Bacchus Marsh supply area

PAL BUS 6.04 - BMH supply area - Jan2020 - Public

Regulatory proposal 2021–2025

Contents

1 Overview

Business	Powercor
Title	Bacchus Marsh supply area
Project ID	PAL BUS 6.04 - BMH supply area - Jan2020 - Public
Category	Augmentation
Identified need	The identified need is to maintain a reliable supply of electricity to customers in the Bacchus Marsh supply area as the level of energy at risk continues to grow over time, and as the existing number one transformer at our BMH zone substation approaches the end of its service life
Recommended option	Install a third transformer (25/33 MVA), 66kV and 22kV circuit breakers and a new control room
Proposed start date	2022
Proposed commission date	2024
Supporting documents	PAL MOD 6.07 - BMH supply area - Jan2020 - Public PAL ATT102 - CulterMerz - Review of demand management - Feb2019 - Public PAL ATT134 - VPA - Bacchus Marsh urban growth framework - Aug2018 - Public PAL RIN001 - Workbook 1 - Forecast templates - Jan2020 - Public

Source: Powercor

The Bacchus Marsh supply area is part of the western growth corridor that is forecast to continue experiencing increased electricity maximum demand over the next 10 years. This growth is driven primarily by forecast population increases.

The supply area is currently serviced by our existing Bacchus Marsh zone substation, and this business case is focused on several options to ensure we continue to provide a reliable supply of electricity to these customers. For the reasons outlined in this document, our preferred network solution is to install a third transformer and undertake the associated works.

The forecast capital and operating expenditure requirements for the 2021–2026 regulatory period, for the preferred option, are outlined in table 1. These forecasts have been developed in calendar year terms, and converted to financial years in our consolidated expenditure modelling following changes to our reporting period (as required by the Victorian Government and the Australian Energy Regulator).

Table 1 Expenditure forecasts for preferred option ($ million, 2019)

Expenditure forecast	2021/22	2022/23	2023/24	2024/25	2025/26	Total
Capital expenditure	0.4	1.4	3.3	2.3	-	7.4
Operating expenditure	-	0.0	0.0	0.0	0.1	0.1
Total	**0.4**	**1.4**	**3.3**	**2.4**	**0.1**	**7.5**

Source: Powercor
Notes: May not add due to rounding

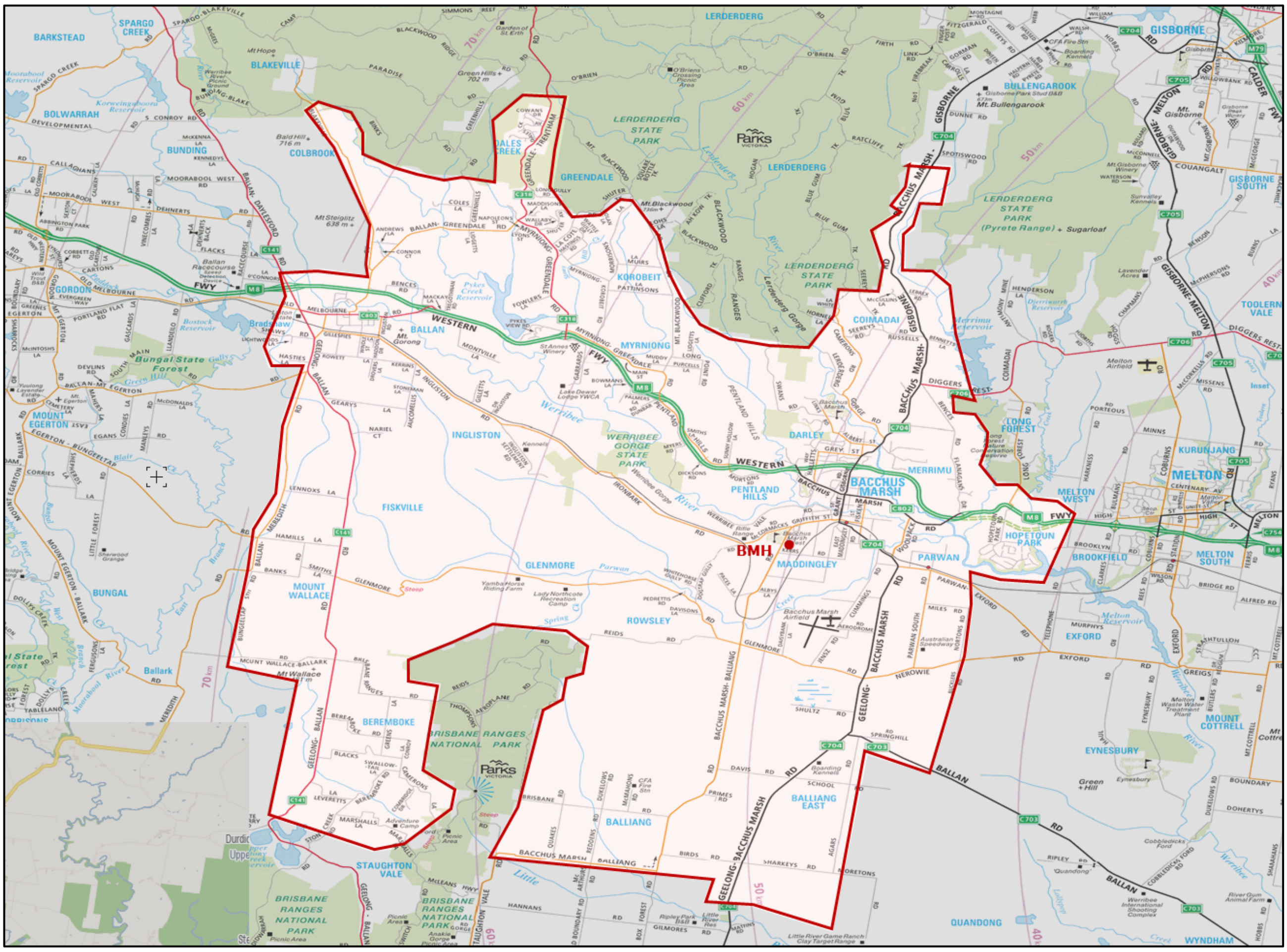
2 Background

2.1 Bacchus Marsh zone substation supply area

Bacchus Marsh zone substation (**BMH**) is located on the corner of Bacchus Marsh-Balliang Road and Kerrs Road, Maddingley. BMH zone substation provides electricity supply to a total of 10,566 customers, including 9,431 domestic, 719 commercial, 169 industrial, and 247 agricultural customers. The suburbs supplied include Bacchus Marsh, Maddingley, Darley, Greendale, Ballan and Myrniong.

A map of the BMH supply area is shown in figure 1.

Figure 1 BMH supply area



Source: Powercor

2.2 Existing network characteristics

BMH is a banked zone substation consisting of two 10/13.5 MVA 66/22 kV transformers supplying two 22 kV outdoor buses with four distribution feeders. These transformers were installed in the 1960s, and are both showing signs of deteriorating condition.

The zone substation is currently supplied by a 66 kV sub-transmission line from Brooklyn terminal station (**BLTS**) and a 66 kV sub-transmission line from Ballarat terminal station (**BATS**).

3 Identified need

The identified need is to maintain a reliable supply of electricity to customers in the BMH supply area as the level of energy at risk continues to grow, and our existing assets deteriorate over time. Our load forecasts for the supply area and the energy at risk are discussed below.

3.1 Forecast demand

Our BMH zone substation is a summer critical zone substation. The zone substation experiences both a summer evening air-conditioning peak and winter hot water peak due to the lack of residential gas reticulation in the Bacchus Marsh region. Our maximum demand forecasts indicate an average annual compound growth rate of 6.9% in the BMH supply area up to 2028.

The demand growth in the BMH supply area is primarily due to forecast population increases, as its proximity to Melbourne and affordable land and housing make it popular for people wanting a rural lifestyle with metropolitan convenience.

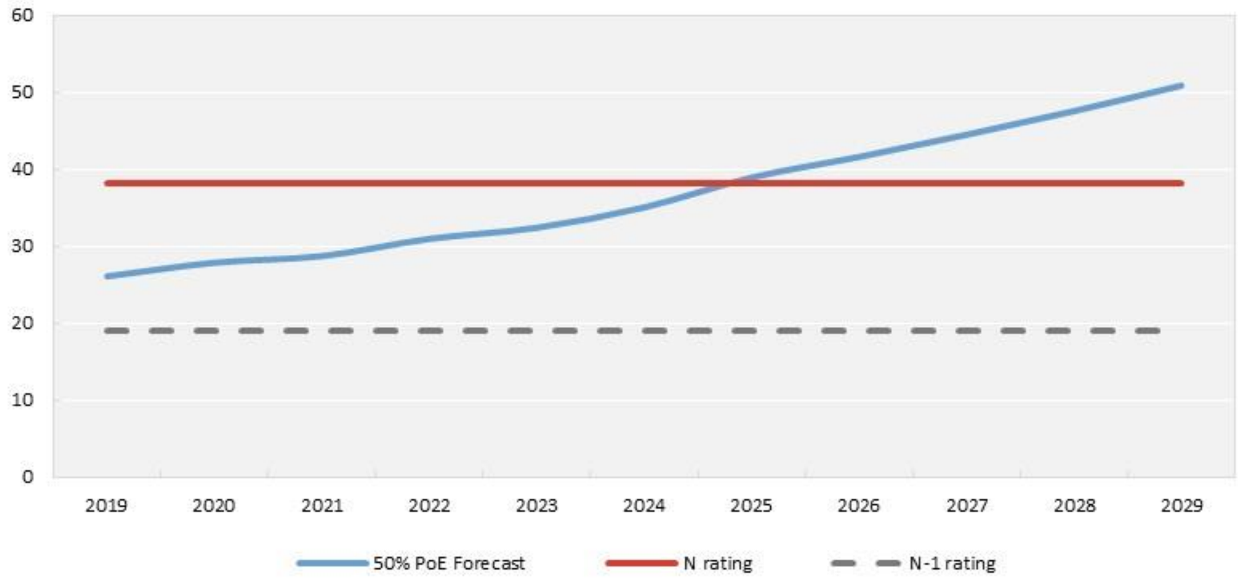
Further detail on the urban growth framework for Bacchus Marsh is set out in appendix A.

3.1.1 Zone substation maximum demand

As shown in figure 2, our BMH zone substation is currently operating above its N-1 rating under 50% probability of exceedance (**PoE**) weather conditions.[1] Therefore, with one transformer out of service (N-1 rating), customer load shedding will be required because there will be insufficient capacity at the station to supply all demand.

Peak demand is also approaching the station N rating, and is forecast to exceed this rating in 2025.

Figure 2 BMH zone substation: maximum demand at 50% probability of exceedance (MVA)



Source: Powercor

1 PoE refers to weather in any given summer exceeding the specified reference level (or the percentile) based on the last 50 years of historical weather data.

3.2 Energy at risk

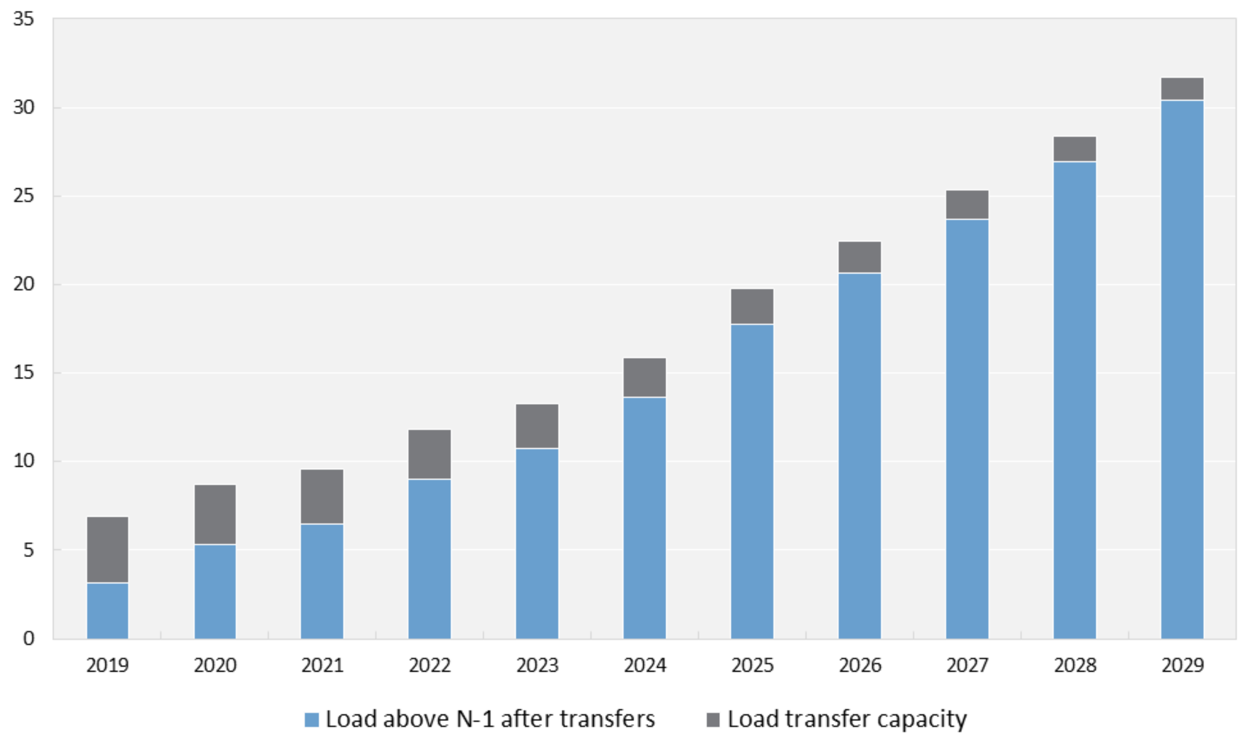
Consistent with our probabilistic planning approach, the quantity and value of energy at risk is a critical parameter in assessing prospective network investment or other action in response to an emerging constraint.

3.2.1 Load transfer capacity

Due to its location in our network, there is limited contingency load transfer capability between BMH and the neighbouring zone substations at Melton (**MLN**) and Ballarat North (**BAN**). At any given time, actual available transfer capability is dependent on network operating conditions and the availability of spare capacity at adjacent zone substations. As the forecast load growth continues in the wider region, the contingency transfer capability will diminish further, leaving a greater number of customers exposed to the risk of a supply interruption. The available load transfers are shown in in the attached model.[2]

The expected load above N-1 after transfers following a major outage of one of the transformers at our BMH zone substation during peak demand conditions is shown in **Error! Reference source not found.**. After load ransfers are established, a shortfall in capacity of approximately 20 MVA is forecast for 2026 (or loss of supply for approximately 6,700 customers).

Figure 3 Load above N-1 after transfers at 50% probability of exceedance (MVA)



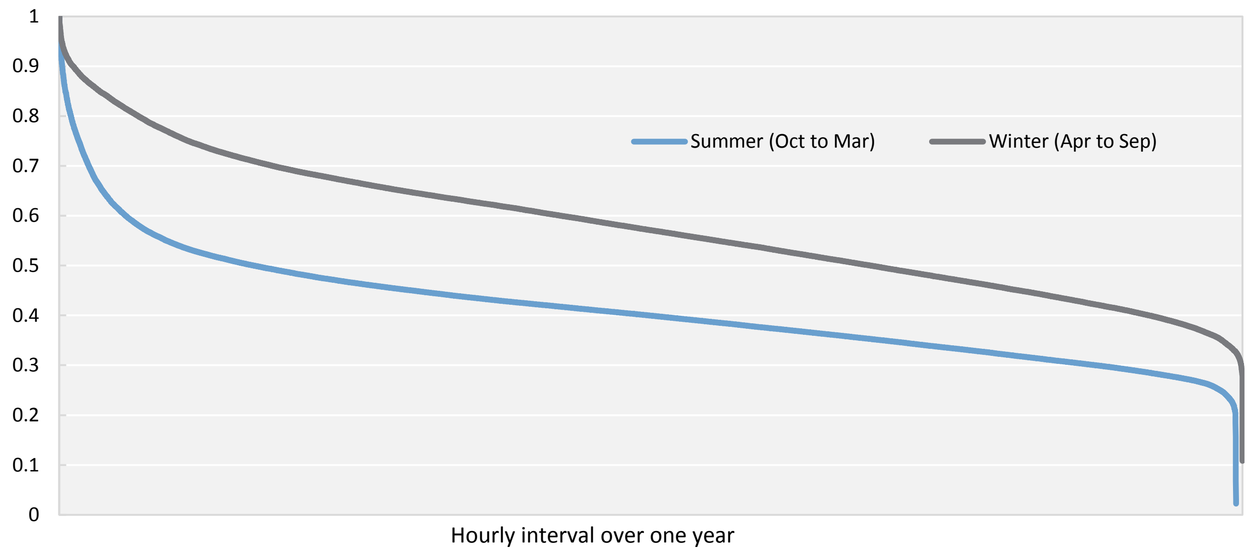
Source: Powercor

[2] PAL MOD 6.07 - BMH supply area - Jan2020 - Public

3.2.2 Energy at risk after load transfers

A load-duration curve, based on historical load data, is used to determine the amount of energy at risk over the N and N-1 ratings each year. The load duration curve is disaggregated into summer and winter curves, with each representing the duration that demand reaches a given percentage of the summer and winter maximum demands respectively.[3] The load-duration curves for our BMH zone substation are shown in figure 4.

Figure 4 Load-duration curve (percentage of maximum demand)

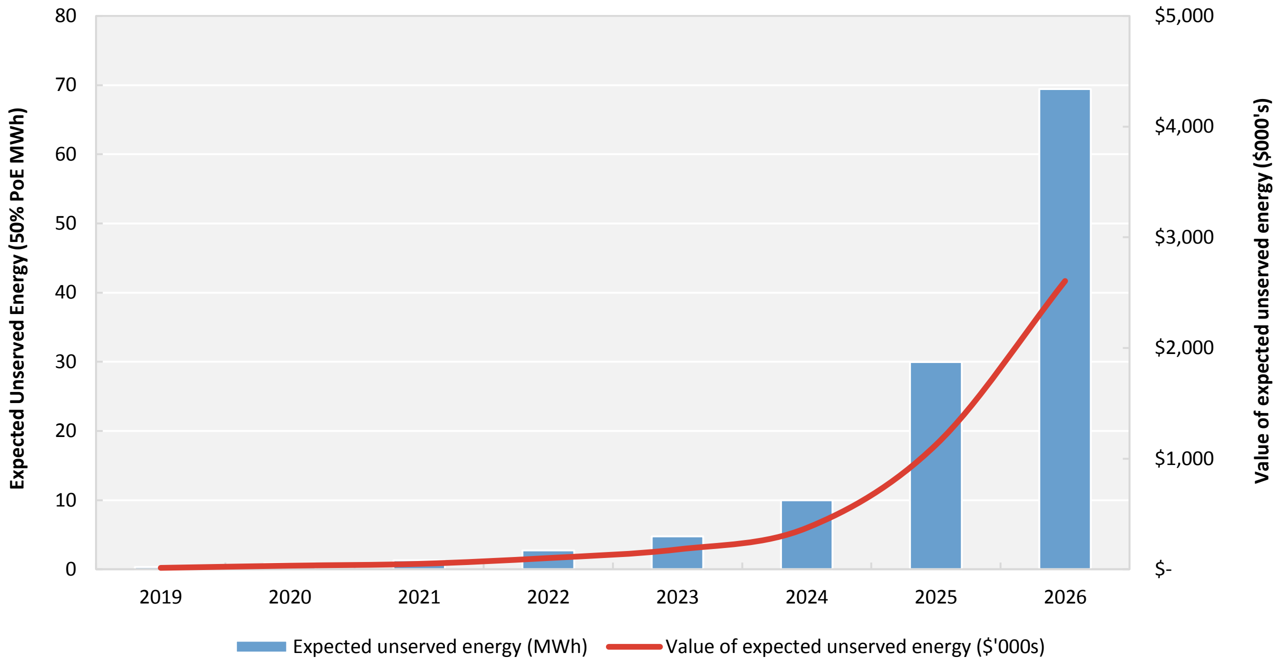


Source: Powercor

The energy at risk is weighted by the probability of an outage to determine the expected unserved energy. The expected unserved energy is estimated using a 30:70 weighting of the 10% PoE and 50% PoE. The expected cost of the energy at risk at BMH zone substation is shown in figure 5.

3 Typically zone substations in our network are summer peaking. Winter load duration curves are often higher than summer curves because the maximum demand in winter is lower.

Figure 5 Expected energy at risk (MWh) and expected value of unserved energy ($'000s)



Source: Powercor

Figure 6 demonstrates that the expected unserved energy levels for the supply area will increase significantly from current levels. This will result in deteriorating reliability of supply for the customers in this area, particularly during hot summer days. This business case demonstrates there is an identified need and an economic case to invest in the area to maintain reliability of supply at current levels.

3.3 Transformer condition and zone substation supply security

The BMH zone substation transformers are configured in a banked switching formation. This means that for any transformer or 22kV feeder bus fault, the 66kV line circuit breakers will operate (i.e. open), resulting in a supply outage for the whole zone substation. In these circumstances, all customers will be off supply until a HV operator can arrive on site to manually isolate the fault.

Further, as outlined previously, the two existing zone substation transformers were installed in the 1960s and recent maintenance testing indicates that both transformers are showing signs of deteriorating condition. As the condition of the existing transformers deteriorate, the risk due to one or multiple transformer failures will become even more significant.

4 Options analysis

Several options were considered to address the identified need in the BMH supply area. These options address the identified need to varying extents, and as such, the preferred option is that which maximises the net economic benefits. This assessment of net economic benefits is presented relative to a 'do-nothing' scenario.

As shown in table 2, the preferred network solution is option two—install a third transformer (25/33 MVA), 66kV and 22kV circuit breakers and a new control room.

Table 2 Summary of net economic benefits ($ million, 2019)

	Option	Net economic benefits
Do nothing	Maintain the status-quo	-
1	Install a third transformer (10/13 MVA), 66kV and 22kV circuit breakers and a new control room	293.1
2	Install a third transformer (25/33 MVA), 66kV and 22kV circuit breakers and a new control room	297.3
3	Install a third transformer (25/33 MVA), 66kV circuit breaker, 22kV indoor switchroom and a new control room	296.7
4	Non-network solution to defer preferred network option	297.1

Source: Powercor

The options considered are discussed in further detail below. The analysis supporting our assessment of alternative options, including relevant assumptions, is included in the attached model.[4]

This project will also be subject to a regulatory investment test for distribution (**RIT–D**). Engagement of non-network service providers to seek alternative solutions to defer investment is a major part of the RIT-D consultation. We will initiate consultation well before the economic timing of the preferred network option in order to maximise the chance of a viable non-network solution being identified.

4.1 Assessment of credible options

4.1.1 Do nothing: maintain the status-quo

The 'maintain status-quo' option does not involve any capital expenditure. Under this option, we would continue to supply customers by our BMH zone substation without any intervention to manage the existing and forecast energy at risk, other than through currently available operational responses such as limited load transfers. As a result, this option will lead to significant supply interruptions and potential asset failures as forecast loads reach or exceed the thermal ratings of distribution assets.

This option, therefore, fails to address the identified need (as set out in section 3).

[4] PAL MOD 6.07 - BMH supply area - Jan2020 - Public

4.1.2 Option one: install a third transformer (10/13 MVA), 66kV and 22kV circuit breakers and a new control room

This option involves installing a third transformer (10/13 MVA) with the associated 66kV and 22kV circuit breakers and a new control room.

The current layout and configuration of the outdoor switchyard will require existing structures and plant items to be re-aligned to accommodate the additional circuit breakers (both 66kV and 22kV). These are required to ensure security of supply in accordance with our planning policeis, and to safely operate and maintain the transformer.

A summary of the market benefits and costs of this option relative to the do-nothing option is shown in table 3.

Table 3 Option one: benefits assessment summary ($ million, 2019)

Option	NPV costs	NPV benefits	Net economic benefits
Install a third transformer (10/13 MVA), 66kV and 22kV circuit breakers and a new control room	-3.1	296.2	293.1

Source: Powercor

4.1.3 Option two: a third transformer (25/33 MVA), 66kV and 22kV circuit breakers and a new control room

This option involves installing a larger capacity third transformer (25/33 MVA) with the associated 66kV and 22kV circuit breakers and a new control room. The material cost difference between the smaller capacity transformer in option one is marginal for double the transformer capacity. The larger transformer capacity will also accommodate future load growth and the continued development expected in the Bacchus Marsh supply area.

The current layout and configuration of the outdoor switchyard will require existing structures and plant items to be re-aligned to accommodate the additional transformer circuit breakers (both 66kV and 22kV). In addition, sections of the 22kV outdoor bus will be upgraded to accommodate the increase in transformer capacity. A breakdown of the costs for this option is provided in our attached reset Regulatory Information Notice (**RIN**).[5]

A summary of the market benefits and costs of this option relative to the do-nothing option is shown in table 4.

Table 4 Option two: benefits assessment summary ($ million, 2019)

Option	NPV costs	NPV benefits	Net economic benefits
Install a third transformer (25/33 MVA) , 66kV and 22kV circuit breakers and a new control room	-3.4	300.8	297.3

Source: Powercor

[5] PAL RIN001: Powercor, Reset RIN, template 2.3(a).

4.1.4 Option three: install a third transformer (25/33 MVA), 66kV circuit breaker, 22kV indoor switchroom and a new control room

This option involves installing a third transformer (25/33 MVA) with a 66kV breaker, a new 22kV indoor switchroom and a new control room.

To minimise the health and safety hazards and construction work required to re-align sections of the existing outdoor switchyard, a new modular 22kV indoor switchboard would be installed and gradually transition the transformers and 22kV distribution feeders. The new indoor switchboard can be installed in a vacant section of the zone substation yard with minimal disruption to the operation of the zone substation and greatly reduce health and safety risk in working in the vicinity of live assets in confined spaces.

Once the new switchboard has been commissioned, the old outdoor 22kV switchyard will be de-energised and removed. The remaining outdoor 22kV circuit breakers will be put into storage and used for spare parts, as there are only a few remaining circuit breakers of that type in operation in our network (with the manufacturer no longer supplying spare equipment for that model of circuit breaker).

A summary of the market benefits and costs of this option relative to the do-nothing option is shown in table 5.

Table 5 Option three: benefits assessment summary ($ million, 2019)

Option	NPV costs	NPV benefits	Net economic benefits
Install a third transformer (25/33 MVA), 66kV circuit breaker, 22kV indoor switchroom and a new control room	-4.1	300.8	296.7

Source: Powercor

4.1.5 Option four: non-network solution to defer preferred network option

This option considers the ability of a non-network solution to defer the preferred network option. For this assessment, we have estimated the cost of a non-network solution that would result in the energy at risk remaining at the same level as that forecast in the year immediately prior to the commissioning date of the preferred solution.

We have based the cost of a non-network solution on a benchmark rate of $87,000 per MW per annum. This rate is based on observed rates, and is supported by comparative analysis of other distributors experience provided by CutlerMerz.[6]

The estimated non-network support requirements are summarised in table 6. For example, a 4.1MW non-network solution would bring the combined station load at risk back to the previous year's level and defer by one year the preferred network solution. The magnitude of the required non-network support increases over time so that the expected energy at risk remains constant.

[6] PAL ATT102: CutlerMerz, *Review of demand management unit rates*, February 2019.

Table 6 Non-network support requirements (MW)

Year	2024	2025	2026	2027	2028
Demand at risk after load transfers	13.7	17.8	20.6	23.7	26.9
Non-network support	-	4.1	7.0	10.0	13.3

Source: Powercor

Based on the above, the full cost of a demand management solution is equal to the required network support multiplied by the benchmark rate, plus the annual costs of any residual unserved energy. In this case, the net economic benefits of the demand management option are not as great as the preferred option, due in part to the lower residual unserved energy in the preferred option.

A summary of the market benefits and costs of this option relative to the do-nothing option is shown in table 7.

Table 7 Option four: benefits assessment summary ($million, 2019)

Option	NPV costs	NPV benefits	Net economic benefits
Non-network solution to defer preferred network option	-3.4	300.5	297.1

Source: Powercor

Irrespective of this high-level assessment, this project will be subject to assessment as required under the RIT-D. We will initiate consultation well before the economic timing of the preferred network option to maximise the chance of a viable non-network solution being identified.

4.2 Sensitivity analysis

Sensitivity assessment was performed to assess the impact on the ranking of the options from varying the demand and capital expenditure forecasts. Two scenarios were applied (equal to ±2% for demand forecasts, and ±10% for capital expenditure forecasts), reflecting best and worst-case scenarios.

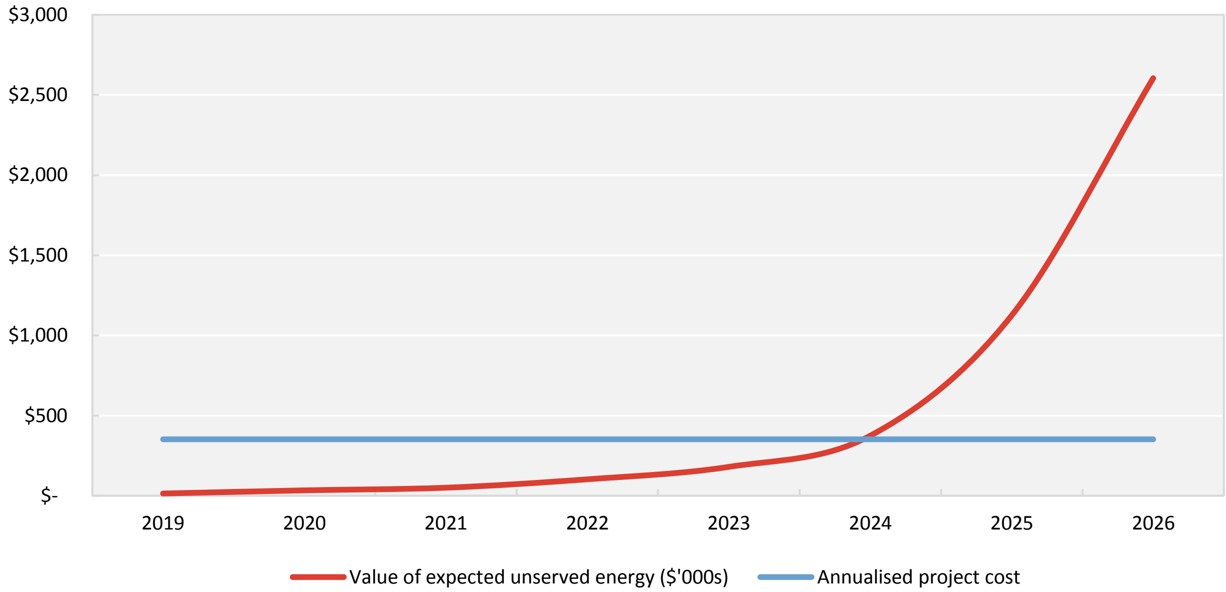
The results found the ranking of the preferred network option remains unchanged in all sensitivity scenarios.

5 Recommendation

The preferred option, as set out in section 4, is to install a third transformer (25/33 MVA), 66kV and 22kV circuit breakers and a new control room. The design of the BMH zone substation after completion of the proposed works is shown in appendix B.

A detailed economic assessment was performed to evaluate the optimum timing of the preferred network option. As shown in figure 6, the net market benefits of installing a third transformer and associated works at BMH zone substation are maximised if the asset is commissioned no earlier than 2024.

Figure 6 Timing of preferred option ($million, 2019)



Source: Powercor

The forecast capital and operating expenditure requirements for the 2021–2026 regulatory period, for the preferred option, are outlined in table 8. These forecasts have been developed in calendar year terms, and converted to financial years in our consolidated expenditure modelling following changes to our reporting period (as required by the Victorian Government and the Australian Energy Regulator).

Table 8 Expenditure forecasts for preferred option ($ million, 2019)

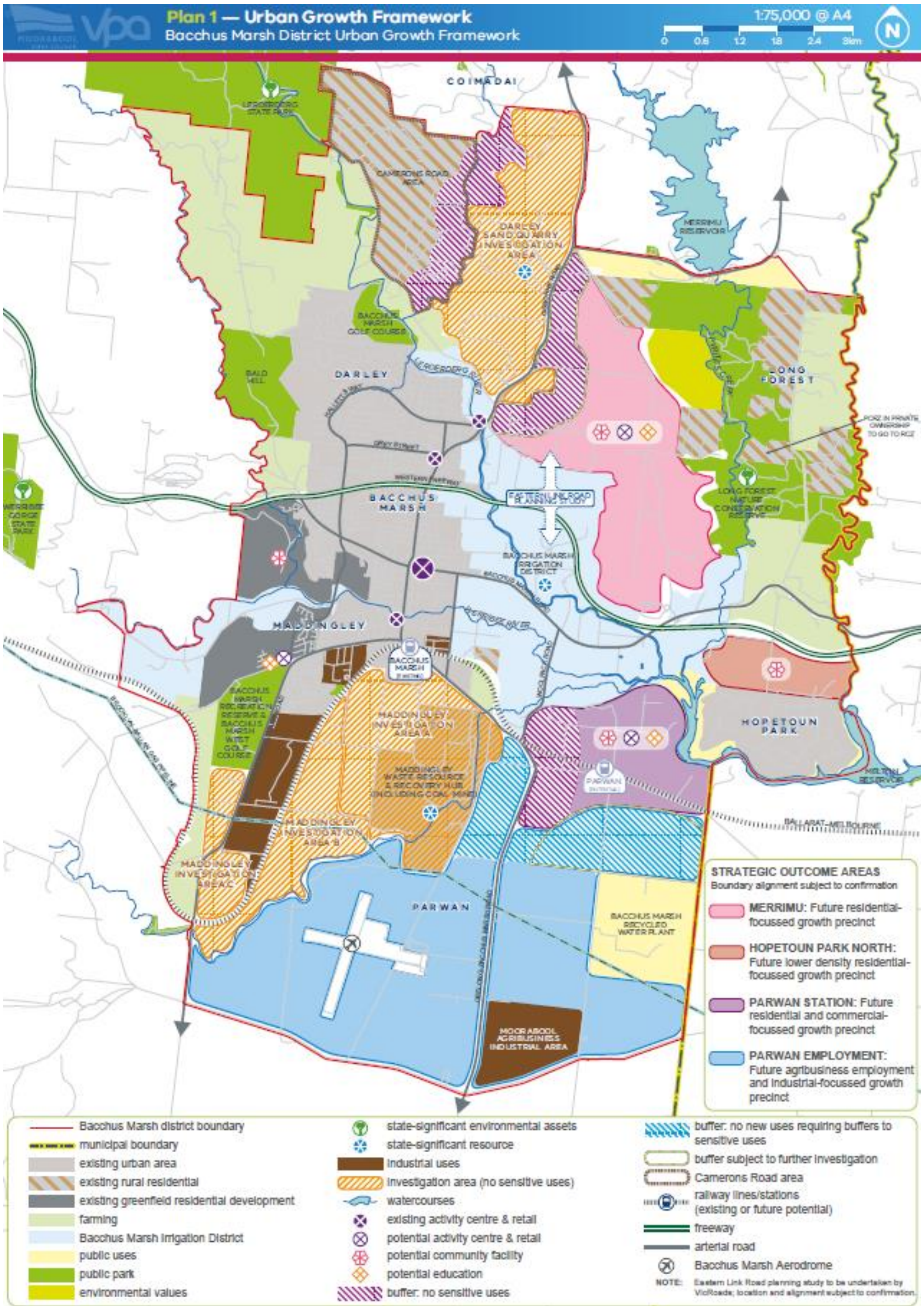
Expenditure forecast	2021/22	2022/23	2023/24	2024/25	2025/26	Total
Capital expenditure	0.4	1.4	3.3	2.3	-	7.4
Operating expenditure	-	0.0	0.0	0.0	0.1	0.1
Total	**0.4**	**1.4**	**3.3**	**2.4**	**0.1**	**7.5**

Source: Powercor
Notes: May not add due to rounding

A Bacchus Marsh urban growth framework

In 2018, the Victorian Planning Authority released the Bacchus Marsh urban growth framework detailing long-term land use plan for the future development of the Bacchus Marsh area. An outline of the urban growth plan, including the separate precincts, is shown in figure 7.

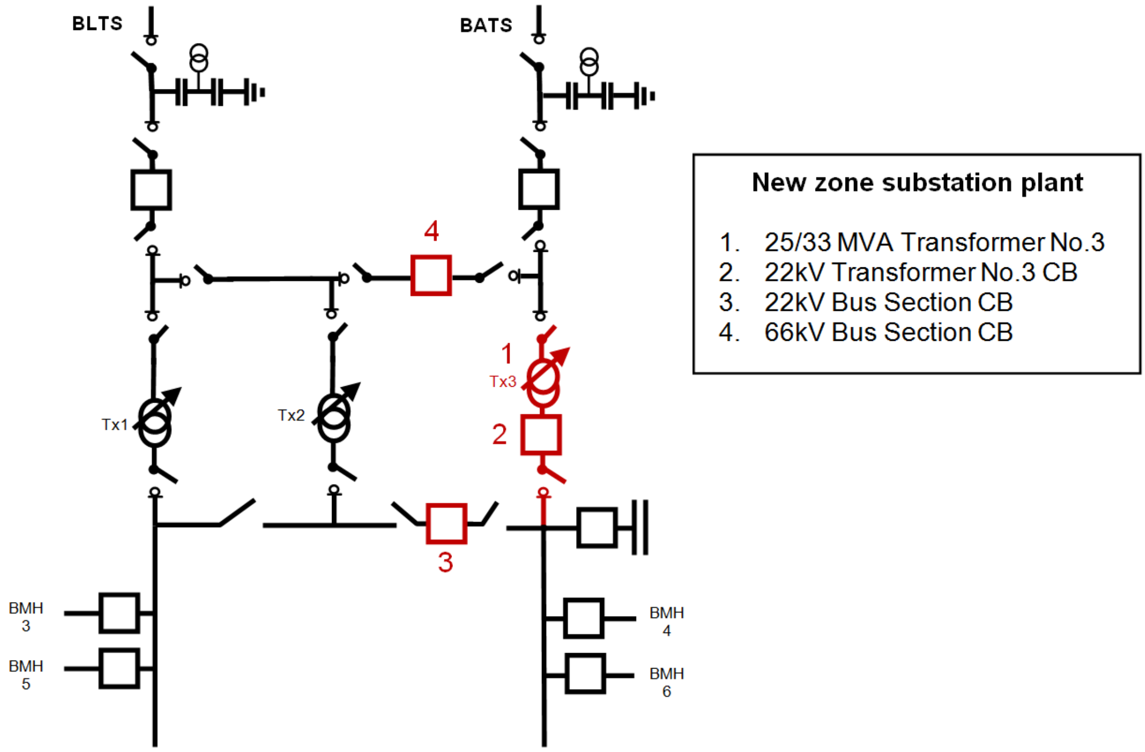
Figure 7 Bacchus Marsh urban growth plan



Source: Victorian Planning Authority, Bacchus Marsh urban growth framework, August 2018

B BMH zone substation diagram

Figure 8 Schematic of BMH zone substation after completion of proposed works



Source: Powercor