00	1.00	1.00	
Differences in the timing of unrelated network expenditure	Factor	1.00	1.00	1.00	1.00	
Changes in load transfer capacity	Factor	1.00	1.00	1.00	1.00	
Additional option value	Factor	1.00	1.00	1.00	1.00	
Changes in electrical energy losses	Factor	1.00	1.00	1.00	1.00	
Scenario weightings		Central	High	Low	[Extra]	Notes
Weightings	%	0.50	0.25	0.25	0.00	

Figure 17 - HK model scenario parameters

Table 11 - Summary of scenarios investigated

Variable	Scenario 1 – baseline	Scenario 2 – high benefits	Scenario 3 – low benefits
Capital cost	Estimated network capital costs	25% decrease in the estimated network capital costs	25% increase in the estimated network capital costs
Value of customer reliability (VCR)	\$47.2\$/kWh	\$59.0/kWh 30% higher than baseline	\$35.4\$/kWh 30% lower than baseline
Discount rate	3.26% (WACC)	2.22%	4.3%
Maintenance costs	Estimated network maintenance costs	25% increase in the estimated network maintenance costs	25% decrease in the estimated network maintenance costs
Scenario weighting	50%	25%	25%

The scenarios have been weighted as 50% for Scenario 1 being the most likely with Scenarios 2 and 3 being given a weighting of 25%. The weighted NPV for each option is shown in Table 12 below which demonstrates that Option 2B still has the greatest NPV.

Table 12 - Weighted NPV of Options

Option	Scenario 1 NPV (\$M)	Scenario 2 NPV (\$M)	Scenario 3 NPV (\$M)	Weighted NPV (\$M)	Option ranking
Option 2A	100.01	946.55	47.94	298.63	3
Option 2B	125.27	1040.12	60.47	337.78	1
Option 2C	123.88	1039.11	58.71	336.39	2

3.5 Proposed Investment Timing

The optimal timing where the value of unserved energy from the 'No Proactive Intervention' scenario exceeds investment costs for Option 2B is 2026 as per Figure 18. This timing aligns with the proposed commissioning date of Option 2B.

Annualised cost and optimal commissioning year for 2		
Option name	Annualised cost	Optimal year
2B - Permanent Be	634,698	2026

Visualisation of optimal commissioning date for 2B - Permanent Berrima Junction

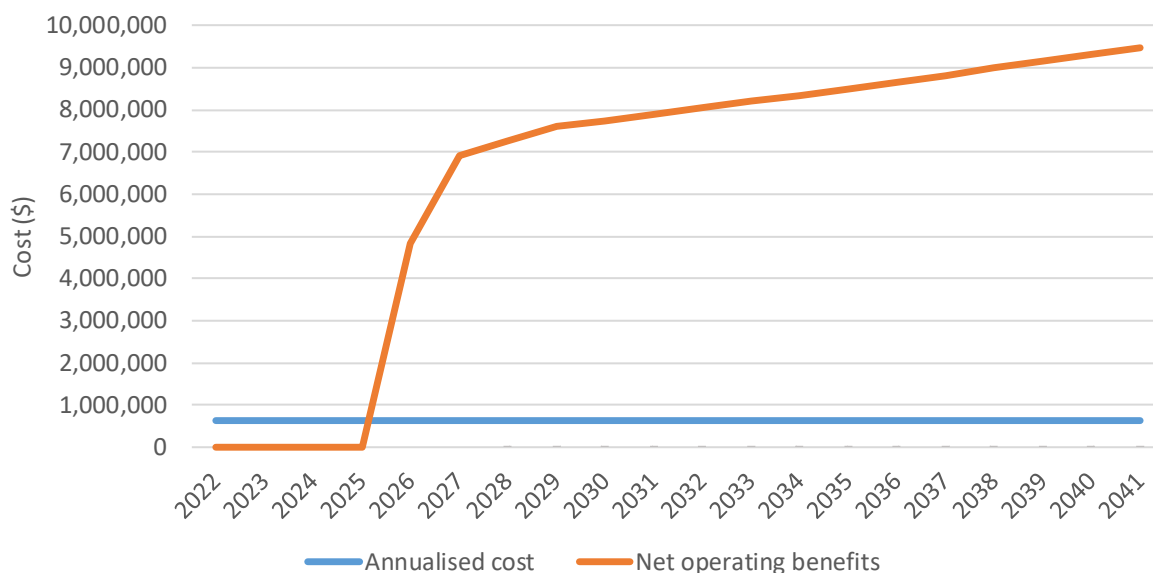


Figure 18: Houston Kemp optimal timing output for Option 2B

3.6 Non-network Options to Defer Network Investment

3.6.1 Scope

Electricity Distributors in NSW operate under the licence requirement (under the NSW Electricity Supply Act 1995) to investigate non-network alternatives to network augmentation for specific capital expenditure projects. The National Electricity Rules (NER) require Distribution Network Service Providers (DNSP) to investigate non-network options by utilising a consultation process as part of planning for major network augmentations.

The New Technology Master Plan (NTMP) tool and internal discussion with Endeavour Energy's Future Grid Team was used to evaluate credible non-network options with the constraint of the existing mobile substation. Figure 19 shows the comparison of non-network solutions and network solutions against the base case ("no proactive intervention"), while Figure 20 compares non-network solutions against the network solution.

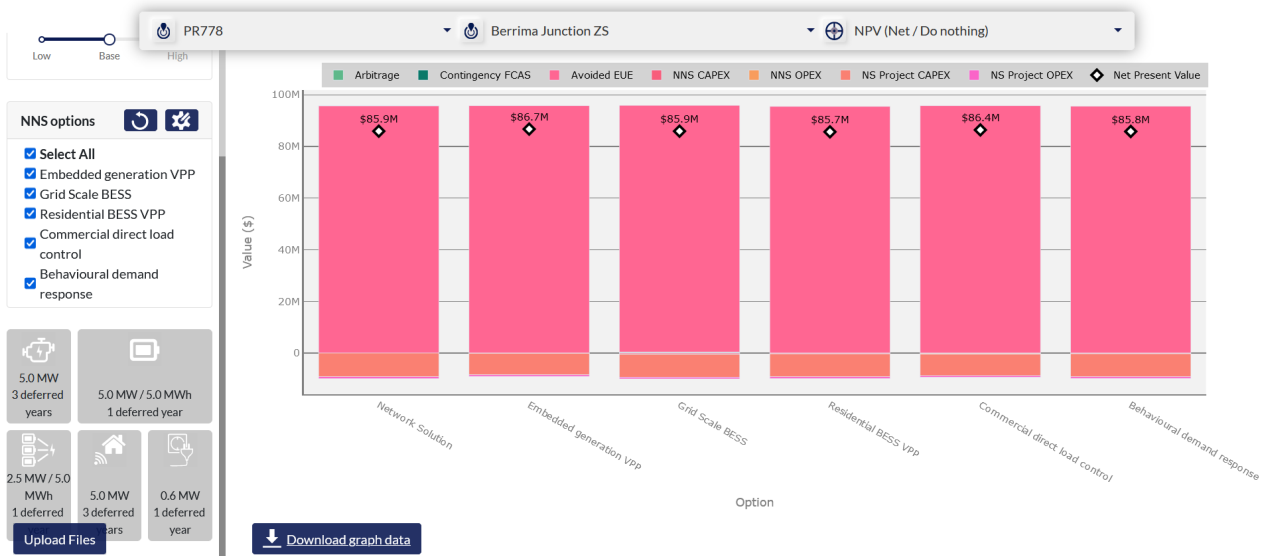


Figure 19: NTMP Output for Non-Network Options when compared to the Base Case ("no proactive intervention")

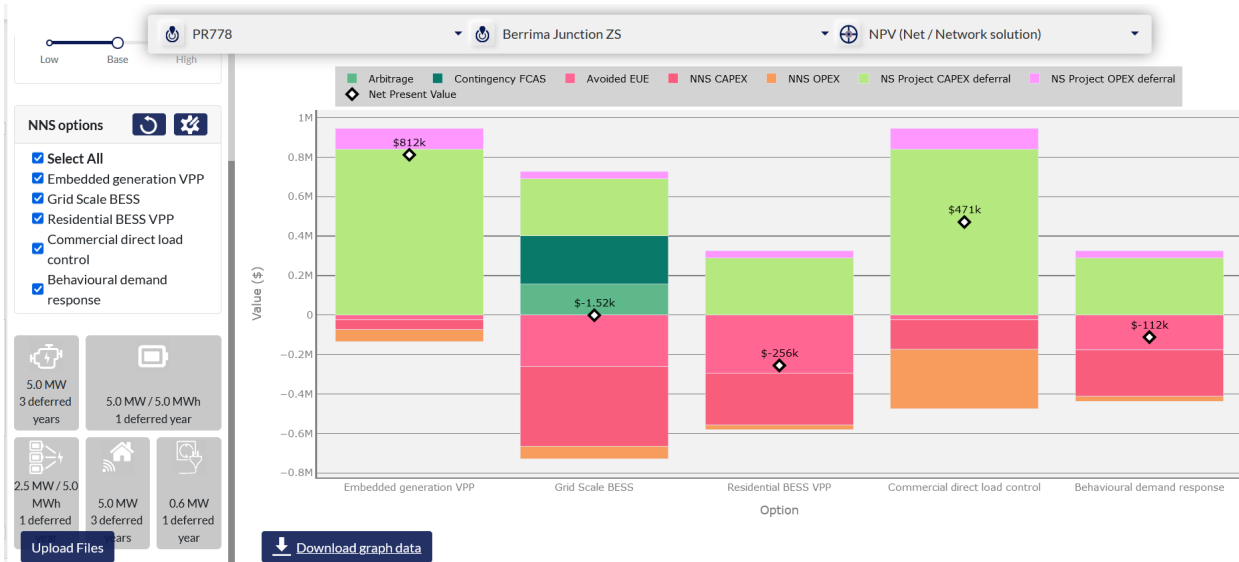


Figure 20 :NTMP Output for Non-Network Options when compared to the Network Solution

Table 13 provides an overview of the outputs from the NTMP tool and overlays with qualitative assessment.

Table 13: Non-Network / New Technology Options

Non-Network Options	Outcomes	Qualitative Assessment	Comments
Grid-Scale Storage (5MW /5 MWh)	Potentially defer the network investment by 1 year	✗	Not feasible due to lack of greenfield infrastructure. Additionally, it is NPV negative when compared to the network option and provides minimal deferral of network investment
VPP (5.0 MW)	Potentially defer the network investment by 3 years	✗	Not a feasible option as this is a new development which initially requires customers to connect to the network which is not feasible with existing network infrastructure.
Residential BESS VPP (2.5 MW /5 MWh)	Potentially defer the network investment by 1 year	✗	Not a feasible option as this is a new development which initially requires customers to connect. Additionally, it is NPV negative when compared to the network option and provides minimal deferral of network investment
Commercial Direct Load Control (5.0 MW)	Potentially defer the network investment by 3 years	✓	Commercial Load Control could be a feasible option to defer network investment if there is participation from existing customers and should be investigated further. Note that the deferred network investment may still fall within the FY25-29 regulatory cycle.
Behavioural Demand Response (0.6 MW)	Potentially defer the network investment by 1 years	✓	Behavioural Demand Response could be a feasible option to defer network investment if there is participation from existing customers and should be investigated further. Note that the deferred network investment may still fall within the FY25-29 regulatory cycle.

3.6.2 Summary

The NTMP tool and the subsequent qualitative analysis found at least two credible non-network options (Commercial Direct Load Control & Behavioural Demand Response). These options need to be further evaluated using the screening test in the RIT-D process. As part of the RIT-D process, Endeavour Energy will issue a non-network options report before progressing with the Draft Project Assessment Report (DPAR).

4. Detailed description and costs of preferred option

The scope of works for preferred Option 2B is:

- Establish a permanent Berrima Junction ZS on the site of the existing temporary zone sub. The new substation shall have 2 x 35 MVA 33/11 kV transformer, 2 x transmission feeder bay and 2 x 11 kV switchboards.
 - Substation Design has previously advised that construction of the permanent zone sub is possible without first de-commissioning the existing temporary zone sub.
- De-commission the existing temporary Berrima Junction ZS.
- Augment Moss Vale ZS:
 - Extend west-most 33 kV busbar to allow for two 33 kV feeder bays
 - Install two new 33 kV feeder bays on west-most 33 kV busbar
 - Relocate Feeder 7906 to from CB MV32 feeder bay to west-most new feeder bay
 - Remove CB MV32 feeder bay to make room for a new bus section circuit breaker bay
 - Install a new bus section circuit breaker bay in ex-CB MV32 feeder bay
- Establish a new 33 kV Feeder from Moss Vale ZS to Berrima Junction ZS.

The proposed commissioning date of preferred Option 2 is FY26.

Total capex forecast

The total cost of preferred Option 2B is \$14.9M with a contingency of \$1.5M, and costs p.a. were assumed to be 60%-40%.

Table 14 – Capex forecast for preferred Option 2B. The costs in this table include CPI.

CAPEX (\$M)	FY22	FY23	FY24	FY25	Total
Option 2	0.0	0.0	8.92	5.95	14.9

The breakdown of the capex for preferred Option 2B is as follows (see Appendix C for full details):

Table 15 – Capex breakdown for preferred Option 2.

Cost item	Cost (\$M) / %
Resource costs	0.02M / 0%
Labour costs	2.01M / 13%
Store costs	0.13M / 1%
Plant costs	0.08M / 1%
Direct charges	12.15M / 82%

Distribution works	0.47M / 3%
CPI	0.02 / 0%
Total cost, including CPI	14.9M / 100%

5. Recommendations and Next Steps

Based on the Endeavour Energy's RIT-D process (Figure 21), it is recommended that:

- A Non-Network Options Report be issued seeking submissions for non-network options, given that credible non-network options are available.
- If a feasible and cost-effective non network option is not received, proceed with the recommended network solution which is the establishment of a new permanent substation (Berrima Junction ZS) with a firm capacity of 35 MVA by 2026 with a new transmission feeder from Moss Vale VS to Berrima Junction ZS. This option is estimated to cost **\$14.9 Million** with a contingency of **\$1.5 Million** to be spread over two year from 2024-25.
- It is recommended that the project value of **\$16.4 Million** (inclusive of contingency) be approved for consideration in the FY23 Portfolio Investment Plan.
- The CFI will be finalised at the completion of the RIT-D process and a final approval will then be submitted to the confirm if the scope will include a non-network option and if the recommended timing of investment of the preferred network option will change.

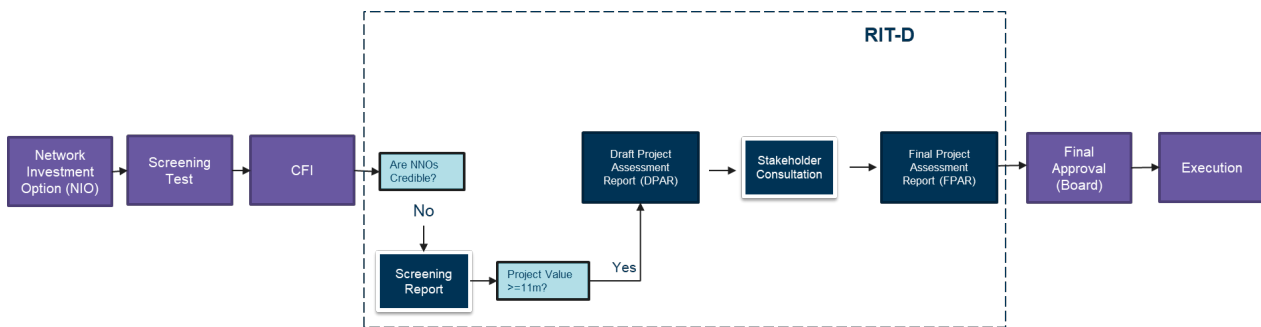


Figure 21: Endeavour Energy's RIT-D Process for this Project



Appendices

A. Listing of benefits, risks, and residual risks considered

The NER states that quantifiable economic market benefits (needs) include changes in involuntary load shedding. The costs and benefits analysis described in the previous section included this benefit in determining the best option. Endeavour Energy's Unserved Energy Template was used to estimate the involuntary load shedding that can be prevented as a result of proactive action. The involuntary load shedding was utilised by the HK model along with a Value of Customer Reliability to calculate a market benefit. There were no other identified risks that were included in the costs and benefits analysis.

8.1 Safety Considerations

The constraints analysed in the Berrima Junction area are capacity related and there are no known safety issues with the existing network assets. In analysing expected unserved energy for the constraint we have considered the impact of potential widespread outages. The proposed investment solutions will be designed to current network standards to ensure safe operation of the network for our staff and general public. The proposed solution reduces the expected unserved energy and is considered SFAIRP.

B. RIT-D / market engagement process

Electricity Distributors in NSW operate under the licence requirement (under the NSW Electricity Supply Act 1995) to investigate non-network alternatives to network augmentation for specific capital expenditure projects. The National Electricity Rules (NER) requires Distribution Network Service Providers (DNSP) to investigate non-network (demand management) options by utilising a thorough consultation process as part of planning for major network upgrades.

The NER calls for a regulatory investment test for distributors (RIT-D) process to be used in identifying the solution delivering the highest net market benefit in removing the network limitation. A “screening test” is performed for all network limitations where the most expensive credible option is greater than \$6 Million.

C. Detailed costs and benefits analysis

Expected unserved energy (EUE) scenarios

Seven EUE scenarios were investigated:

1. Berrima Junction TX failure, prior to switching to 11 kV backup
2. Berrima Junction TX failure, after switching to 11 kV backup
3. FDR 7905 failure between ABS 73410 and ABS 73409
4. FDR 7903 or 7904 failure
5. FDR 7908 failure
6. FDR 7905 failure between Fairfax Lane TS and ABS 73410
7. FDR 7905 failure between BCW Berrima and ABS 73409

Forecasts

Each scenario was given a forecast:

- For Berrima Junction ZS's forecast, the existing 1.5 MVA were combined with the following loads:
 - The data centre was assumed to grow by 2.4 MVA p.a., starting in FY23 with a max of 12 MVA, which is the applied 15 MVA multiplied by an 80% load actualisation factor.
 - The industrial subdivision loads were assumed to draw 40 VA/m² at each lot and then a 60% load actualisation factor was applied on top.
 - A diversity of 80% was used when summing all loads. Network Planning believes this forecast is a conservative forecast to strengthen the case for the preferred option.
 - Once load growth stagnated, a load growth of 1% p.a. was assumed.
 - See (Lee, Berrima Junction forecast load, 2022) for more details.
- The *Summer Demand Forecasts 2022* was used to find the forecasts for other loads.
 - Moss Vale was subjected to a 0.5% p.a. growth outside of the forecast while BCW Berrima was not subjected to any load growth.
- Network losses were not considered to be conservative.
- No diversity was applied when summing the zone substation and BCW Berrima loads together to calculate transmission feeder forecasts.
- Power factor was assumed to be 1.000.
- The (Lee, RIT-D EUE - Summary, 2022) spreadsheet was used to summate forecasts.

Case	Forecast	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Berrima Junction TX (before switching; w/o ENL)		1.50	3.72	5.94	8.41	10.87	13.33	13.57	13.81	13.95	14.09
Berrima Junction TX fail (after switching; w/o ENL)		1.50	3.72	5.94	8.41	10.87	13.33	13.57	13.81	13.95	14.09
FDR 7905 middle failure (w/o ENL)		1.50	3.72	5.94	8.41	10.87	13.33	13.57	13.81	13.95	14.09
FDR 7903/4 failure (w/o ENL)		41.90	44.42	46.64	49.11	51.67	54.23	54.57	54.81	55.05	55.19
FDR 7908 failure (w/o ENL)		24.90	27.12	29.34	31.81	34.27	36.73	36.97	37.21	37.35	37.49
FDR 7905 fail (before switching; w/o ENL)		1.50	3.72	5.94	8.41	10.87	13.33	13.57	13.81	13.95	14.09
FDR 7905 upper fail (after switching; w/o ENL)		24.90	27.12	29.34	31.81	34.27	36.73	36.97	37.21	37.35	37.49

Figure 22 – Forecasts used for the seven EUE scenarios.

Expected unserved energy

The expected unserved energy (EUE) for the seven EUE scenarios were calculated by Network Planning's EUE calculator. The main assumptions and changes are:

- Version 0.8 of the calculator was used.
- A modelling period of 30 years with 2022 as the base year.
- The forecasting data shown above.
- Custom load duration curves (LDCs) were used in this calculation:
 - For Berrima Junction ZS, a composite LDC was used using Smeaton Grange SS's profile (data centre) and Moorebank ZS's profile (industrial-commercial ZS). These profiles were scaled by the forecast loads in FY25, the proposed commissioning year.
 - For failure of FDR 7903 or FDR 7904, the custom Berrima Junction LDC was combined with BCW Berrima and Moss Vale ZS.
 - For the other transmission feeder failures, the custom Berrima Junction LDC was combined with BCW Berrima.
 - See (Lee, LDC calc & diversity, 2022) for more detail.
- The other inputs are as follows:

Asset unavailability	Transformers		Lines		Custom asset						
	Number of transformers	OH length (km)	UG length (km)	Line class	Number o	Failures/a	Outage duration (hrs)				
FDR 7905 upper fail (after switching; with ENL)					0.11	7.00	8.00				
Berrima Junction TX (before switching; w/o ENL)					1.00	0.01	2.00				
Berrima Junction TX fail (after switching; w/o ENL)					1.00	0.01	1896.00				
FDR 7905 middle failure (w/o ENL)		1.1		Rural							
FDR 7903/4 failure (w/o ENL)		8.9		Rural							
FDR 7908 failure (w/o ENL)		14.1		Rural							
FDR 7905 fail (before switching; w/o ENL)					0.20	7.00	1.00				
FDR 7905 upper fail (after switching; w/o ENL)					0.11	7.00	8.00				
Capacity	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	
FDR 7905 upper fail (after switching; with ENL)	66	66	66	66	66	66	66	66	66	66	66
Berrima Junction TX (before switching; w/o ENL)	20	20	20	20	20	20	20	20	20	20	20
Berrima Junction TX fail (after switching; w/o ENL)	20	20	20	20	20	20	20	20	20	20	20
FDR 7905 middle failure (w/o ENL)	33	33	33	33	33	33	33	33	33	33	33
FDR 7903/4 failure (w/o ENL)	99	99	99	99	99	99	99	99	99	99	99
FDR 7908 failure (w/o ENL)	66	66	66	66	66	66	66	66	66	66	66
FDR 7905 fail (before switching; w/o ENL)	66	66	66	66	66	66	66	66	66	66	66
FDR 7905 upper fail (after switching; w/o ENL)	66	66	66	66	66	66	66	66	66	66	66
Firm	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	
FDR 7905 upper fail (after switching; with ENL)	33	33	33	33	33	33	33	33	33	33	33
Berrima Junction TX (before switching; w/o ENL)	0	0	0	0	0	0	0	0	0	0	0
Berrima Junction TX fail (after switching; w/o ENL)	3.143672	3.127953855	3.112314085	3.0967525	3.081269	3.065862	3.050533	3.03528	3.020104	3.005004	
FDR 7905 middle failure (with ENL)	3.143672	3.127953855	3.112314085	3.0967525	3.081269	3.065862	3.050533	3.03528	3.020104	3.005004	
FDR 7903/4 failure (w/o ENL)	66	66	66	66	66	66	66	66	66	66	66
FDR 7908 failure (w/o ENL)	33	33	33	33	33	33	33	33	33	33	33
FDR 7905 fail (before switching; w/o ENL)	0	0	0	0	0	0	0	0	0	0	0
FDR 7905 upper fail (after switching; w/o ENL)	33	33	33	33	33	33	33	33	33	33	33

Figure 23 – Asset unavailabilities, total capacities and firm capacities for the seven EUE scenarios.

- For the firm capacity for Berrima Junction TX failure and FDR 7905 middle failure, the available 11 kV backup from Moss Vale ZS was used, depreciating at 0.5% p.a.

D. Referenced documents and appendices

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Produced by Asset Planning & Performance

W Endeavourenergy.com.au
E news@endeavourenergy.com.au
T 131 081



ABN 11 247 365 823