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## Electricity Distribution Price Review FY2027 to FY2031

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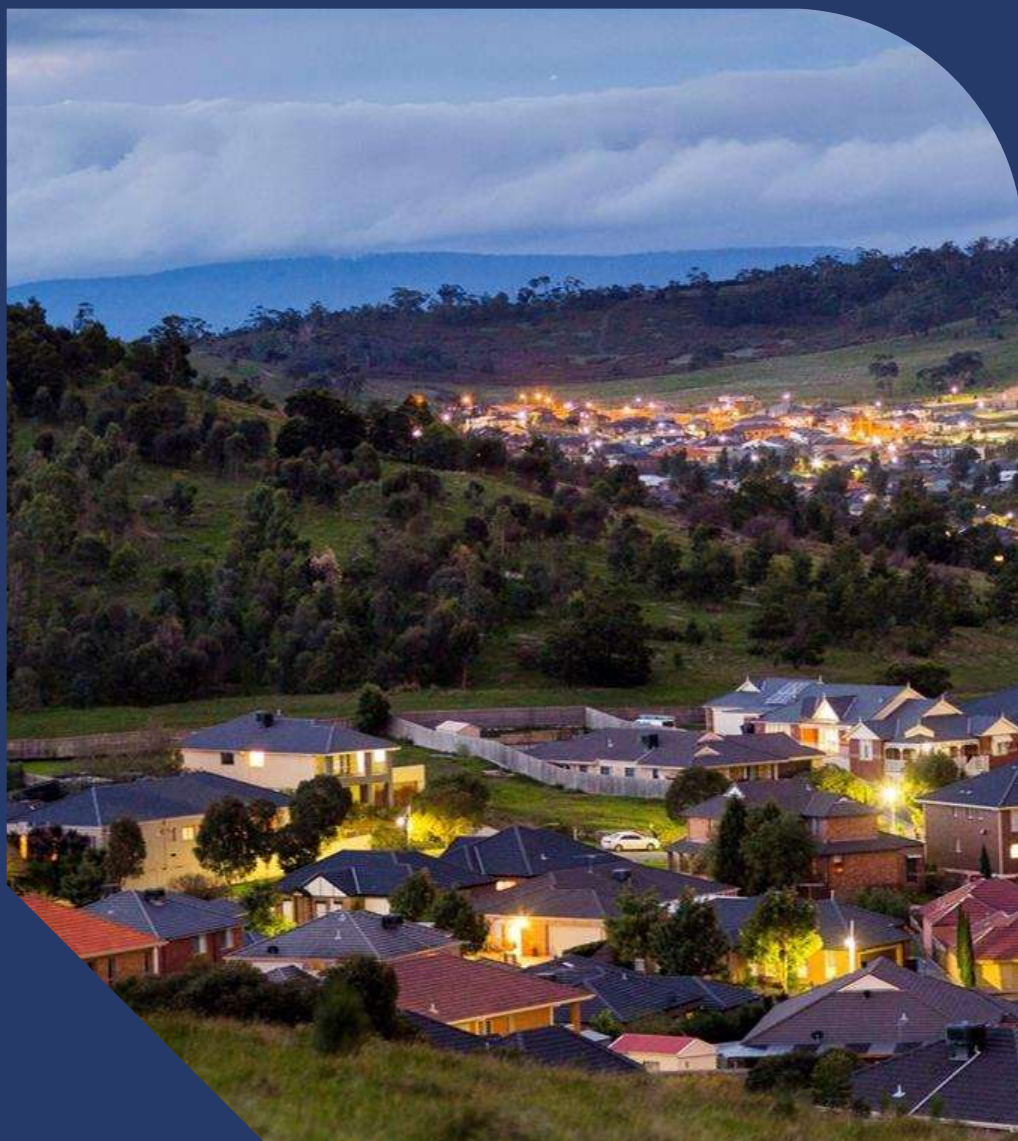
Business case: Benalla 11 – High Voltage Feeder

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# Table of contents

<b>1.</b>	<b>Introduction</b>	<b>2</b>
1.1.	Background	2
1.2.	Feeder Summary	2
1.3.	Feeder Reliability Summary	4
<b>2.</b>	<b>Investment Analysis</b>	<b>9</b>
2.1.	Intervention Philosophy	9
2.2.	Recent Investments	9
2.3.	No Proactive Interventions	10
2.4.	Potential and Recommended Interventions	11
<b>3.</b>	<b>Investment Recommendation</b>	<b>16</b>
<b>4.</b>	<b>Appendices</b>	<b>17</b>
4.1.	Appendix 1 – Single Line Diagram	17
4.2.	Geographic Location of Feeder	18
4.3.	Heat Map of Outages	19
4.4.	Outage History	23
4.5.	Summary of key risk assessment variables and assumptions	33
4.6.	Option Analysis Inputs	34

# 1. Introduction

## 1.1. Background

The document outlines a business case for intervention investments as they relate to improving the reliability and resilience of the customers at Benalla, Violet Town and Euroa, by specifically looking at the reliability of distribution feeder BN11.

This investment is required under the Electricity Distribution Code of Practice (EDCOP) which states:

*"A distributor must use best endeavours to meet targets determined by the AER in the current distribution determination and targets published under clause 13.2.1 and otherwise meet reasonable customer expectations of reliability of supply." (clause 13.3.1)*

We are acutely aware of the reliability expectations of this community and consider these reasonable. To maintain compliance with the EDCOP, we are proposing an Express Feeder which would provide route diversity that will benefit customers in the township of Euroa and surrounding areas.

This business case outlines the following processes:

- **Analysed data to forecast risk:** Utilising historical network reliability and asset data to outline the current exposure risk associated with the investigated feeder.
- **Assessed various options:** Analysing potential investment factoring in cost and benefit, and comparing them against the status-quo / do-nothing options.
- **Identified the preferred option:** Costs and benefits from above were converted into cashflow streams to allow the Net Present Value (NPV) to be calculated. We have selected the preferred option based on the option that is able to deliver the highest NPV of all the options assessed, across all sensitivity scenarios.

## 1.2. Feeder Summary

The following table gives a summary into the feeder:

**Table 1: Feeder BN11 Summary**

Feeder Name	Benalla BN11			
Feeder Type	Rural Long			
Feeder Zone Substation	Benalla			
REFCL Coverage / Area	YES – commissioned in late 2023.			
Length of Line	22kV		12.7kV SWER	
	Total (kms)	661.7	Total (kms)	547
	OH (kms)	653.1 (99%)	OH (kms)	546 (99.5%)
	UG (kms)	8.37 (1%)	UG (kms)	1 (0.5%)
	Complete MV Feeder Length (kms)	1216		
Feeder Length through treed areas <sup>1</sup>	273kms (23% of total feeder length)			
Number of Customers	4,723			
Number of Life Support Customers	137 (3%)			
Number of Switches	Total Reclosers	39		
	Total Sectionalisers	7		

<sup>1</sup> As per Vicmap Vegetation - Tree Density Polygon

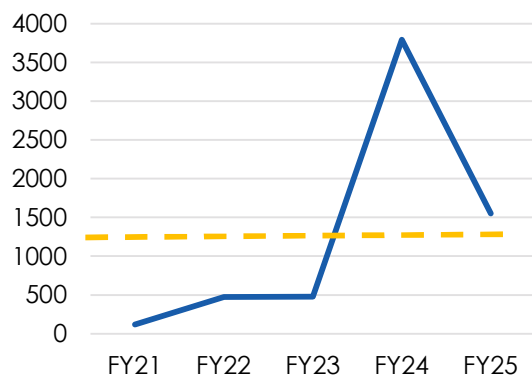
Tie points	Total	1	Automated	0 (0%)
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The BN11 feeder supplies customers to the west of Benalla. The supply area covers the townships of Violet Town and Euroa as well as the surrounding areas. The BN11 feeder largely falls within a high bushfire risk area and the BN11 feeder is Rapid Earth Fault Current Limiter (REFCL) enabled. This feeder is the longest feeder within AusNet's MV network.

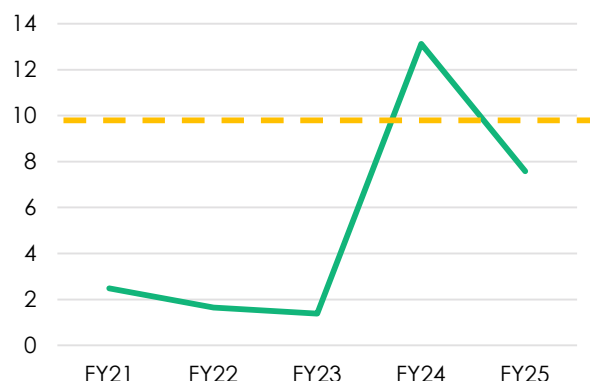
# 1.3. Feeder Reliability Summary

The following graphs show a rolling 12-month reliability summary for both frequency (SAIFI) and duration (SAIDI) of normalised unplanned sustained outages. This performance is compared against a performance threshold<sup>2</sup>.

**Feeder SAIDI**



**Feeder SAIFI**



As it can be seen from the above graphs, this feeder became poor performing during FY24 due to both duration of outages and number of outages. It remained poor performing for FY25 due to outage duration.

## 1.3.1. Cause Summary

Table 2 compares average sustained historical performance against the last 12 months (non-MED performance).

**Table 2: Cause type summary**

Cause Type	Quantity			Feeder CMOS			Average Contribution per event (Av CMOS / Av No Incidents)
	Avg p.a. (FY20-25)	Last 12 months	% of average	Avg p.a. (FY20-25)	Last 12 months	% of average	
Animal	26	9	34%	252,565	504,911	200%	9,640
Asset failure	12	16	133%	24,677	25,206	102%	2,056
Other	4	4	95%	33,521	61,645	184%	7,981
Overload	3	2	63%	261,649	1,278,065	488%	81,765
Vegetation	8	5	63%	1,867,882	4,575,406	245%	233,485
Weather - Lightning	31	23	76%	1,526,630	258,589	17%	50,218
Weather - Other	15	7	46%	1,574,615	536,708	34%	103,593
Unknown	19	13	69%	499,227	60,534	12%	26,555
<b>Total</b>	<b>118</b>	<b>79</b>	<b>67%</b>	<b>6,040,766</b>	<b>7,301,064</b>	<b>121%</b>	<b>51,193</b>

As it can be seen from the above table, the feeder experiences an average of 118 sustained interruptions per year, with an average contribution of 6.040 million customer minutes. The predominate causes of incidents on this feeder are:

<sup>2</sup> As there are currently no published individual feeder thresholds for Victoria, the published NSW thresholds have been used for Short Rural, Urban and Long Rural Metrics.

- **Vegetation**

- Attributing 21% of total CMOS and 7% of the number incidents. Indicating that whilst infrequent, the time to restore is significant.
- Approximately 40% of these incidents are vegetation being blown into the mains and 40% are trees coming into contact with the mains.
- However the blow-in vegetation is accounting for nearly 70% of the duration of outages.
- With the feeder having 23% tree coverage, this performance is not unexpected.

- **Adverse weather**

- Contributing 32% of the CMOS and 13% of number incidents.
- The data is not specific enough to determine the root cause of majority of incidents;
- There is a small portion which can be attributed to vegetation.

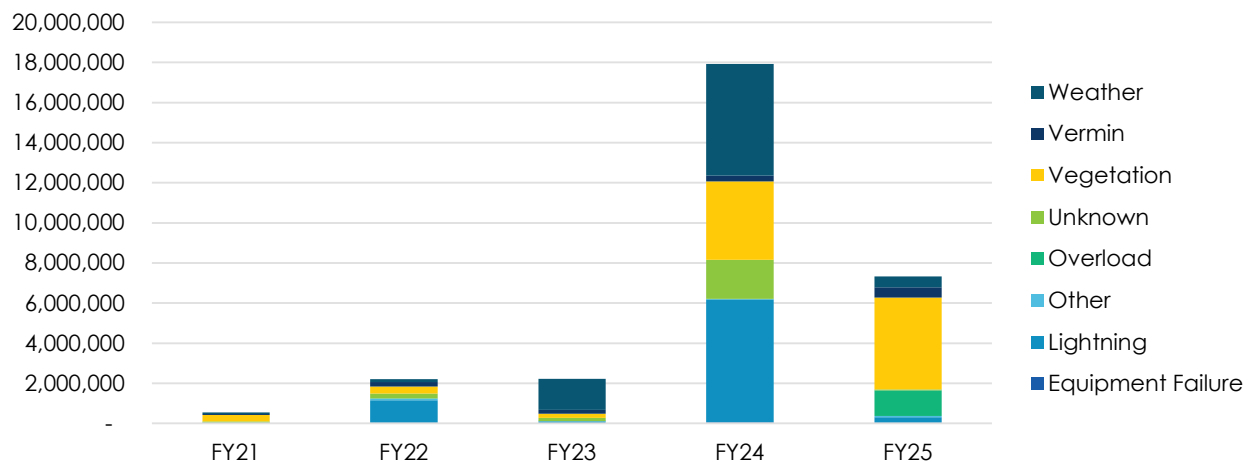
- **Lightning**

- Contributing 32% of the CMOS and 25% of the number incidents.
- With reference to Appendix 4.32, around Euroa and the feeder length between Benalla and Violet Town are hot-spot areas.

- **Animal impacts**

- While only contributing 3% of CMOS, contributes 23% of the number incidents.
- 23% of the animal impacts are due to birds, 40% due to possums and/or sugar gliders and 38% are unknown or not specified.
- Typically results in a blown fuse, resulting in the impact being localised.

The variability of the performance of this feeder is due to weather related impacts (both storm and lightning), and due to vegetation impacts.



**Figure 1 – Feeder outage duration contribution by cause**

### 1.3.2. Major Event Day Summary

The following gives a break down on the number and size of the major event days which have impacted this feeder.

**Table 2 – Recorded Major Event Days**

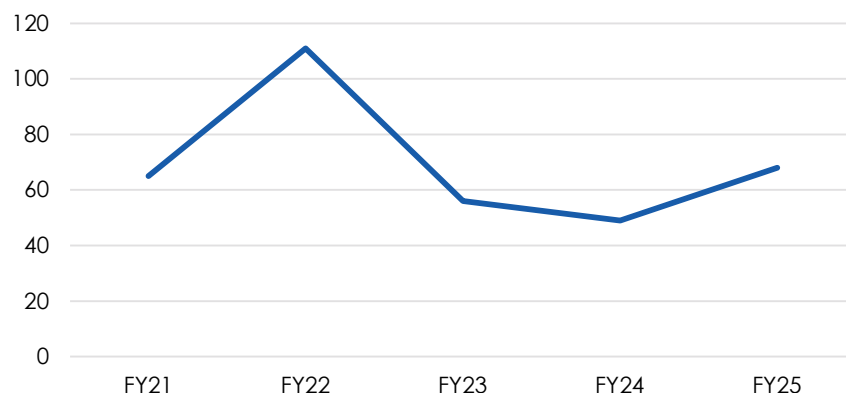
Date	Major Event Day Cause	Number of Customers Interrupted	Total CMOS	Average customer outage duration mins (CMOS / No of Customers Interrupted)
09-Jun-2021	Storm	912	34,793	38
10-Jun-2021	Storm	1	1,015	1015
28-Oct-2021	Lightning Storm	4360	985,897	226
29-Oct-2021	Storm	590	455,073	771
19-Dec-2021	Lightning Storm	1555	86,411	56
21-Nov-2022	Storm	30	7,827	261
13-Dec-2023	Lightning Storm	4364	3,786,421	868
02-Jan-2024	Storm	4335	4,832,310	1115
13-Feb-2024	Storm	4715	1,519,379	322
28-Aug-2024	Storm	9	4,239	471
02-Sep-2024	Lightning Storm	9426**	0**	0**
<b>Total</b>	<b>11 Incidents</b>	<b>20,871</b>	<b>11,713,365</b>	<b>5143</b>
<b>Average</b>	<b>2.2 inc / year</b>	<b>2087 customers / incident</b>	<b>1,1713,336 per incident</b>	<b>561 mins per incident</b>

\*\* - Data not recorded and as such removed from calculations

As it can be seen from the above table, this feeder is susceptible to major events, experiencing more than 2 incidents per year, interrupting 44% of the feeder customers (2087), for an average of 9hrs each time. The worst day being the 2<sup>nd</sup> Jan 2024, where customers were off on an average of 18.5hrs. From this feeder alone, it is adding 1.46 organisational SAIDI mins per year.

### 1.3.3. Momentary Outage Performance

The following graph shows the number of momentary outages on the feeder. On average the feeder experiences approximately 70 outages a year (1.3 per week).



**Figure 2 - Momentary Outages on BN11**

### 1.3.4. Impact of REFCL Commissioning

Since the commissioning of the BNVT remote REFCL in 2023, has seen a deterioration in the performance of BN11. The monthly incident count has increased over the summer months, as expected (once in two-year biennial trend). The increase in CMOS is well above biennial trend and has occurred since the commissioning of the BNVT Remote REFCL.

Toward the end of the fire season, the incident count and CMOS has trended down which is reflective off previous years and the addition of several targeted reliability measures



Figure 3a and Figure 3b – Graphs showing the impact of REFCL commissioning on reliability performance

Table 2: Difference in performance levels pre and post REFCL

	Quantity			Feeder CMOS		
	Avg p.a. (FY21-23)	Avg p.a. (FY24-25)	% Difference	Avg p.a. (FY21-23)	Avg p.a. (FY24-25)	% Difference
Value	93	131	142%	1,476,161	12,051,518	816%



### 1.3.5. Feeder summary

BN11 is the longest distribution feeder in Victoria with a route length of 1,216kms. The feeder has a substantial amount of customers connected to the single, radial feeder, which has very little back-feed and feeder tie connections. Conversely, this feeder is a bare overhead system, which makes it prone to vegetation and lightning strike events. Approximately 273kms of the feeder spans through vegetated areas, which represents 23% of the total feeder length.

Customers in this area experience higher than average frequency of outages and given the long route length, duration outages are often prolonged. Additionally, the introduction of the REFCL network has led to a significant deterioration of service.

The reliability of this feeder does not meet reasonable customer expectations. On this basis reliability corrective action is warranted and required to maintain compliance with the Electricity Distribution Code of Practice (EDCOP), which states:

*"A distributor must use best endeavours to meet targets determined by the AER in the current distribution determination and targets published under clause 13.2.1 and otherwise meet reasonable customer expectations of reliability of supply." (clause 13.3.1)*

## 2. Investment Analysis

### 2.1. Intervention Philosophy

This business case—and others of a similar nature—has been developed to deliver a level of reliability and resilience that reflects customer expectations and stakeholder endorsement.

The Electricity Safety Rules and the Essential Services Commission's Code of Practice aim to ensure safe and reliable electricity distribution in line with reasonable customer expectations. Where feeders demonstrate persistent underperformance, targeted investment is necessary to restore service levels to an acceptable standard. This investment approach is consistent with the principles outlined by the Australian Energy Regulator (AER) in its Distribution Reliability Measures Guideline, which emphasises tailoring interventions to reduce either the probability of supply interruptions or the duration of outages to cost-justified levels.

Our methodology applies five years of historical performance data (See Section 1.3 above), incorporating the 2024 Value of Customer Reliability (VCR) as published by the AER, adjusted for feeder loading and customer categories, to establish a baseline risk cost. We then assess adjusted risk levels based on intervention effectiveness and unit cost, in line with the AEMC's recommended framework for reliability measures across jurisdictions.

### 2.2. Recent Investments

The following is an outline of the recent investments completed on this feeder.

**Table 3 – Completed and planned investment summary**

Investment Title	Investment Scheduled Completion Date	Status
Animal Proofing at 46 sites	June 2024	Completed
Vegetation assessment and hazard tree removal	May 2024	Completed
Replacement of 8 NOJA ACR's with S&C Intellirupter's (Advanced ACR with Fault detection)	June 2024	Completed
Disabled Fast trips on BN18925 when REFCL is in service.	January 2024	Completed
BNBVT Bypassed when fire danger is low,	January 2024	Completed
New GFNSEF fault target settings	February 2024	Completed
Fusesaver settings adjustment (1F1S 20 second deadtime applied).	March 2024	Completed
Protection settings reviewed on BN11 ACRs and modified to provide better coordination with BNBVT REFCL.	June 2024	Completed

## 2.3. No Proactive Interventions

With no proactive intervention, the business as usual (BAU) reliability risk costs are detailed in Table 4 and Table 5. Reliability risk costs are calculated using the Values of Customer Reliability (VCR) and an average of Customer Minutes of Interruption (CMOS) per annum across 5 years of historical interruptions.

**Table 4: Summary of risk by cause type**

Cause Types	Avg CMOS p.a. (between FY20 & FY25)	Baseline risk cost p.a. (between FY20 & FY25)
Animal	252,565	126,844
Asset failure	24,677	12,394
Other	33,521	16,835
Overload	261,649	131,405
Vegetation	1,867,882	938,089
Weather - Lightning	1,526,630	766,705
Weather - Other	1,574,615	790,805
Unknown	499,227	250,722
<b>Total</b>	<b>6,040,766</b>	<b>\$3,033,798</b>

**Table 5: BAU risk cost summary**

	Baseline risk cost p.a.	PV20 of baseline risk
<b>BAU reliability risk cost</b>	\$3,033,798	\$39.15 M

## 2.4. Potential and Recommended Interventions

The following sections detail the potential investment options considered categorised in the three investment areas: Operational actions, network options and non-network options.

### 2.4.1. Operational Actions

The following table outlines the operational actions that have been considered in this review:

**Table 6: Operational Interventions considered**

Identified Options	Investigation assessment	Option credibility
<b>1. Initiating Targeted Patrols for momentary outage areas</b>	Targeting areas of repeated momentary outages, can indicate a potential site for future sustained interruptions. However, initial reviews have indicated, low effectiveness to reducing faults occurring or mitigating their consequence.	Not Credible
<b>2. Standing down response crews prior to forecasted weather events, to ensure adequate resources to respond to forecasted weather events.</b>	Operationally complex; needs careful timing and risk assessment to avoid under-resourcing. Due to the complexity of implementing the solution, this isn't being proposed.	Not Credible

### 2.4.2. Network Options

Table 7 outlines identified network options.

**Table 7: Network options assessment**

Identified Options	Investigation assessment	Option credibility
<b>4. Euroa zone substation with three new feeders.</b>	Building a ZS at Euroa, avoids Euroa town customers, and customers downstream of Euroa, being impacted by upstream faults between Euroa and Benalla zone substation. However, it is a high cost and only provides minimal benefit (beyond the Benalla to Euroa uplift) to customers downstream of Euroa as the sectionalisation is still at Euroa. This option is not economic.	Not Credible
<b>5. New zone substation next to a new third party terminal station, which may be developed in the vicinity of Euroa by a wind farm developer.</b>	The same benefit as Option 4, although the terminal station will allow for a (future) large generator connection, however another high cost options which is not economic.	Not Credible

Identified Options	Investigation assessment	Option credibility
<b>6. Battery energy storage system (BESS) at Euroa.</b>	<p>Installation of a BESS, would allow the BESS to be used in the situation where faults occur on the line between BN zone substation and Euroa. The BESS can feed unaffected feeders and no new 66kV line would be required.</p> <p>A remote REFCL will be required to maintain compliance. The BESS and REFCL combination will need to be tested.</p> <p>The BESS storage capacity is generally limited. It may not be viable for long duration outages. A diesel generator may be required to support long duration outages.</p> <p>Not economic due to the remote REFCL requirement, future replacement cost and O&amp;M.</p>	Credible
<b>7. Partial supply of BN11 load from Powercor's Shepparton and Mooroopna feeders.</b>	<p>AusNet's proposed connection points will assist for outages between BN zone substation and Violet Town (for the STN11 connection), and outages between BN zone substation and Euroa (for the MNA34 connection).</p> <p>The Powercor feeders are non-REFCL, meaning that this option is not feasible under the current Electricity Safety (Bushfire Mitigation) Regulations. An exemption can be sought from Energy Safe Victoria (ESV). However, given the length of line requiring exemption, it is highly unlikely that ESV will accept this option. Also, the capacity of support feeders may be limited in future peak demand times.</p>	Not Credible
<b>8. Partial supply of BN11 load from RUBA12 and MSD2.</b>	<p>AusNet's proposed connection points will assist for outages between BN zone substation and Euroa (for the MSD2 connection), and for customer downstream of BN064 ACR as those customers will have an alternative supply. Open points to be determined.</p> <p>This option will need a technical review as it may impact the performance of the REFCLs. Additional underground cable may be required in certain sections to avoid bushland which will add capacitance and impact the REFCL.</p> <p>Potentially economic. Although it will create future challenges.</p>	Credible
<b>9. Partial supply of BN11 load from a new feeder from a nearby AusNet zone substation, Benalla, Mansfield, Rubicon or Seymour. (Benalla to Euroa express feeder with a remote REFCL changeover station)</b>	<p>AusNet's proposed connection points will assist for outages between BN zone substation and Euroa (for the new feeder).</p> <p>This option will need a technical review as it may impact the performance of the REFCLs. Additional underground cable may be required in certain sections to avoid bushland which will add capacitance and impact the REFCL.</p> <p>Seymour has been deemed unviable due to REFCL capacitance limitations. Potentially economic over the long term.</p>	Credible
Lightning-specific interventions		
<b>10. Network Augmentation to improve lightning protection (additional surge arresters, upgrading HV earths, OPGW installation)</b>	<p>Based on the early cost estimates from AusNet, these solutions appear uneconomic. However, further investigation and analysis will continue.</p>	Not Credible
Animal-proofing interventions		

Identified Options	Investigation assessment	Option credibility
<b>11. Additional animal proofing in frequently impacted areas</b>	46 sites have previously been identified for potential animal proofing. The effectiveness will vary depending on the type of animal impacts and the proposed solutions, but an average has been assumed. Analysis into additional sites were proven to be uneconomical.	Not Credible
Vegetation-specific interventions		
<b>12. Replace frequently impacted vegetation spans with covered conductor</b>	Replacing bare conductor with covered conductor will reduce the probability of vegetation blow-ins impacting the line resulting in either a momentary or sustained outage. Referring to Section 4.3.1, the exposure, historical incident rate and average customer impact was calculated, and this was not economical based on reliability risk.	Credible
<b>13. Replace frequently impacted vegetation spans with undergrounding solution</b>	Similar to option 13, but undergrounding parts of the network. Due to the significant cost of undergrounding this was not economically justified.	Not Credible
<b>14. Additional Hazard tree removal</b>	Currently all identified hazard trees adjacent to BN11 have been treated. As such, no further works are proposed.	Not Credible

### 2.4.3. Non-Network Options

Table 8 outlines identified non-network options.

**Table 8: Non-network option assessment**

Identified Options	Investigation assessment	Option Credibility
<b>15. Small BESS downstream of Euroa on problem feeder sections</b>	Installation of a small BESS will enable islanding of un-faulted feeder sections downstream of Euroa. The islanded sections won't be REFCL protected. Therefore this approach can only operate when the REFCL is in bypass mode. Not economic.	Not credible
<b>16. Small diesel generators downstream of Euroa on problem feeder sections</b>	Average demand on the sections exiting Euroa is ~ 0.4-0.6MVA. 700kVA pad mount diesel generators on each section. 750kVA step up transformer and ACR also required. Similar to option 15, there is not enough benefit to justify the capital investment for a permanent installation as costs cannot be recovered.	Not credible
<b>17. Euroa diesel generators</b>	Diesel generators are easier to procure, and they can run off a dedicated tank on site. Creates a new generation source that can be leased to a third party retailer or generation company, however will create noise during operation O&M can be kept low if the diesels only run occasionally. This option may be economic over the long term.	Credible

## 2.4.4. Economic Evaluation

Table 9 details the credible network investments identified in this investigation.

**Table 9: Investment summary**

Option	Investment details	Estimated OPEX Cost (\$ '000,000)	Estimated CAPEX Cost (\$ '000,000)
6	Battery energy storage system (BESS) at Euroa.	CIC	CIC
8	Partial supply of BN11 load from RUBA12 and MSD2.	CIC	CIC
9	Proposed Benalla to Euroa express feeder with a remote REFCL changeover station	CIC	CIC
12	Replacing bare conductor with covered conductor will reduce the probability of vegetation blow-ins	CIC	CIC
17	Euroa diesel generators	CIC	CIC

Table 10 summarises the cost-benefit assessments for proposed investments as compared to the BAU case using net present value (NPV) calculations over a 30-year assessment period.

**Table 10: Economic evaluation summary**

Option	Risk cost	PV of benefits	PV of investment	Benefit to Cost Ratio (BCR)	Rank	Comments
BAU	43.7	-	-	-		BAU – Does not capture benefits
6	40.6	3.1	16.0	0.20	4	
8	39.8	3.9	23.5	0.17	5	
9	34.3	9.4	40.6	0.23	2	
12	36.5	7.2	2.2	3.27	1	Highest BCR
17	40.6	3.1	15.0	0.21	3	

## 2.4.5. Sensitivity Analysis

The sensitivity analysis has confirmed that Option 12 is favourable in all cases as indicated in Table 11.

**Table Error!: Net Present Value (\$m, 2025 dollars)**

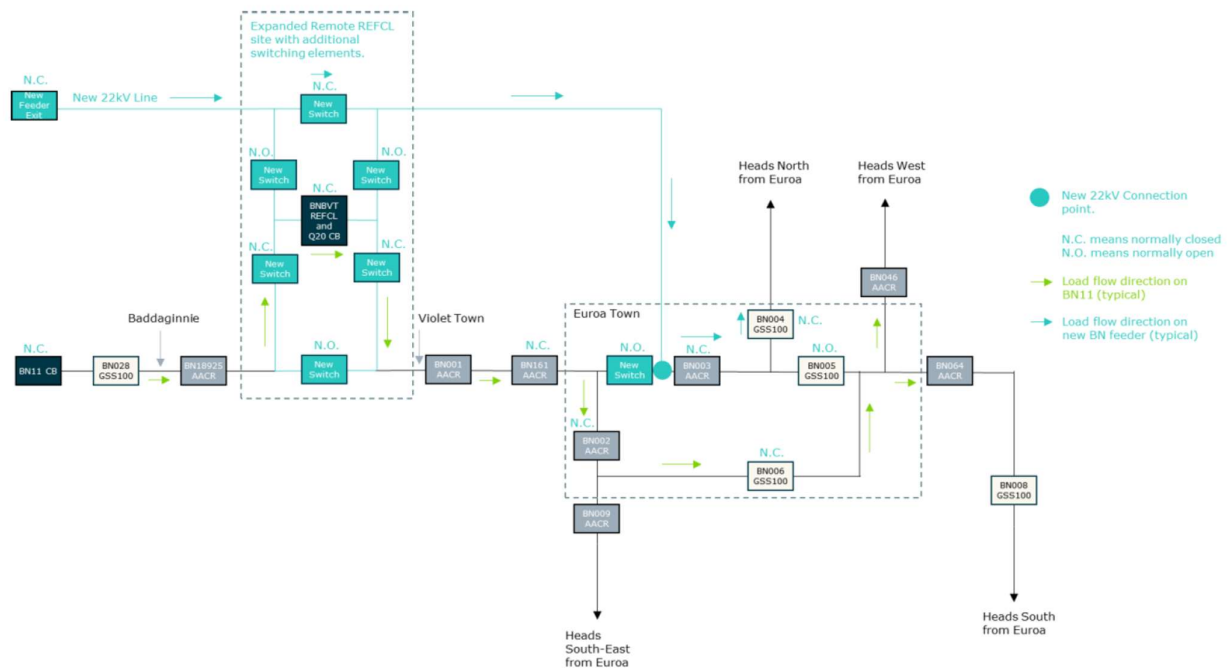
	Central assumptions	Higher WACC	10% increase in capex	Comments
Do nothing	-	-	-	
Option 12	5.0	4.09	4.8	This is the preferred option under all scenarios
Option 9	-31	-32	-35	

## 2.4.6. Proposed Solution

While Option 9 (Express Euroa Feeder) does not represent the most economically efficient option when assessed against the traditional cost-benefit criteria, it has emerged as the preferred solution through our engagement and co-design process with our customer stakeholder committee. During consultation, customers placed strong emphasis on reliability, regional equity and long-term service outcomes, and the express feeder was identified as the solution that best aligned with their expectations. It is therefore the only solution that will achieve compliance with EDCOP 13.3.1.

Option 12 (replacing bare conductor with covered conductor will reduce the probability of vegetation blow-ins) is the most economically efficient option with the highest BCR of all options assessed. In spite of this, it is not our preferred solution given that it does not address existing network capacity constraints that exist on the BN11 22kV feeder and does not cater for future load growth, thus limiting economic development in the large area serviced by BN11. We do not consider that this solution will meet reasonable customer expectations of reliability of supply.

**Figure 4 – Proposed Benalla to Euroa express 22kV feeder with remote REFCL changeover station** (normal supply arrangement shown)





### 3. Investment Recommendation

To improve the reliability performance of Feeder BN11, it is recommended to complete the construction of an express 22kV feeder from Benalla to Euroa, at a total project cost of \$40.64m. This is option 9.

The option to install a new 22kV feeder provides route diversity that will benefit customers in the township of Euroa and surrounding areas as it addresses the following identified drivers of reliability issues associated with the existing BN11 feeder:

- Animal
- Asset failure
- Vegetation
- Weather - Lightning
- Weather - Other

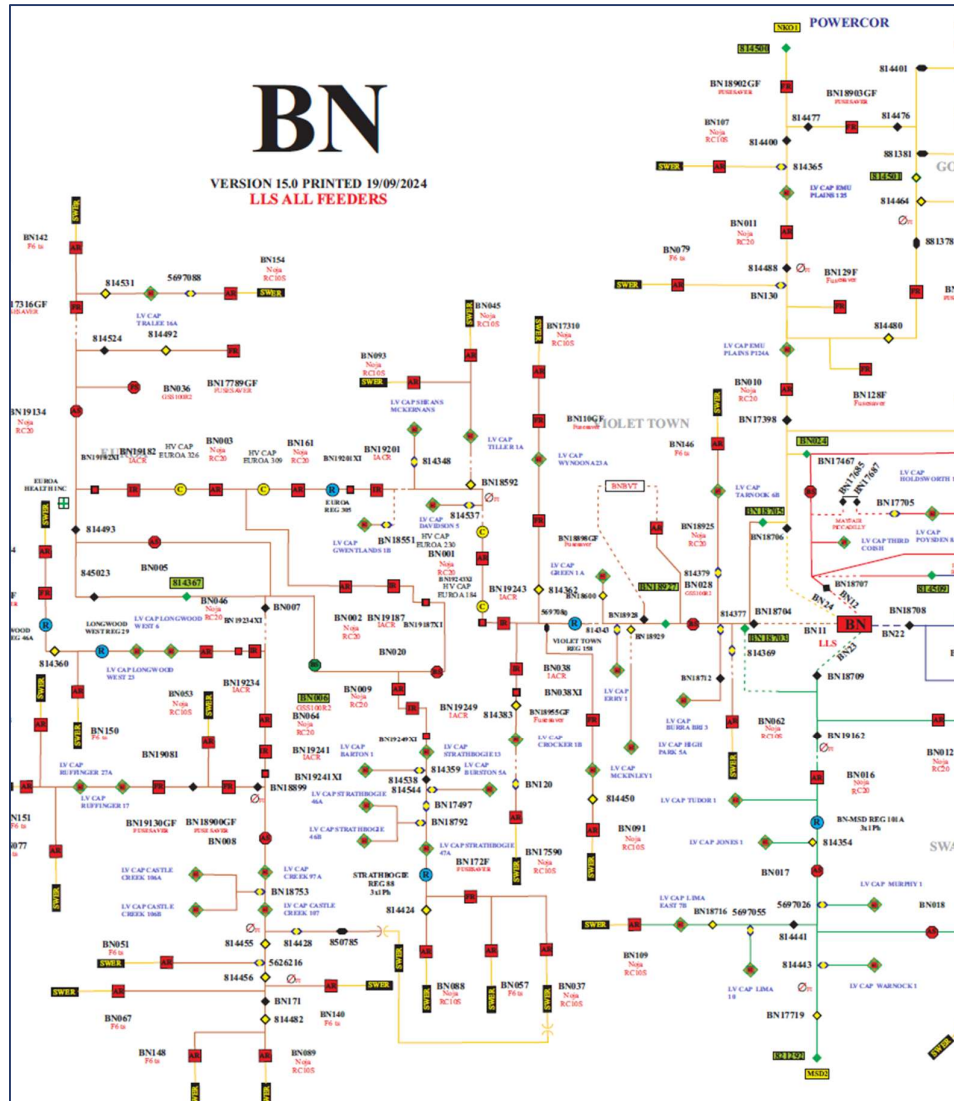
Through feeder route diversity, the likelihood of a co-incidental incident occurring at the same time is significantly reduced. This option utilises existing remote REFCL technology at Violet Town to further reduce costs associated with this option.

Implementing this option also addresses a network capacity constraint that exists on the existing BN11 22kV feeder. In preparation for each summer, up to 3MW of temporary diesel generation is deployed in Euroa to support summer peak demand for electricity on BN11. A new 22kV express feeder provides additional capacity to service Euroa and surrounding areas and will address the existing network constraint thereby removing the need to deploy temporary diesel generation annually.

In addition, the new feeder will unlock capacity for future load growth and further economic development of the large area serviced by BN11. The existing feeder is the longest distribution feeder in Victoria and covers a route length of 1,216kms. Demand growth across the coverage area of the feeder is constrained due to insufficient network capacity.

## 4. Appendices

### 4.1. Appendix 1 – Single Line Diagram



## 4.2. Geographic Location of Feeder

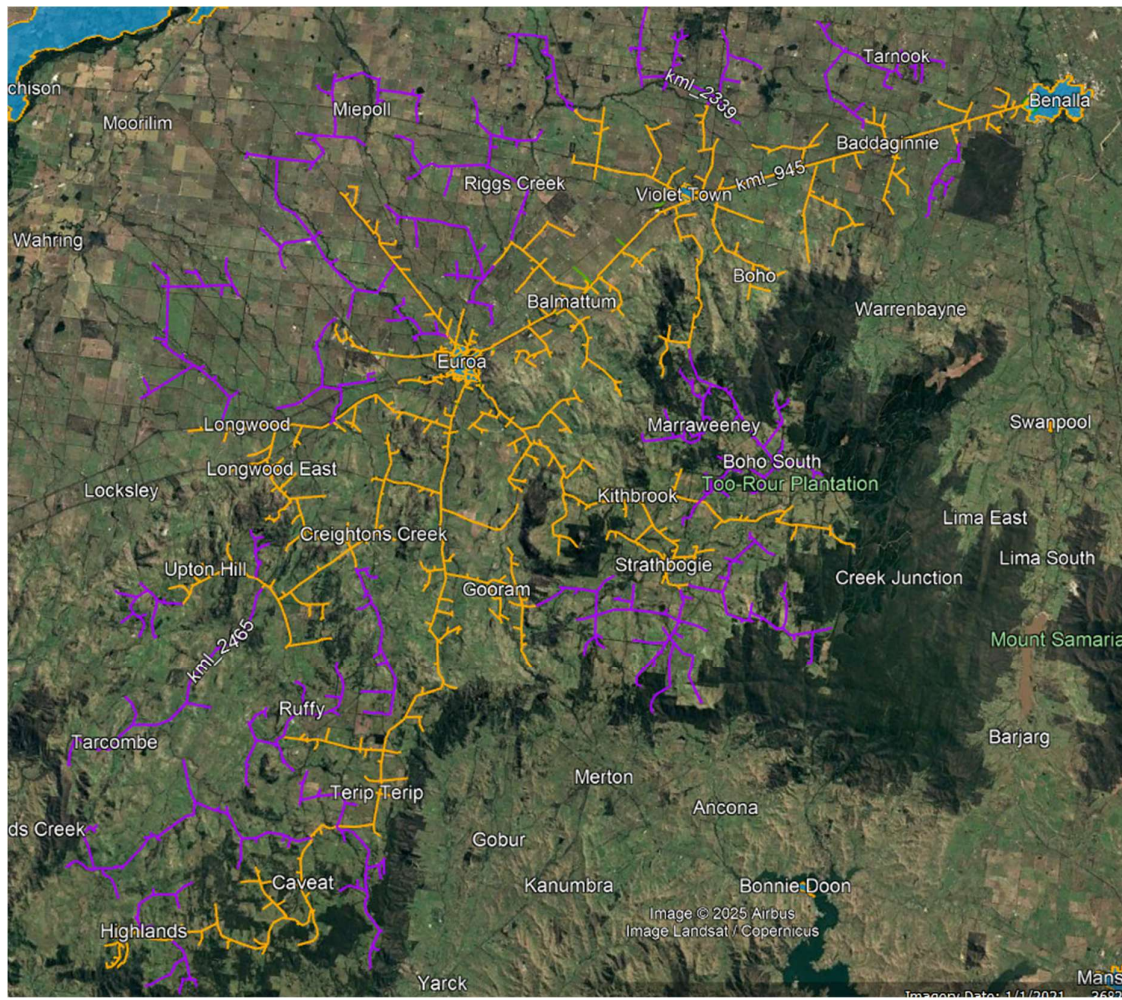


Figure 5: Map view of the BN11 feeder (Orange: 22kV, Purple: 12.7kV)

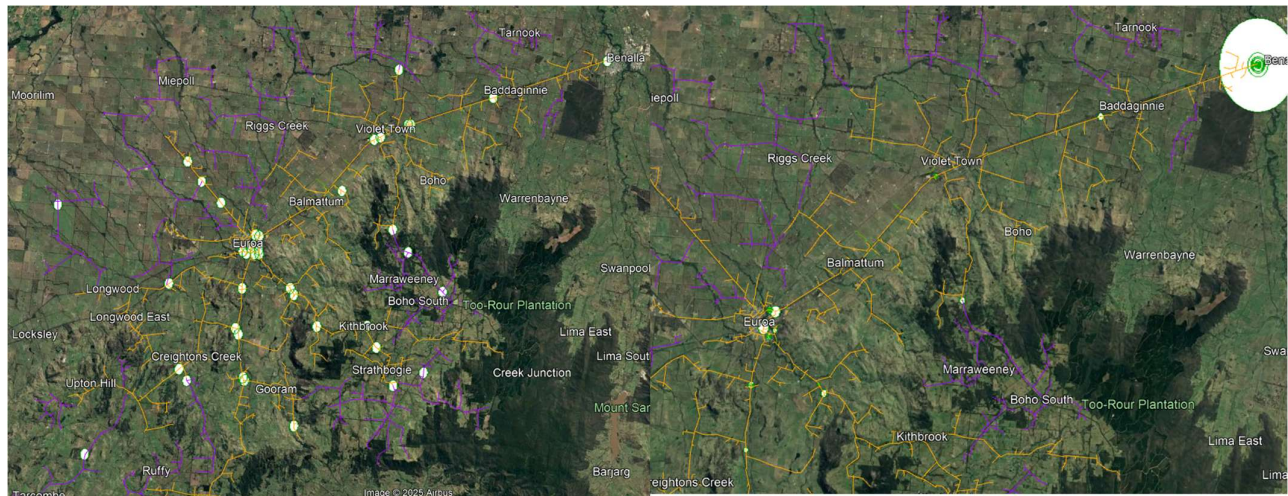


## 4.3. Heat Map of Outages

Ausnet's failure data is not specific enough to give pinpoint failure information, but rather is tied to the protection device which operates. As such, depending on grading, the failure might be some distance from the fault.

### 4.3.1. Vegetation

The following outputs show the location of the vegetation impacts relative to the nearest protection device. Other than a cluster near Euroa and a small cluster near violet town, the vegetation impacts are sporadic across the feeder. When looking at the impact size, there is an evident concentration at Euroa, and at the zone substation (indicating, the entire feeder typically trips off for vegetation impacts).



Location of Vegetation Incidents

Relative Impact of Vegetation Impacts

### 4.3.2. Method for calculation of probability of failure

Due to the incidents not having a precise location and only where the protection device operated, BN11 was segmented into 5 sections, namely:

- Section 1: Benalla to Violet Town
- Section 2: Violet Town to Euroa
- Section 3: Euroa to Kithbrook
- Section 4: Euroa to Longwood
- Section 5: Euroa to Highlands

For each of these sections, the average number of vegetation incidents (both momentary and sustained) was calculated using the previous 5-year period, and the consequence value applied.

Section	Average Number of Incidents per year (FY24-FY25)		CMOS Impact (FY24-FY25)	
	Momentary	Sustained	Per Sustained Incident	Total CMOS per year per section
Section 1	0.27	0.56	1,755,481	975,267.36
Section 2	0.09	0.89	129,493	115,105.48
Section 3	0.09	1.78	180,639	321,137.56
Section 4	0.64	1.00	90,529	90,529.00

Section 5	0.45	1.11	17,206	19,118.33
<b>Total</b>	<b>1.55</b>	<b>5.33</b>		<b>1,521,157</b>

### 4.3.3. Vegetation Exposure per km

To determine the amount of conductor potentially requiring covering or undergrounding, the amount of conductor which was in close proximity to dense vegetation was calculated using a VicData dataset.

This resulted in the following information:

Section	Amount of bare powerline in proximity to dense vegetation		Cost to Augment with covered conductor	
	22kV	12.7kV	22kV	12.7kV
Section 1	6.25	2.23	CIC	CIC
Section 2	2.72	0.01	CIC	CIC
Section 3	3.60	8.14	CIC	CIC
Section 4	6.86	4.55	CIC	CIC
Section 5	0.52	1.40	CIC	CIC
<b>Total</b>	<b>23.05</b>	<b>23.24</b>	<b>CIC</b>	<b>CIC</b>

Therefore, to cover the spans most at risk of a vegetation impact, would cost a total of \$CIC M for BN11.

### 4.3.4. Benefit to Cost Ratio (BCR) Calculation

The VCR was then calculated using the Feeder VCR, multiplied by the average customer load on BN11 and the average customer minutes off supply (CMOS). This was compared against the cost of installing both covered conductor.

**Table 11 – BCR Calculation**

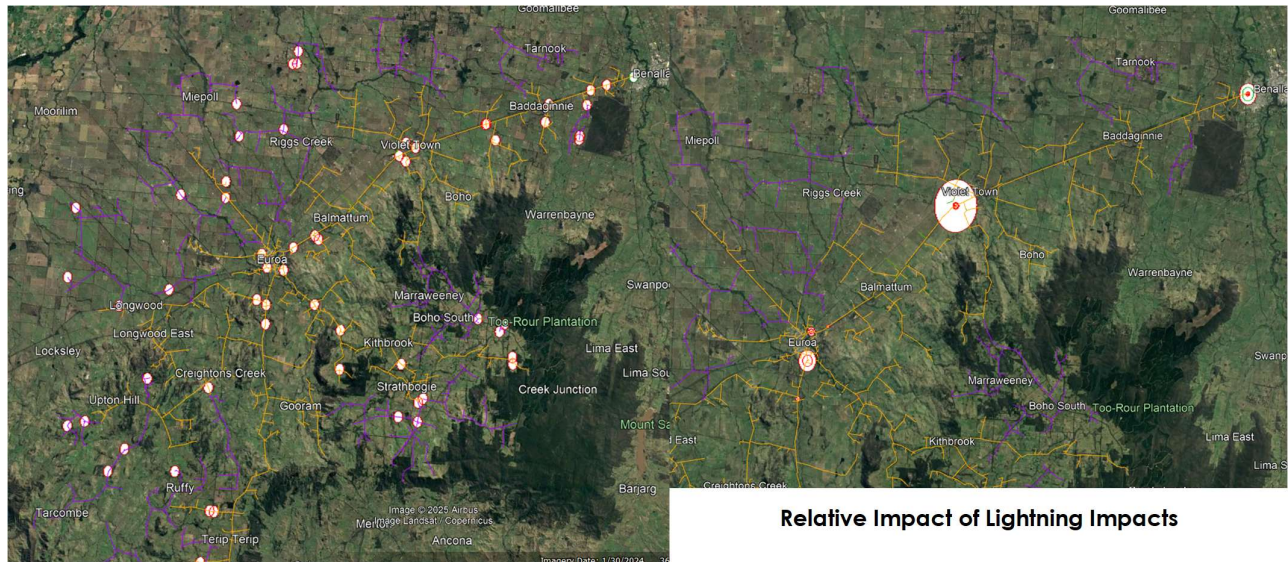
Section	Baseline Vegetation Reliability Risk Cost	Risk Cost After Covered Conductor Installation	Risk Cost Reduction	NPV Risk Cost Reduction	Cost Augment 22kV with Covered	Benefit to Cost Ratio (BCR)
Section 1	463,133	105,929	357,203	\$4,212,619	CIC	3.0
Section 2	54,661	12,502	42,159	\$497,192	CIC	0.82
Section 3	152,501	34,881	117,620	\$1,387,137	CIC	1.72
Section 4	42,990	9,833	33,157	\$391,035.	CIC	0.25
Section 5	9,079	2,077	7,002	\$82,580	CIC	0.71

As it can be seen from the above table, Sections 1 and 3 are cost justified for replacement.



### 4.3.5. Lightning

The following outputs show the location of the lightning impacts relative to the nearest protection device. There are small clusters around Euroa, Violet town, and along the backbone between the ZS and Violet town. When looking at the impact size, there is a concentration at Violet Town.



Location of Lightning Impacts

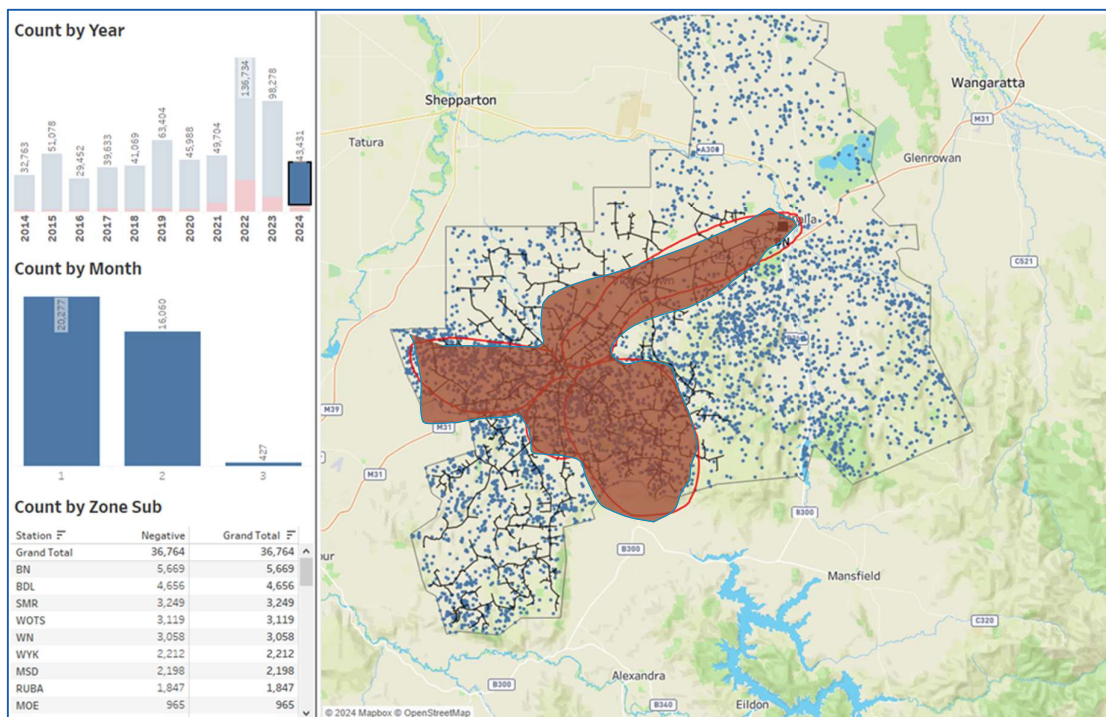
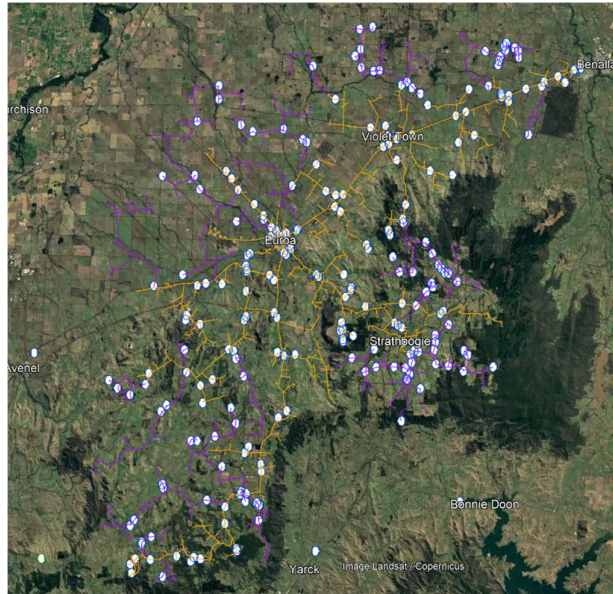


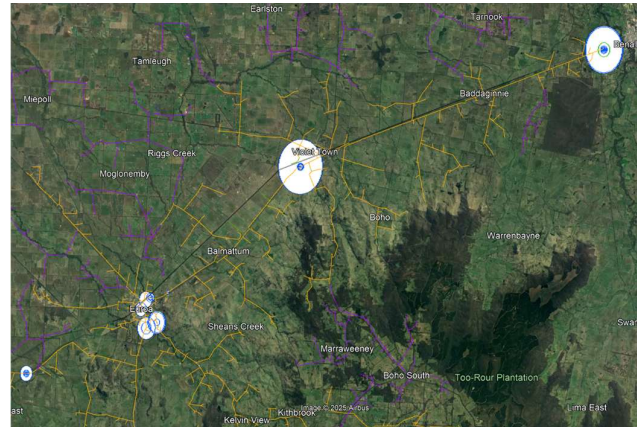
Figure 6 – Lightning (cloud-ground) strike map for Benalla with concentration of strikes located in red.

### 4.3.6. Extreme Weather

The following outputs show the location of the weather impacts relative to the nearest protection device. The weather impacts are spread across the entire feeder, with concentrations of Violet Town and Euroa and at the ZS.



**Location of Weather Impacts**



**Relative Size of Weather Impacts**

## 4.4. Outage History

Date	Incident Number	Cause	CMOS	Customers Interrupted	Type of Interruption	Feeder SAIDI
20200704	INCD-574-a	Vermín	236	1	Sustained	0.05
20200709	INCD-1141-a	Unknown	151	1	Sustained	0.03
20200717	INCD-2082-a	Vermín	130	2	Sustained	0.03
20200725	INCD-3168-a	Equipment Failure	6,380	29	Sustained	1.35
20200804	INCD-4087-a	Vermín	164	2	Sustained	0.03
20200804	INCD-4097-a	Unknown	24	4	Sustained	0.01
20200809	INCD-4456-a	Vermín	15,423	159	Sustained	3.27
20200811	INCD-4528-a	Unknown	696	58	Sustained	0.15
20200819	INCD-4882-a	Unknown	525	3	Sustained	0.11
20200825	INCD-5637-a	Vermín	46	1	Sustained	0.01
20200911	INCD-7947-a	Other	20	2	Sustained	0.00
20200927	INCD-8706-a	Vermín	240	3	Sustained	0.05
20201008	INCD-9219-a	Lightning	10,846	58	Sustained	2.30
20201008	INCD-9250-a	Lightning	678	2	Sustained	0.14
20201008	INCD-9263-a	Lightning	1,632	6	Sustained	0.35
20201008	INCD-9270-a	Lightning	8,610	21	Sustained	1.82
20201008	INCD-5591-b	Lightning	8	2	Sustained	0.00
20201008	INCD-9293-a	Lightning	136	1	Sustained	0.03
20201009	INCD-9394-a	Corrosion	535	1	Sustained	0.11
20201009	INCD-9385-a	Weather	217	1	Sustained	0.05
20201009	INCD-9394-a	Corrosion	27	1	Sustained	0.01
20201009	INCD-9395-a	Weather	55	1	Sustained	0.01
20201010	INCD-9413-a	Lightning	95	1	Sustained	0.02
20201012	INCD-9527-a	Corrosion	1,796	1	Sustained	0.38
20201016	INCD-9734-a	Unknown	105	1	Sustained	0.02
20201023	INCD-10066-a	Vermín	262	2	Sustained	0.06
20201024	INCD-10111-a	Vermín	1,560	12	Sustained	0.33
20201030	INCD-3381-c	Vegetation	444	111	Sustained	0.09
20201030	INCD-3381-c	Vegetation	219	3	Sustained	
20201030	INCD-10474-a	Vermín	85	1	Sustained	
20201030	INCD-3381-c	Vegetation	555	0	Sustained	
20201030	INCD-10487-a	Weather	2,408	2	Sustained	
20201031	INCD-10506-a	Vermín	120	1	Sustained	0.03
20201111	INCD-11042-a	Unknown	31,445	1655	Sustained	6.66
20201120	INCD-56749-s	Unknown	18	3	Sustained	0.00
20201214	INCD-7431-b	Unknown	22	2	Sustained	0.00
20201217	INCD-13667-a	Equipment Failure	43	1	Sustained	0.01
20201222	INCD-14136-a	Vermín	100	1	Sustained	0.02
20201231	INCD-14849-a	Vermín	262	2	Sustained	0.06
20210103	INCD-15144-a	Vermín	342	3	Sustained	0.07
20210107	INCD-15591-a	Vegetation	26,197	67	Sustained	5.55
20210111	INCD-15996-a	Vermín	14,948	148	Sustained	3.16
20210112	INCD-16007-a	Unknown	240	4	Sustained	0.05
20210129	INCD-9664-c	Unknown	1,311	19	Sustained	0.28



Date	Incident Number	Cause	CMOS	Customers Interrupted	Type of Interruption	Feeder SAIDI
20210205	INCD-17457-a	Lightning	282	3	Sustained	0.06
20210208	INCD-17638-a	Vermine	229	1	Sustained	0.05
20210227	INCD-18533-a	Vermine	370	2	Sustained	0.08
20210302	INCD-18669-a	Vegetation	18,810	190	Sustained	3.98
20210302	INCD-18669-a	Vegetation	242,667	4113	Sustained	51.38
20210312	INCD-19072-a	Vermine	144	2	Sustained	0.03
20210313	INCD-19127-a	Vermine	101	1	Sustained	0.02
20210313	INCD-19139-a	Vermine	202	2	Sustained	0.04
20210315	INCD-19240-a	Unknown	5,285	35	Sustained	1.12
20210323	INCD-19573-a	Unknown	198	2	Sustained	0.04
20210327	INCD-19909-a	Vermine	198	2	Sustained	0.04
20210404	INCD-20206-a	Unknown	16,898	119	Sustained	3.58
20210404	INCD-20206-a	Unknown	4,205	29	Sustained	0.89
20210427	INCD-12016-b	Unknown	1,260	20	Sustained	0.27
20210503	INCD-21572-a	Weather	74,416	4651	Sustained	15.76
20210503	INCD-21583-a	Vermine	164	1	Sustained	0.03
20210508	INCD-21767-a	Vermine	5,454	54	Sustained	1.15
20210609	INCD-15747-b	Vermine	193	1	Sustained	0.04
20210609	INCD-23351-a	Vegetation	34,600	40	Sustained	7.33
20210610	INCD-23809-a	Weather	1,015	1	Sustained	0.21
20210618	INCD-25311-a	Equipment Failure	383	1	Sustained	0.08
20210701	INCD-26145-a	Vermine	558	1	Sustained	0.12
20210721	INCD-20109-c	Unknown	1,512	42	Sustained	0.32
20210721	INCD-20109-c	Unknown	72	2	Sustained	0.02
20210724	INCD-27192-a	Lightning	2,324	14	Sustained	0.49
20210724	INCD-27192-a	Lightning	173	1	Sustained	0.04
20210724	INCD-27192-a	Lightning	182	1	Sustained	0.04
20210725	INCD-27215-a	Lightning	102	1	Sustained	0.02
20210726	INCD-27287-a	Unknown	178	2	Sustained	0.04
20210726	INCD-27312-a	Vermine	3,600	36	Sustained	0.76
20210803	INCD-27905-a	Vegetation	2,828	7	Sustained	0.60
20210813	INCD-28219-a	Vermine	175	1	Sustained	0.04
20210830	INCD-28786-a	Corrosion	157	1	Sustained	0.03
20210905	INCD-29055-a	Vegetation	12,485	55	Sustained	2.64
20210905	INCD-29055-a	Vegetation	5,954	26	Sustained	1.26
20210905	INCD-29055-a	Vegetation	540	1	Sustained	0.11
20210905	INCD-29055-a	Vegetation	540	1	Sustained	0.11
20210906	INCD-29145-a	Vermine	188	1	Sustained	0.04
20210915	INCD-29431-a	Vermine	3,333	33	Sustained	0.71
20210915	INCD-29431-a	Vermine	3,582	18	Sustained	0.76
20210915	INCD-29431-a	Vermine	4,142	19	Sustained	0.88
20210918	INCD-29753-a	Lightning	146	2	Sustained	0.03
20210927	INCD-22341-b	Other	19	1	Sustained	0.00
20210928	INCD-30078-a	Vegetation	2,024	22	Sustained	0.43
20210928	INCD-30082-a	Vegetation	18,832	88	Sustained	3.99
20211001	INCD-30233-a	Vermine	378	2	Sustained	0.08
20211004	INCD-30346-a	Lightning	8	2	Sustained	0.00
20211013	INCD-30713-a	Vermine	620	5	Sustained	0.13

Date	Incident Number	Cause	CMOS	Customers Interrupted	Type of Interruption	Feeder SAIDI
20211015	INCD-30891-a	Unknown	20,770	155	Sustained	4.40
20211017	INCD-31266-a	Vermine	144	2	Sustained	0.03
20211022	INCD-31939-a	Corrosion	464	2	Sustained	0.10
20211027	INCD-32339-a	Vermine	216	2	Sustained	0.05
20211028	INCD-32600-a	Unknown	5,084	2	Sustained	1.08
20211028	INCD-32609-a	Weather	1,056	1	Sustained	0.22
20211028	INCD-32755-a	Lightning	8,570	10	Sustained	1.81
20211028	INCD-32631-a	Lightning	2,844	12	Sustained	0.60
20211029	INCD-34448-a	Weather	19,981	29	Sustained	4.23
20211029	INCD-34448-a	Weather	6,495	3	Sustained	1.38
20211029	INCD-34496-a	Unknown	37,760	32	Sustained	7.99
20211029	INCD-34496-a	Unknown	39,840	30	Sustained	8.44
20211029	INCD-34496-a	Unknown	42,294	21	Sustained	8.95
20211028	INCD-32755-a	Lightning	141,300	628	Sustained	29.92
20211029	INCD-34379-a	Vegetation	233,840	296	Sustained	49.51
20211028	INCD-32755-a	Lightning	49,608	318	Sustained	10.50
20211028	INCD-32755-a	Lightning	9,680	44	Sustained	2.05
20211028	INCD-32755-a	Lightning	767,275	3265	Sustained	162.46
20211029	INCD-34350-a	Weather	51,550	50	Sustained	10.91
20211029	INCD-34350-a	Weather	18,648	18	Sustained	3.95
20211029	INCD-34496-a	Unknown	672	32	Sustained	0.14
20211101	INCD-35563-a	Weather	622	2	Sustained	0.13
20211102	INCD-35880-a	Vermine	23,310	126	Sustained	4.94
20211102	INCD-35880-a	Vermine	6,293	29	Sustained	1.33
20211103	INCD-36428-a	Weather	5	1	Sustained	0.00
20211104	INCD-36574-a	Lightning	4	1	Sustained	0.00
20211106	INCD-37091-a	Lightning	1,716	11	Sustained	0.36
20211111	INCD-37959-a	Vermine	80	1	Sustained	0.02
20211112	INCD-37972-a	Other	250	1	Sustained	0.05
20211112	INCD-24033-b	Overload	50	5	Sustained	0.01
20211112	INCD-24034-b	Overload	21	1	Sustained	0.00
20211130	INCD-39910-a	Vermine	486	3	Sustained	0.10
20211201	INCD-40297-a	Lightning	2,614	2	Sustained	0.55
20211204	INCD-41522-a	Vermine	864	6	Sustained	0.18
20211209	INCD-42439-a	Equipment Failure	4,550	65	Sustained	0.96
20211213	INCD-42798-a	Vermine	1,475	59	Sustained	0.31
20211213	INCD-42824-a	Vermine	327	3	Sustained	0.07
20211219	INCD-43606-a	Lightning	1,700	2	Sustained	0.36
20211219	INCD-43608-a	Lightning	1,702	2	Sustained	0.36
20211219	INCD-43676-a	Lightning	1,345	1	Sustained	0.28
20211219	INCD-43851-a	Lightning	3,886	2	Sustained	0.82
20211219	INCD-43951-a	Lightning	2,211	1	Sustained	0.47
20211219	INCD-43732-a	Lightning	636	1	Sustained	0.13
20211219	INCD-43636-a	Lightning	1,091	1	Sustained	0.23
20211219	INCD-43904-a	Lightning	3,180	6	Sustained	0.67
20211219	INCD-43636-a	Lightning	20,210	47	Sustained	4.28
20211219	INCD-43637-a	Lightning	4,797	3	Sustained	1.02
20211219	INCD-43655-a	Lightning	4,644	12	Sustained	0.98

Date	Incident Number	Cause	CMOS	Customers Interrupted	Type of Interruption	Feeder SAIDI
20211219	INCD-44493-a	Lightning	3,066	1	Sustained	0.65
20211219	INCD-44532-a	Lightning	3,605	1	Sustained	0.76
20211219	INCD-43752-a	Lightning	3,696	6	Sustained	0.78
20211219	INCD-43923-a	Lightning	649	1	Sustained	0.14
20211219	INCD-43752-a	Lightning	9,370	2	Sustained	1.98
20211219	INCD-44157-a	Lightning	2,619	3	Sustained	0.55
20211219	INCD-43699-a	Lightning	9,867	33	Sustained	2.09
20211219	INCD-43752-a	Lightning	580	1	Sustained	0.12
20211219	INCD-43709-a	Weather	69	3	Sustained	0.01
20211220	INCD-44232-a	Lightning	130	1	Sustained	0.03
20211220	INCD-44204-a	Other	10	2	Sustained	0.00
20211220	INCD-44217-a	Lightning	1,111	1	Sustained	0.24
20211231	INCD-45518-a	Vermis	412	2	Sustained	0.09
20220101	INCD-45555-a	Other	5,772	26	Sustained	1.22
20220101	INCD-45555-a	Other	476	2	Sustained	0.10
20220101	INCD-45555-a	Other	6,575	25	Sustained	1.39
20220101	INCD-45555-a	Other	64,022	238	Sustained	13.56
20220106	INCD-46422-a	Lightning	1,169	1	Sustained	0.25
20220106	INCD-46363-a	Weather	244	1	Sustained	0.05
20220107	INCD-46768-a	Lightning	4,067	7	Sustained	0.86
20220107	INCD-46507-a	Lightning	159	1	Sustained	0.03
20220107	INCD-46535-a	Lightning	212	2	Sustained	0.04
20220107	INCD-46841-a	Weather	8,085	7	Sustained	1.71
20220109	INCD-47039-a	Vegetation	1,232	7	Sustained	0.26
20220109	INCD-47081-a	Lightning	151	1	Sustained	0.03
20220110	INCD-47137-a	Vermis	1,837	11	Sustained	0.39
20220110	INCD-47150-a	Vermis	6,669	19	Sustained	1.41
20220111	INCD-47305-a	Vermis	19,530	126	Sustained	4.14
20220111	INCD-47305-a	Vermis	4,524	29	Sustained	0.96
20220111	INCD-47423-a	Lightning	1,013	1	Sustained	0.21
20220111	INCD-47418-a	Lightning	1,453	1	Sustained	0.31
20220111	INCD-47433-a	Lightning	852	2	Sustained	0.18
20220111	INCD-47341-a	Lightning	9,870	42	Sustained	2.09
20220111	INCD-47432-a	Lightning	838	2	Sustained	0.18
20220111	INCD-47430-a	Lightning	320	2	Sustained	0.07
20220111	INCD-47435-a	Lightning	10	1	Sustained	0.00
20220111	INCD-47472-a	Overload	3,528	42	Sustained	0.75
20220114	INCD-49188-a	Lightning	11,206	2	Sustained	2.37
20220114	INCD-48797-a	Lightning	4,674	2	Sustained	0.99
20220114	INCD-48313-a	Lightning	2,067	13	Sustained	0.44
20220114	INCD-48586-a	Lightning	1,244	1	Sustained	0.26
20220114	INCD-48591-a	Lightning	2,566	2	Sustained	0.54
20220114	INCD-48584-a	Lightning	2,076	2	Sustained	0.44
20220114	INCD-48580-a	Weather	9,724	11	Sustained	2.06
20220114	INCD-48580-a	Weather	23,348	26	Sustained	4.94
20220114	INCD-48580-a	Weather	909	1	Sustained	0.19
20220114	INCD-48580-a	Weather	948	1	Sustained	0.20
20220115	INCD-48651-a	Lightning	209	1	Sustained	0.04

Date	Incident Number	Cause	CMOS	Customers Interrupted	Type of Interruption	Feeder SAIDI
20220115	INCD-48708-a	Vermin	519	1	Sustained	0.11
20220115	INCD-48759-a	Lightning	470	2	Sustained	0.10
20220115	INCD-48825-a	Lightning	1,352	13	Sustained	0.29
20220115	INCD-48837-a	Lightning	997	1	Sustained	0.21
20220119	INCD-49360-a	Lightning	225	1	Sustained	0.05
20220119	INCD-49492-a	Lightning	163	1	Sustained	0.03
20220123	INCD-49919-a	Vermin	167	1	Sustained	0.04
20220126	INCD-50480-a	Vermin	175	1	Sustained	0.04
20220126	INCD-51089-a	Lightning	5,060	2	Sustained	1.07
20220127	INCD-50600-a	Vegetation	53,298	63	Sustained	11.28
20220127	INCD-50600-a	Vegetation	8,568	56	Sustained	1.81
20220127	INCD-50604-a	Weather	432	2	Sustained	0.09
20220127	INCD-50600-a	Vegetation	92	4	Sustained	0.02
20220129	INCD-51641-a	Vermin	856	2	Sustained	0.18
20220130	INCD-51810-a	Lightning	1,229	1	Sustained	0.26
20220202	INCD-52308-a	Vermin	460	2	Sustained	0.10
20220204	INCD-52639-a	Vermin	35,400	75	Sustained	7.50
20220204	INCD-52639-a	Vermin	9,087	39	Sustained	1.92
20220210	INCD-53474-a	Vermin	216	2	Sustained	0.05
20220211	INCD-53496-a	Vermin	91	1	Sustained	0.02
20220213	INCD-53714-a	Vermin	204	2	Sustained	0.04
20220216	INCD-54079-a	Vermin	516	1	Sustained	0.11
20220216	INCD-54141-a	Vermin	218	1	Sustained	0.05
20220224	INCD-55128-a	Lightning	11,264	64	Sustained	2.38
20220226	INCD-55382-a	Lightning	2,416	2	Sustained	0.51
20220226	INCD-55368-a	Lightning	99	1	Sustained	0.02
20220309	INCD-56943-a	Vermin	122	1	Sustained	0.03
20220313	INCD-57385-a	Not applicable	116	1	Sustained	0.02
20220316	INCD-57951-a	Vermin	3,600	15	Sustained	0.76
20220402	INCD-59930-a	Vermin	490	1	Sustained	0.10
20220410	INCD-60815-a	Lightning	199	1	Sustained	0.04
20220413	INCD-60997-a	Vermin	507	1	Sustained	0.11
20220414	INCD-61060-a	Vermin	3,420	36	Sustained	0.72
20220417	INCD-61122-a	Vermin	3,586	11	Sustained	0.76
20220417	INCD-25553-b	Vermin	116	1	Sustained	0.02
20220418	INCD-61164-a	Unknown	834	3	Sustained	0.18
20220427	INCD-61425-a	Unknown	558	3	Sustained	0.12
20220504	INCD-61960-a	Vermin	15,748	127	Sustained	3.33
20220504	INCD-61960-a	Vermin	3,596	29	Sustained	0.76
20220515	INCD-63333-a	Unknown	502	2	Sustained	0.11
20220522	INCD-64084-a	Vermin	37,734	114	Sustained	7.99
20220529	INCD-64603-a	Vermin	28,917	243	Sustained	6.12
20220619	INCD-65596-a	Vermin	554	2	Sustained	0.12
20220619	INCD-65591-a	Other	7,260	33	Sustained	1.54
20220619	INCD-65600-a	Vermin	98	1	Sustained	0.02
20220620	INCD-65621-a	Unknown	49,920	128	Sustained	10.57
20220620	INCD-65621-a	Unknown	11,339	29	Sustained	2.40
20220629	INCD-65988-a	Vermin	1,438	2	Sustained	0.30

Date	Incident Number	Cause	CMOS	Customers Interrupted	Type of Interruption	Feeder SAIDI
20220725	INCD-67800-a	Vermin	1,088	2	Sustained	0.23
20220823	INCD-71399-a	Vermin	630	3	Sustained	0.13
20220907	INCD-72481-a	Unknown	7	1	Sustained	0.00
20221001	INCD-73803-a	Unknown	453	1	Sustained	0.10
20221007	INCD-74053-a	Unknown	28,710	90	Sustained	6.08
20221012	INCD-74170-a	Vermin	22,436	158	Sustained	4.75
20221013	INCD-74513-a	Lightning	11,332	2	Sustained	2.40
20221013	INCD-74307-a	Unknown	10,127	19	Sustained	2.14
20221013	INCD-74246-a	Vegetation	426	2	Sustained	0.09
20221013	INCD-74246-a	Vegetation	9,552	24	Sustained	2.02
20221013	INCD-74246-a	Vegetation	9,611	7	Sustained	2.03
20221013	INCD-74246-a	Vegetation	30,471	21	Sustained	6.45
20221013	INCD-74246-a	Vegetation	48,384	28	Sustained	10.24
20221013	INCD-74314-a	Weather	42,525	25	Sustained	9.00
20221013	INCD-74259-a	Weather	3,060	12	Sustained	0.65
20221013	INCD-74259-a	Weather	265,088	872	Sustained	56.13
20221013	INCD-74259-a	Weather	708,100	1825	Sustained	149.93
20221013	INCD-74259-a	Weather	310,992	627	Sustained	65.85
20221013	INCD-74259-a	Weather	22,974	14	Sustained	4.86
20221013	INCD-74246-a	Vegetation	32	0	Sustained	0.01
20221013	INCD-74246-a	Vegetation	1,134	0	Sustained	0.24
20221021	INCD-75385-a	Lightning	12,926	1	Sustained	2.74
20221021	INCD-32274-b	Lightning	165	3	Sustained	0.03
20221025	INCD-74939-a	Vegetation	1,896	6	Sustained	0.40
20221025	INCD-74939-a	Vegetation	608	2	Sustained	0.13
20221025	INCD-32511-b	Lightning	189	1	Sustained	0.04
20221025	INCD-74939-a	Vegetation	2,970	15	Sustained	0.63
20221029	INCD-75347-a	Vermin	381	3	Sustained	0.08
20221101	INCD-75564-a	Vermin	940	2	Sustained	0.20
20221106	INCD-75858-a	Lightning	959	1	Sustained	0.20
20221108	INCD-76001-a	Vermin	1,066	2	Sustained	0.23
20221108	INCD-75977-a	Vermin	139	1	Sustained	0.03
20221108	INCD-76001-a	Vermin	19	1	Sustained	0.00
20221108	INCD-76001-a	Vermin	258	1	Sustained	0.05
20221115	INCD-34783-b	Vermin	2,012	4	Sustained	0.43
20221115	INCD-76624-a	Lightning	29,646	61	Sustained	6.28
20221116	INCD-76693-a	Vermin	1,809	3	Sustained	0.38
20221118	INCD-76782-a	Lightning	734	2	Sustained	0.16
20221119	INCD-77531-a	Equipment Failure	6,976	1	Sustained	1.48
20221119	INCD-76848-a	Lightning	495	1	Sustained	0.10
20221119	INCD-77033-a	Other	2,531	1	Sustained	0.54
20221119	INCD-76836-a	Lightning	17,974	11	Sustained	3.81
20221120	INCD-77048-a	Vegetation	4,356	3	Sustained	0.92
20221120	INCD-77001-a	Weather	39	1	Sustained	0.01
20221121	INCD-35618-b	Foreign Object	7,772	29	Sustained	1.65
20221121	INCD-35618-b	Foreign Object	55	1	Sustained	0.01
20221126	INCD-77641-a	Vermin	15,750	125	Sustained	3.33
20221126	INCD-77641-a	Vermin	1,536	12	Sustained	0.33

Date	Incident Number	Cause	CMOS	Customers Interrupted	Type of Interruption	Feeder SAIDI
20221126	INCD-77654-a	Equipment Failure	141	1	Sustained	0.03
20221221	INCD-78826-a	Vermin	308	2	Sustained	0.07
20221221	INCD-78838-a	Vermin	892	2	Sustained	0.19
20230102	INCD-80082-a	Lightning	459	3	Sustained	0.10
20230102	INCD-80089-a	Lightning	170	1	Sustained	0.04
20230107	INCD-80690-a	Vegetation	14,442	83	Sustained	3.06
20230110	INCD-80989-a	Equipment Failure	1,250	1	Sustained	0.26
20230110	INCD-80989-a	Equipment Failure	1,272	1	Sustained	0.27
20230110	INCD-80989-a	Equipment Failure	970	1	Sustained	0.21
20230110	INCD-80989-a	Equipment Failure	970	1	Sustained	0.21
20230110	INCD-80989-a	Equipment Failure	866	1	Sustained	0.18
20230110	INCD-80989-a	Equipment Failure	858	1	Sustained	0.18
20230110	INCD-80989-a	Equipment Failure	852	1	Sustained	0.18
20230113	INCD-81324-a	Unknown	24,930	90	Sustained	5.28
20230117	INCD-82280-a	Weather	1,110	222	Sustained	0.24
20230117	INCD-82387-a	Weather	115,433	89	Sustained	24.44
20230117	INCD-82387-a	Weather	22,344	133	Sustained	4.73
20230122	INCD-83014-a	Vermin	10,080	84	Sustained	2.13
20230122	INCD-83014-a	Vermin	1,188	9	Sustained	0.25
20230122	INCD-83014-a	Vermin	575	5	Sustained	0.12
20230122	INCD-83014-a	Vermin	131	1	Sustained	0.03
20230122	INCD-83116-a	Lightning	430	1	Sustained	0.09
20230129	INCD-83989-a	Unknown	1,626	2	Sustained	0.34
20230205	INCD-85013-a	Vegetation	47,241	181	Sustained	10.00
20230205	INCD-85044-a	Unknown	360	1	Sustained	0.08
20230206	INCD-85117-a	Equipment Failure	333	1	Sustained	0.07
20230208	INCD-85437-a	Equipment Failure	832	2	Sustained	0.18
20230208	INCD-85437-a	Equipment Failure	3,038	1	Sustained	0.64
20230212	INCD-85827-a	Corrosion	410	2	Sustained	0.09
20230213	INCD-85927-a	Unknown	27,645	285	Sustained	5.85
20230213	INCD-85927-a	Unknown	314	1	Sustained	0.07
20230220	INCD-86872-a	Unknown	461	1	Sustained	0.10
20230220	INCD-86917-a	Unknown	1,560	10	Sustained	0.33
20230220	INCD-87164-a	Vermin	2,010	1	Sustained	0.43
20230221	INCD-87092-a	Third Party Impact	3,948	28	Sustained	0.84
20230221	INCD-87092-a	Third Party Impact	175	1	Sustained	0.04
20230224	INCD-87535-a	Vermin	324	2	Sustained	0.07
20230305	INCD-88635-a	Vermin	340	1	Sustained	0.07
20230306	INCD-88927-a	Vermin	126,958	494	Sustained	26.88
20230309	INCD-89318-a	Unknown	4,324	46	Sustained	0.92
20230309	INCD-89318-a	Unknown	60,830	385	Sustained	12.88
20230311	INCD-89551-a	Vermin	681	1	Sustained	0.14
20230312	INCD-89604-a	Vermin	1,206	3	Sustained	0.26
20230317	INCD-90167-a	Vermin	270	1	Sustained	0.06
20230317	INCD-90288-a	Vermin	372	3	Sustained	0.08
20230321	INCD-90792-a	Lightning	240	1	Sustained	0.05
20230321	INCD-90917-a	Lightning	1,322	1	Sustained	0.28
20230321	INCD-90816-a	Lightning	279	1	Sustained	0.06

Date	Incident Number	Cause	CMOS	Customers Interrupted	Type of Interruption	Feeder SAIDI
20230321	INCD-90855-a	Lightning	777	1	Sustained	0.16
20230325	INCD-91405-a	Lightning	1,317	1	Sustained	0.28
20230325	INCD-91343-a	Other	1,066	82	Sustained	0.23
20230405	INCD-92751-a	Vermin	7,150	25	Sustained	1.51
20230425	INCD-94558-a	Vermin	138	1	Sustained	0.03
20230514	INCD-40870-b	Vermin	2,195	1	Sustained	0.46
20230601	INCD-96041-a	Vermin	360	2	Sustained	0.08
20230608	INCD-96302-a	Vegetation	23,616	48	Sustained	5.00
20230619	INCD-96766-a	Unknown	4,048	22	Sustained	0.86
20230621	INCD-96891-a	Not applicable	16	2	Sustained	0.00
20230628	INCD-97788-a	Unknown	124	1	Sustained	0.03
20230802	INCD-99610-U	Not applicable	5,460	28	Sustained	1.16
20230823	INCD-100168-V	Unknown	8	2	Sustained	0.00
20230824	INCD-100190-V	Other	18	2	Sustained	0.00
20230825	INCD-101655-U	Vermin	70	1	Sustained	0.01
20230825	INCD-101660-U	Vermin	62	1	Sustained	0.01
20230828	INCD-101880-U	Unknown	36	1	Sustained	0.01
20230902	INCD-102603-U	Unknown	397	1	Sustained	0.08
20230904	INCD-102731-U	Weather	87	1	Sustained	0.02
20230911	INCD-100878-V	Unknown	6	1	Sustained	0.00
20230922	INCD-103934-U	Vermin	118	1	Sustained	0.02
20230926	INCD-104253-U	Vermin	13,230	90	Sustained	2.80
20230929	INCD-104590-U	Vegetation	62,928	414	Sustained	13.32
20230929	INCD-104590-U	Vegetation	7,701	17	Sustained	1.63
20231004	INCD-105120-U	Weather	2,318	19	Sustained	0.49
20231004	INCD-105198-U	Vermin	128	1	Sustained	0.03
20231006	INCD-105462-U	Unknown	3,132	18	Sustained	0.66
20231006	INCD-105462-U	Unknown	523	1	Sustained	0.11
20231012	INCD-106198-U	Weather	414	3	Sustained	0.09
20231024	INCD-107354-U	Vermin	204	1	Sustained	0.04
20231025	INCD-107579-U	Other	10	1	Sustained	0.00
20231106	INCD-108819-U	Vermin	58	1	Sustained	0.01
20231107	INCD-108924-U	Lightning	205	1	Sustained	0.04
20231108	INCD-109026-U	Lightning	103	1	Sustained	0.02
20231108	INCD-109181-U	Lightning	201,699	657	Sustained	42.71
20231108	INCD-109181-U	Lightning	13,272	42	Sustained	2.81
20231108	INCD-109181-U	Lightning	26,228	83	Sustained	5.55
20231108	INCD-109181-U	Lightning	57,246	174	Sustained	12.12
20231108	INCD-109181-U	Lightning	#####	2489	Sustained	405.79
20231108	INCD-109181-U	Lightning	225,998	289	Sustained	47.85
20231108	INCD-109181-U	Lightning	65,680	80	Sustained	13.91
20231108	INCD-109181-U	Lightning	262,720	320	Sustained	55.63
20231108	INCD-109181-U	Lightning	174,416	176	Sustained	36.93
20231108	INCD-109181-U	Lightning	41,287	41	Sustained	8.74
20231108	INCD-109181-U	Lightning	2,066	2	Sustained	0.44
20231108	INCD-109181-U	Lightning	2,070	2	Sustained	0.44
20231108	INCD-109181-U	Lightning	1,276	1	Sustained	0.27
20231108	INCD-109181-U	Lightning	57,420	0	Sustained	12.16

Date	Incident Number	Cause	CMOS	Customers Interrupted	Type of Interruption	Feeder SAIDI
20231109	INCD-109288-U	Lightning	1,480	4	Sustained	0.31
20231116	INCD-110181-U	Unknown	5,423	29	Sustained	1.15
20231116	INCD-110181-U	Unknown	34	2	Sustained	0.01
20231118	INCD-110397-U	Equipment Failure	122	1	Sustained	0.03
20231125	INCD-110673-U	Lightning	22	2	Sustained	0.00
20231201	INCD-110953-U	Overload	10	2	Sustained	0.00
20231208	INCD-112698-U	Unknown	133,168	464	Sustained	28.20
20231208	INCD-112698-U	Unknown	50,750	175	Sustained	10.75
20231208	INCD-112698-U	Unknown	12,306	42	Sustained	2.61
20231208	INCD-112698-U	Unknown	24,402	83	Sustained	5.17
20231208	INCD-112698-U	Unknown	7,400	25	Sustained	1.57
20231208	INCD-112698-U	Unknown	220,934	734	Sustained	46.78
20231208	INCD-112698-U	Unknown	83,377	277	Sustained	17.65
20231208	INCD-112698-U	Unknown	151,658	494	Sustained	32.11
20231208	INCD-112698-U	Unknown	59,136	192	Sustained	12.52
20231208	INCD-112698-U	Unknown	134,590	430	Sustained	28.50
20231208	INCD-112698-U	Unknown	116,592	336	Sustained	24.69
20231208	INCD-112698-U	Unknown	23,430	66	Sustained	4.96
20231208	INCD-112698-U	Unknown	22,869	63	Sustained	4.84
20231208	INCD-112698-U	Unknown	19,610	53	Sustained	4.15
20231208	INCD-112698-U	Unknown	80,352	216	Sustained	17.01
20231208	INCD-112698-U	Unknown	153,408	408	Sustained	32.48
20231208	INCD-112698-U	Unknown	11,550	30	Sustained	2.45
20231208	INCD-112698-U	Unknown	4,788	12	Sustained	1.01
20231208	INCD-112698-U	Unknown	8,976	22	Sustained	1.90
20231208	INCD-112698-U	Unknown	81,322	73	Sustained	17.22
20231208	INCD-112698-U	Unknown	178,560	160	Sustained	37.81
20231208	INCD-112698-U	Unknown	1,172	1	Sustained	0.25
20231208	INCD-112698-U	Unknown	2,374	2	Sustained	0.50
20231208	INCD-112698-U	Unknown	1,192	1	Sustained	0.25
20231208	INCD-112698-U	Unknown	1,199	1	Sustained	0.25
20231208	INCD-112698-U	Unknown	9,288	0	Sustained	1.97
20231210	INCD-112815-U	Vermin	5,478	66	Sustained	1.16
20231212	INCD-113104-U	Vermin	4,818	146	Sustained	1.02
20231213	INCD-113559-U	Weather	535,749	321	Sustained	113.43
20231213	INCD-113567-U	Weather	235,776	192	Sustained	49.92
20231213	INCD-113839-U	Lightning	2,030	1	Sustained	0.43
20231213	INCD-113846-U	Lightning	4,146	2	Sustained	0.88
20231213	INCD-114008-U	Lightning	6,412	2	Sustained	1.36
20231213	INCD-113559-U	Weather	90,180	54	Sustained	19.09
20231213	INCD-113567-U	Weather	785,610	387	Sustained	166.34
20231213	INCD-113559-U	Weather	243,966	146	Sustained	51.65
20231213	INCD-113559-U	Weather	61,938	37	Sustained	13.11
20231213	INCD-113559-U	Weather	15,084	9	Sustained	3.19
20231213	INCD-113559-U	Weather	67,160	40	Sustained	14.22
20231213	INCD-113559-U	Weather	1,915	1	Sustained	0.41
20231213	INCD-113559-U	Weather	47,875	25	Sustained	10.14
20231213	INCD-113559-U	Weather	5,745	3	Sustained	1.22



Date	Incident Number	Cause	CMOS	Customers Interrupted	Type of Interruption	Feeder SAIDI
20231213	INCD-113559-U	Weather	153,200	80	Sustained	32.44
20231213	INCD-113559-U	Weather	225,970	118	Sustained	47.84
20231213	INCD-113559-U	Weather	34,470	18	Sustained	7.30
20231213	INCD-113559-U	Weather	51,705	27	Sustained	10.95
20231213	INCD-113559-U	Weather	1,915	1	Sustained	0.41
20231213	INCD-113559-U	Weather	65,110	34	Sustained	13.79
20231213	INCD-113306-U	Lightning	316,656	733	Sustained	67.05
20231213	INCD-113307-U	Lightning	10,450	25	Sustained	2.21
20231213	INCD-113306-U	Lightning	188,734	427	Sustained	39.96
20231213	INCD-113307-U	Lightning	122,711	277	Sustained	25.98
20231213	INCD-113306-U	Lightning	6,032	13	Sustained	1.28
20231213	INCD-113307-U	Lightning	20,076	42	Sustained	4.25
20231213	INCD-113306-U	Lightning	24,751	53	Sustained	5.24
20231213	INCD-113306-U	Lightning	161,616	336	Sustained	34.22
20231213	INCD-113306-U	Lightning	486	1	Sustained	0.10
20231213	INCD-113308-U	Lightning	166,352	592	Sustained	35.22
20231213	INCD-113308-U	Lightning	12,012	42	Sustained	2.54
20231213	INCD-113308-U	Lightning	5,529	19	Sustained	1.17
20231213	INCD-113308-U	Lightning	14,112	48	Sustained	2.99
20231213	INCD-113308-U	Lightning	24,817	83	Sustained	5.25
20231213	INCD-113308-U	Lightning	43,050	105	Sustained	9.11
20231213	INCD-113308-U	Lightning	15,543	33	Sustained	3.29
20231213	INCD-113308-U	Lightning	17,538	37	Sustained	3.71
20231216	INCD-114080-U	Lightning	126	1	Sustained	0.03
20231224	INCD-114935-U	Vegetation	158,400	660	Sustained	33.54
20231224	INCD-114935-U	Vegetation	10,248	42	Sustained	2.17
20231224	INCD-114935-U	Vegetation	43,225	175	Sustained	9.15
20231224	INCD-114935-U	Vegetation	20,501	83	Sustained	4.34
20231224	INCD-114935-U	Vegetation	6,325	25	Sustained	1.34
20231224	INCD-114935-U	Vegetation	71,484	276	Sustained	15.14
20231224	INCD-114935-U	Vegetation	50,112	192	Sustained	10.61
20231224	INCD-114935-U	Vegetation	65,968	248	Sustained	13.97
20231224	INCD-114935-U	Vegetation	82,344	282	Sustained	17.43

## 4.5. Summary of key risk assessment variables and assumptions

Table 12 -

Paramater	Value	Notes
WACC	5.56%	Current weighted average cost of capital
Base year of investment	FY25	All investments for budgeting purposes in real FY2025 dollars
Calculation horizon	30 years	The timeframe over which the cost-benefit is performed

### Reliability Risk Inputs

Paramater	Value	Notes
Probability of loss of supply event	5 year historical averages	Based on ADMS historical outage information
Reliability VCR (\$/MWh)	\$37.1 (\$/kwh)	AER 2024 VCR Values, modified based on customer loading on BN11
Average Customer Load (kWh)	0.768 kW / customer	From historical feeder loading measurements

## 4.6. Option Analysis Inputs

### 4.6.1. Option 6 - BESS

#### BESS sizing and major equipment:

Average demand downstream of BN161 is ~3MVA and peak demand is ~8MVA. The average sustained outage times are 3-4hrs.

Based on this demand and outage information, it is recommended that the following equipment be installed:

- BESS 2 x 5MVA inverters and 2 x 7.5MWh battery installations (15MWh in total).
- 10MVA three winding step up transformer 415V/415V/22kV.
- 1 x ACR.

#### 4.6.1.1. Cost

The capital cost estimate is shown in Table 8 and the yearly capex is shown in Table 9. The capital cost estimate assumptions are listed below.

Assumptions:

- \$CIC per MWh for BESS storage. This covers the total cost including balance of plant. This is an average of the 2hrs and 4hr \$2024s storage cost figures from the CSIRO Gencost report.
- Transformer and ACR costs based on AusNet's unit rates.
- \$CIC for additional site work
- \$CIC allowance for minor plant and equipment.
- Land costs assumed as \$CIC including transaction costs.
- Design costs estimated at 4% of construction costs (including materials).
- Subcontractor indirect costs of 10%.
- Project management and construction management costs applied at 8% of design and construction costs.
- Risk of 10% added to direct costs.

**Table 13 – Option 6: New BESS for Euroa, capital cost estimate.**

Item	CIC
BESS 2 x 5MVA inverters and 2 x 7.5MWh battery installations (15MWh in total)	CIC
10MVA three winding step up transformer 415V/415V/22kV	CIC
Additional allowance for site work	CIC
ACR	CIC
Allowance for minor plant and equipment	CIC
Land	CIC
Sub-total – construction	CIC
Design	CIC
Sub-total – design and construction	CIC
Subcontractor indirect costs	CIC
Project management and construction management	CIC
Total cost excluding risk	CIC
Risk	CIC
<b>Total</b>	<b>CIC</b>

## 4.6.2. Option 8 - Partial supply of BN11 load from RUBA12 and MSD2

This section investigates the Partial supply of BN11 load from the RUBA12 and MSD2 feeders in further detail.

### REFCL constraint review

Prior to exploring the costs associated with this option, it is important to understand the technical REFCL constraints to factor in any limitations to the benefits.

To assess the REFCL impact, the REFCL capacitance current results were reviewed for BN, MSD and RUBA REFCLs.

The capacitance figures are as follows:

- 71 Amps downstream of the BN11 Remote REFCL
- 71 Amps on MSD Bus 1 which supplies MSD2
- 70 Amps on RUBA Bus 1 which supplies RUBA12
- 21 Amps on MSD2
- 29 Amps on RUBA12

Based on technical advice from AusNet's REFCL specialists:

- If the section downstream of the BN11 remote REFCL is transferred to MSD2 or RUBA12, it will take the MSD and RUBA buses very close to REFCL limits.
- Similarly, if the section downstream of the BN11 remote REFCL is transferred to MSD2 or RUBA12 the feeders will exceed the 80A feeder limit.

This means that a MSD2 or RUBA12 extension will only be able to pick up part of the sections downstream of the BN11 remote REFCL. These feeder tie sections will also get smaller in future as capacitance grows on BN11 and MSD2 or RUBA12.

For the purpose of this assessment, it has been assumed that two ties will be created from BN11 to MSD2 and RUBA12 to split the capacitance impact on the feeders and the buses.

The ties may require underground cable as they pass through areas with vegetation. The underground cable will also impact the capacitance of the network and the additional overhead ties will have some impact on the REFCL.

### 4.6.2.1. Cost

Two feeder ties have been assumed with the assumptions noted below.

#### Assumptions:

- 18kms between Merton and Strathbogie for the MSD2 to BN009 tie.
- 21kms between Yarck and Terip Terip for the RUBA12 to BN064 tie.
- Allow 4km allowance for deviations to direct road based line route.
- Total 43kms: Assume 39 kms of overhead and 4kms of underground. The underground length has been assumed as the new route passes through vegetated areas and reserves.
- Line uprates have not been assessed. If required, it is assumed that they will have a similar cost to new builds as the line will need to be built to the most recent Australian standards.
- Switch costs based on AusNet's unit rates.
- \$CIC allowance for control integration works.
- No costs for easements have been assumed.
- No costs for three phase voltage regulators have been assumed. These may be required following detailed analysis.
- Design costs estimated at 4% of construction costs.
- Subcontractor indirect costs of 10%.
- Project management and construction management costs applied at 8% of design and construction costs.
- Risk of 10% added to direct costs.

The capital cost estimate is shown in Table 13 and the yearly capex is shown in Table 14.

**Table 14 - Partial supply of BN11 load from RUBA12 and MSD2, capital cost estimate.**

Item	\$m
39kms of 22kV overhead line	CIC
4 kms of 22kV underground	CIC
2 x Gas insulated switches	CIC
Allowance for control integration	CIC
Sub-total – construction costs	CIC
Design	CIC
Sub-total – design and construction	CIC
Subcontractor indirect costs	CIC
Project management and construction management	CIC
Total cost excluding risk allowance	CIC
Risk	CIC
<b>Total</b>	<b>CIC</b>

#### 4.6.3. Option 9 - Partial supply of BN11 load from a new feeder from a nearby AusNet zone substation, Benalla, Mansfield, Rubicon or Seymour.

The following costing has been assumed for the Partial supply express feeder for BN11

**Table 15 – Express feeder of BN11 capital cost estimate.**

Item	\$m
Design	CIC
Internal labour	CIC
Materials	CIC
Contracts costs	CIC
<b>Project Direct Expenditure</b>	<b>CIC</b>
P50 Risk	CIC
<b>Project Direct Expenditure Plus P50 Risk</b>	<b>CIC</b>
Management Contingency (P90)	CIC
Overheads – 7%	CIC
Finance Charges (IDC) – 4%	CIC
<b>Total</b>	<b>CIC</b>

#### 4.6.4. Option 17 - Euroa diesel generators

##### Diesel Generator sizing and major equipment

Average demand downstream of BN161 is ~3MVA and peak demand is ~8MVA. The average sustained outage times are 3-4hrs.

Based on this demand and outage information, it is recommended that the following equipment be installed:

- 4 x 2.25MVA (4 x 2MW) diesel generators.
- 2 x 5MVA three winding step up transformers 6.6kV/6.6kV/22kV.
- 2 x ACRs.

##### 4.6.4.1. Cost

The diesel generator capex estimate option has the following assumptions:

- \$ CIC per MW for Diesel generators. This covers the equipment cost.
- \$ CIC installation cost.
- ACR costs based on AusNet's unit rates. Transformer size does not match standard size in the AusNet unit rate list, so an assumption is made in the table below.
- \$ CIC for site work.
- \$ CIC allowance for minor plant and equipment.
- Land costs assumed as \$ CIC including transaction costs.
- Design costs estimated at 4% of construction costs.
- Subcontractor indirect costs of 10%.
- Project management and construction management costs applied at 8% of design and construction costs.
- Risk of 10% added to direct costs.

The capital cost estimate is shown in Table 18 and the yearly capex is shown in Table 19.

**Table 16 – Option 17 Euroa diesel generators, capital cost estimate.**

Item	\$m
Diesel generators 8MW	CIC
2 x 5MVA three winding step up transformers 6.6kV/6.6kV/22kV	CIC
Installation cost	CIC
Additional allowance for site work	CIC
2 x ACRs	CIC
Allowance for minor plant and equipment	CIC
Land	CIC
Sub-total - construction costs	CIC
Design	CIC
Subcontractor indirect costs	CIC
Project management and construction management	CIC
Total cost excluding risk allowance	CIC
Risk	CIC
<b>Total</b>	<b>CIC</b>

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