Cranbourne Terminal Station demand management

UE BUS 9.04 - Cranbourne terminal station - Jan2020 - Public

Regulatory proposal 2021–2026

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Contents

1 Overview

Business	United Energy
Title	Cranbourne Terminal Station demand management
Project ID	UE BUS 9.04 - Cranbourne terminal station - Jan2020 - Public
Category	Operating expenditure
Identified need	To maintain present levels of electricity supply reliability for customers in the CBTS supply area. As the level of energy at risk continues to grow, reliability will deteriorate, triggering the need for investment at this substation.
Recommended option	Option 3—procure a non-network solution for four years to defer the need for a fourth transformer at CBTS by three years
Proposed start date	2021/22
Supporting documents	1. UE MOD 9.06 - Demand management Cranbourne - Jan2020 - Public 2. UE ATT024 - ESCV - Electricity distribution licence - Jan2005 - Public

Cranbourne Terminal Station (**CBTS**) is a transmission connection asset that supplies parts of United Energy's and AusNet Services' (**AusNet**) distribution networks. Its supply area covers one of the fastest growing regions in Victoria including Cranbourne, Cranbourne East, Lyndhurst, Clyde, Clyde North and Pakenham. Since commissioning CBTS in 2005, the maximum demand has grown rapidly and consistently driven by improved access to the region. [1] This growth is forecast to continue, driven by development activities in the area and increased population, resulting in diminishing available capacity at CBTS and triggering the need for investment at this substation.

In Victoria, distributors have the responsibility to plan and direct augmentation of transmission connection facilities (like CBTS) which connect their distribution systems to the shared transmission network. As a party responsible for planning the connection point, we have identified a potential demand management option at the distribution network level to defer augmentation of the CBTS transmission connection assets.

This business case assesses options to support the forecast maximum demand at CBTS. United Energy's and AusNet's preferred option to address the identified need is to procure a non-network solution for four years to defer the need for a fourth transformer at CBTS by three years.

The operating expenditure for the non-network solution will be shared between AusNet and us with a split of 62% and 38% respectively, reflecting the energy consumption for each distributor within the shared transmission station supply area. This will result in incremental operating expenditure above our 2019 base year to fund the non-network solution.

Our forecast operating expenditure requirements for the preferred option are outlined in table 1.

Table 1 Operating expenditure forecast ($ million, 2019)

Expenditure forecast	2021/22	2022/23	2023/24	2024/25	2025/26	Total
Operating expenditure (United Energy portion)	0.37	0.37	0.37	0.37	-	1.47

Source: United Energy

[1] Major infrastructure projects improving access to the region include Eastlink, Monash Freeway widening, Thompsons Rd widening, and Pakenham & Cranbourne railway corridor improvements.

2 Background

2.1 Our role in joint planning arrangements

In Victoria, distributors have the responsibility to plan and direct augmentation of facilities which connect their distribution systems to the shared transmission network. In accordance with our Electricity Distribution Licence, we are 'responsible for planning, and directing the augmentation of, transmission connection assets to assist [us] to fulfil [our] obligations [to offer connection services]'under clause 6.[2]

In our role of transmission connection point planner, we have a duty to identify non-network (or demand management) solutions that could offset the immediate need for augmentation projects if they prove beneficial for the customer. The benefits of demand management include; being less costly than a capital solution, can be provided incrementally as demand grows or declines, can delay long-term and irreversible investments and allowing time to remove uncertainty in forecast maximum demand growth.

The demand management is undertaken at the distribution level meaning the costs are incurred by distributors. Therefore—as recognised by the Australian Energy Market Commission (**AEMC**)—there is be a need for us to recover the costs through the regulatory determination process.[3]

2.2 Planning approach

We plan our transmission connection asset augmentations based on a probabilistic approach. We weight the costs to customers of an outage occurring based on an estimate the probability of such an event occurring within the peak loading season. This allows us to assess:

- the expected reliability cost to customers that will be incurred if no action is taken to address an emerging constraint
- whether it is economic to augment the network capacity to reduce expected supply interruptions.

In other words, recognising that very extreme loading conditions may occur for only a few hours in each year, it may be uneconomic to provide additional capacity to reduce the outage risk.

2.3 CBTS characteristics

CBTS was originally commissioned with two 150 mega volt amp (**MVA**) 220/66 kV transformers in 2005 to reinforce the security of supply and off-load East Rowville Terminal Station (**ERTS**) which was supplying the area at the time. With consistent electricity demand growth in the area, a third 150 MVA 220/66 kV transformer was commissioned in 2009. CBTS has been operating with three transformers since this time to the current day.

CBTS provides electricity supply to approximately 168,000 customers, which are predominantly residential and some light industrial and commercial establishments. The area supplied spans from Narre Warren in the north to Clyde in the south and from Pakenham in the east to Carrum and Frankston in the west. CBTS services 62% of AusNet's and 38% of our distribution networks based on energy consumption. A simplified single line diagram of CBTS is provided in the figure 1.

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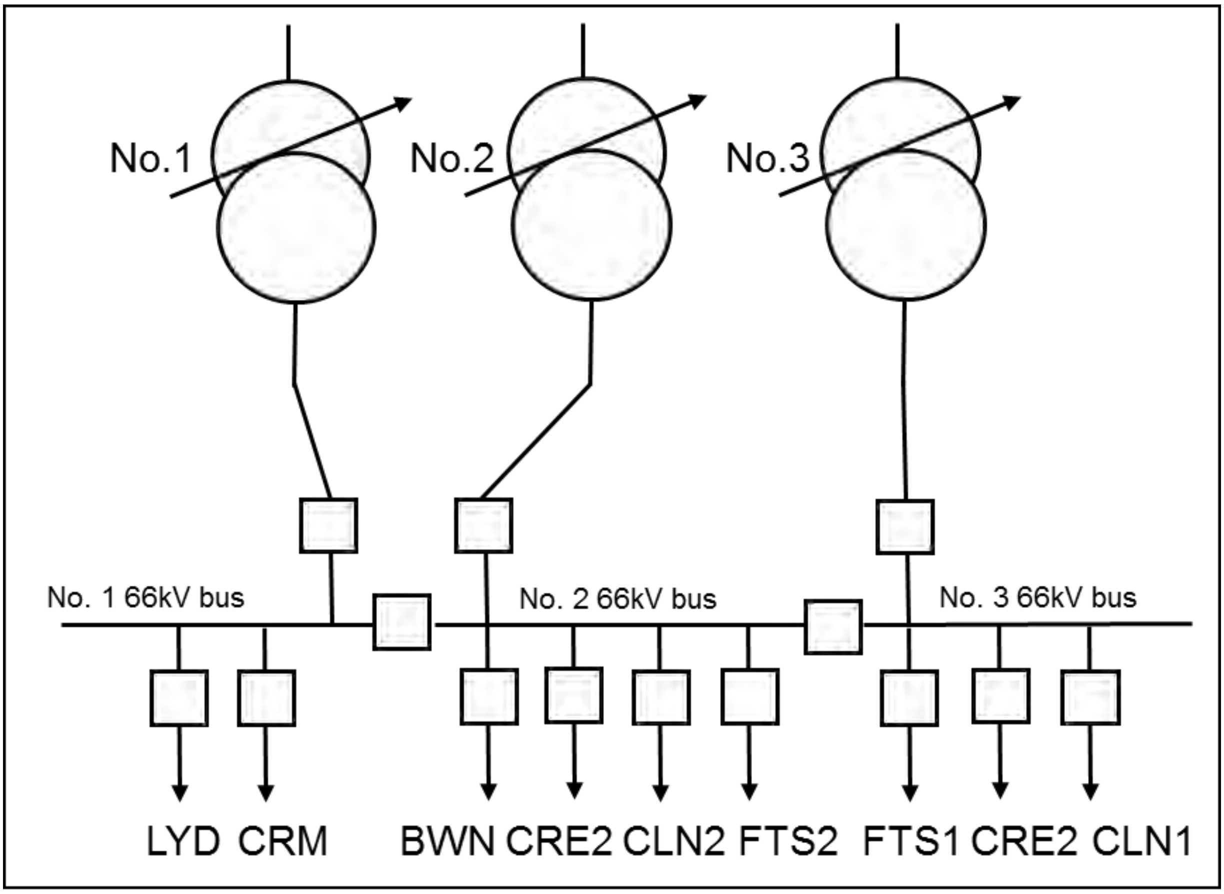
2 UE ATT024 - ESCV - Electricity distribution licence - Jan2005 - Public.

3 AEMC, Rule determination: Recovery of Network Support Payments, 31 October 2013, p. 3.

Figure 1 **CBTS Single Line Diagram**



Source: United Energy

3 Identified need

The identified need is to maintain present levels of electricity supply reliability for customers in the CBTS supply area. As the level of energy at risk continues to grow, reliability will deteriorate, triggering the need for investment at this substation. The level of energy at risk is discussed below.

3.1 Maximum demand growth and capacity

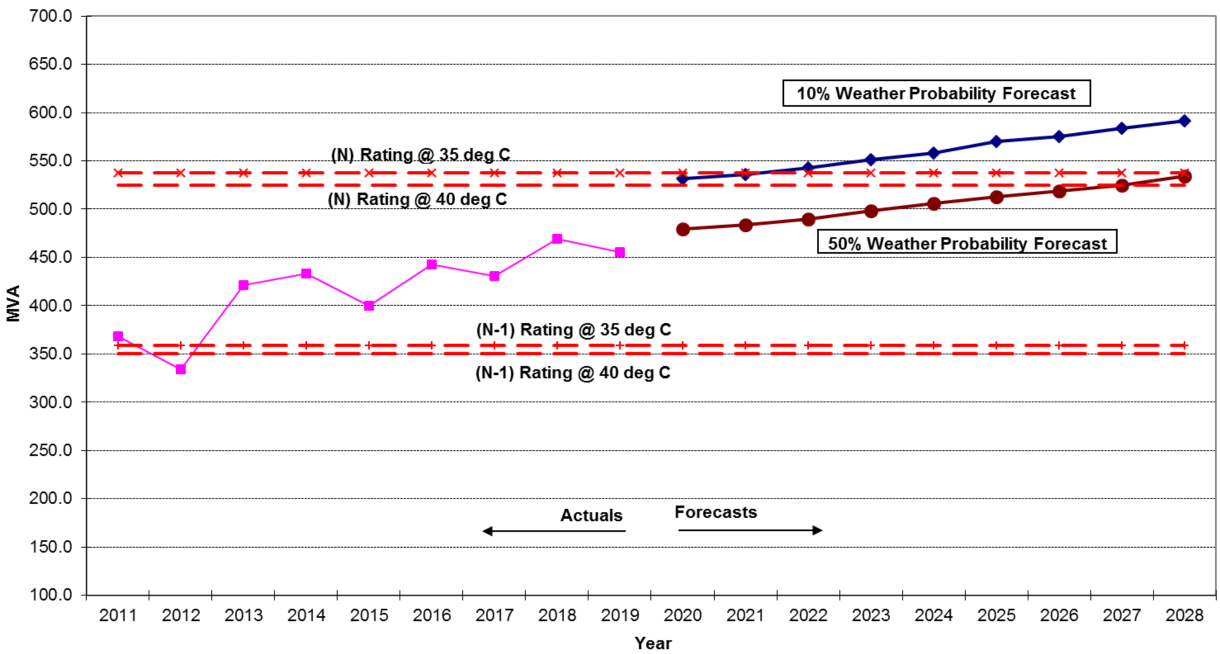
Growth in maximum demand at CBTS has been rapid and consistent with a 4.2% annual average compound growth since 2008. This high growth is forecast to continue at an average annual compound growth rate of 1.7% under 50% probability of exceedance (**POE**) weather conditions. The demand growth in the CBTS supply area is primarily due to the following:

- staged development of residential estates and other residential sub-divisions
- commercial developments such as shopping centres, childcare centres, schools, medical centres and retail hubs, associated with new large residential developments
- development of light industrial areas.

This is discussed further in appendix A.

Figure 2 shows the 50% POE and 10% POE actual and forecast maximum demand at CBTS.

Figure 2 CBTS actual and forecast demand at 10% and 50% POE (MW)



Source: United Energy

There is insufficient capacity to supply the growing demand at CBTS from 2020 under system normal operating conditions for a 10% POE maximum demand.

Historical and forecast maximum demand under the 10% and 50% POE conditions have been above the N-1 rating since 2011/12.[4] Additionally, the station N rating is reached under a 50% POE forecast by 2029. Under the 10% POE forecast, load is:

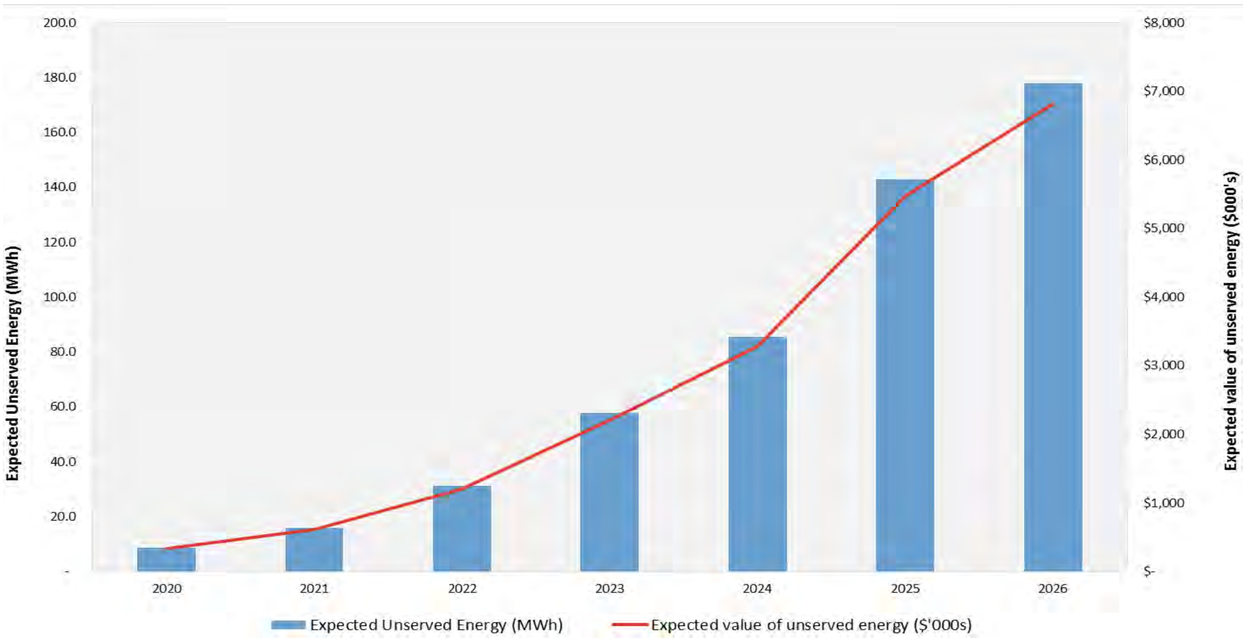
- 6 MVA above the station rating in 2019/20, equivalent to approximately 1,800 customers
- 26 MVA above the station rating in 2022/23, equivalent to approximately 9,000 customers.

3.1.1 Value of expected energy at risk

When a substation is operating above its N capacity, pre-contingent actions are required to manage the demand, meaning the probability of such risk is 1 because all plant must be in service to supply the demand. There are additional risks under contingency conditions when a transformer is out of service (N-1) which can partially mitigated through the use of contingency plans and emergency load transfers to other adjacent terminal stations at East Rowville (**ERTS**) 66 kV, Tyabb (**TBTS**) 66 kV and Heatherton (**HTS**) 66 kV. The risk is estimated using a 30:70 weighting of the 10% POE and 50% POE maximum demand forecasts to take into account weather variability year on year to determine the expected unserved energy.

CBTS has an estimated 70 MVA of (N-1) load transfer available for summer 2019/20. In reality use of these transfers creates additional risk on the surrounding terminal stations, zone substations, and feeders however for the purpose of this risk assessment, to simplify the analysis, it has been assumed that these load transfers can be implemented at zero risk. This is considered a reasonable assumption (but does marginally understate the risk) as the operation of CBTS above N capacity provides the majority of the risk which drives the timing in this case. The expected cost of energy at risk at CBTS is shown in figure 3.

Figure 3 Expected energy at risk (MWh) and value of unserved energy ($ 000)



Source: United Energy

[4] 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.

4 Options analysis

Four options were considered to address the identified need in the CBTS supply area. As shown in table 2, the preferred solution is option three—undertake a non-network solution followed by installing a fourth 220/66 kV transformer at CBTS.

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

	Option	Net economic benefits
-	Status quo	-
1	CBTS fourth transformer	115.69
2	Reactive power compensation followed by a fourth transformer	113.34
3	Non-network solution followed by CBTS fourth transformer	116.17
4	New 220/66 kV terminal station	N/A

Source: United Energy

The options considered are discussed in further detail below. The analysis supporting our assessment of alternative options, including relevant assumptions, is included in the CBTS demand management model.[5]

4.1 'Do nothing' option—maintain the status quo

Maintaining the status quo—continuing to supply customers serviced by the CBTS without any intervention to manage energy at risk—will lead to significant supply interruptions during a single transformer outage at peak times. It will also lead to supply interruptions with all transformers in service during hot summers. This option, therefore, fails to address the identified need (as set out in section 3) and is not the least lifecycle cost option.

4.2 Option one—install a fourth transformer at CBTS

Option one is to install a fourth transformer at CBTS before summer 2022/23.

There is sufficient space for a fourth transformer within CBTS switchyard and the control room has provision for accommodating protection and control panels. Therefore the scope of works for this option includes:

- supply and installation of a new fourth 220/66 kV 150 MVA transformer to the west of the existing transformers, complete with firewalls
- installation of a new 220 kV circuit breaker
- extend No.1 66 kV bus with two new circuit breakers and establish a new No.4 66 kV bus with five new 66 kV circuit breakers
- supply and install a neutral earth reactor at the new fourth transformer 66 kV neutral that matches the neutral earth reactors at all existing transformers
- a new auto-reclose scheme, which will provide for parallel operation of three transformers in the event of a transformer or bus outage

[5] UE MOD 9.06 - Demand management Cranbourne - Jan2020 - Public

- installation of a wall tubular busbar under the transformer exits
- relocation of AusNet and United Energy 66 kV feeder exits.

A summary of the market benefits and costs of this option are summarised in table 3.

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

Option	NPV costs	NPV benefits	Net economic benefits
CBTS fourth 220/66kV transformer	-15.52	131.21	115.69

Source: United Energy

4.3 Option two—reactive power compensation followed by a fourth transformer at CBTS

Under this option we will install capacitor banks to reduce the demand through the transformers and defer the need for a fourth transformer at CBTS.

CBTS currently does not have 66 kV capacitor banks and the station operates with a power factor around 0.97 lagging in summer. Two 50 MVA (reactive) 66 kV capacitor banks will reduce approximately 15 MVA from being supplied by the transformers, and could defer a network augmentation by two years.

A summary of the market benefits and costs of this option are shown in table 4.

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

Option	NPV costs	NPV benefits	Net economic benefits
Reactive power compensation followed by a fourth transformer	-16.20	129.53	113.34

Source: United Energy

4.4 Option three—non-network solution followed by a fourth transformer at CBTS

Under this option we will undertake a non-network solution followed by the installation of a fourth transformer at CBTS.

The risk of interruption to CBTS 66 kV supplies for a single contingency event was first assessed as being unacceptable in 2010. A Request for Information was published by AusNet, United Energy and AEMO in March 2011 to seek non-network alternatives to this emerging constraint. In response, two offers were received, one for demand management and one for connecting embedded generation. We and AusNet commenced negotiation with the generation proponent to establish a network support contract for 40 MW that would allow the installation of the fourth 220/66 kV 150 MVA transformer to be deferred.

After receiving this solution, the forecast demand growth rate and actuals declined. This, compounded with a lower Value of Customer Reliability (**VCR**), deferred the need for a non-network solution and economic timing for the installation of a fourth transformer.

Based on new actual demands and forecasts and the costs of a 40 MW that was generator previously negotiated, beginning this solution in summer 2021/22 will economically defer the current need for a fourth transformer by three years.

The estimated non-network support requirements are summarised in table 5.

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

Option	NPV costs	NPV benefits	Net economic benefits
Non-network solution followed by CBTS fourth transformer	-15.47	131.64	116.17

Source: United Energy

This project will be subject to assessment as required under the Regulatory Investment Test for Transmission (**RIT-T**). We will initiate consultation on a RIT-T before the economic timing of the preferred network option to maximise the likelihood of receiving a non-network solution offer.

4.5 Option four—establish a new 220/66 kV terminal station

AusNet expects that a new terminal station in the Pakenham area (with a site yet to be acquired) will be required in around 10 to 20 years to service demand growth in the region. This development will help to off-load CBTS as well as address constraints on the existing AusNet 66 kV sub-transmission network from CBTS to the Pakenham area. AusNet will carry out planning studies to assess whether this option is economic, and if so, to determine the optimal timing of any investment. An alternative would be to develop a new terminal station on a reserved site in North Pearcedale. The North Pearcedale site, however, is not located within the growth area and is considered suboptimal at this time.

This is the most expensive option and expected to be cost about $130–$150 million. Therefore, no further assessment is undertaken on this option in this report.

4.6 Sensitivity analysis

A sensitivity assessment was performed to assess the impact on the ranking of the options from varying the demand forecast, assumed discount rates, and the capital and operating expenditure forecasts. Two extreme scenarios were applied (equal to ±4% for demand forecasts, and ±10% for other variables), reflecting best and worst case scenarios, noting the base case forecast growth used is significantly lower than the actual historical average growth.[6]

Under both the scenarios, the ranking of the preferred option remains unchanged, shown in table 6 and table 7.

6 The sensitivity variance for demand forecasts (±4%) is consistent with the difference in growth between NIEIR's base, high and low forecast scenarios.

Table 6 Summary of net economic benefits—sensitivity best case ($ million, 2019)

	Option	Net economic benefits	Rank
-	Status quo	-	4
1	CBTS fourth transformer	219.21	2
2	Reactive power compensation followed by a fourth transformer	211.61	3
3	Non-network solution followed by CBTS fourth transformer	219.42	1
4	New 220/66 kV terminal station	N/A	5

Source: United Energy

Table 7 Summary of net economic benefits—sensitivity worst case ($ million, 2019)

	Option	Net economic benefits	Rank
-	Status quo	-	4
1	CBTS fourth transformer	43.26	2
2	Reactive power compensation followed by a fourth transformer	42.24	3
3	Non-network solution followed by CBTS fourth transformer	43.64	1
4	New 220/66 kV terminal station	N/A	5

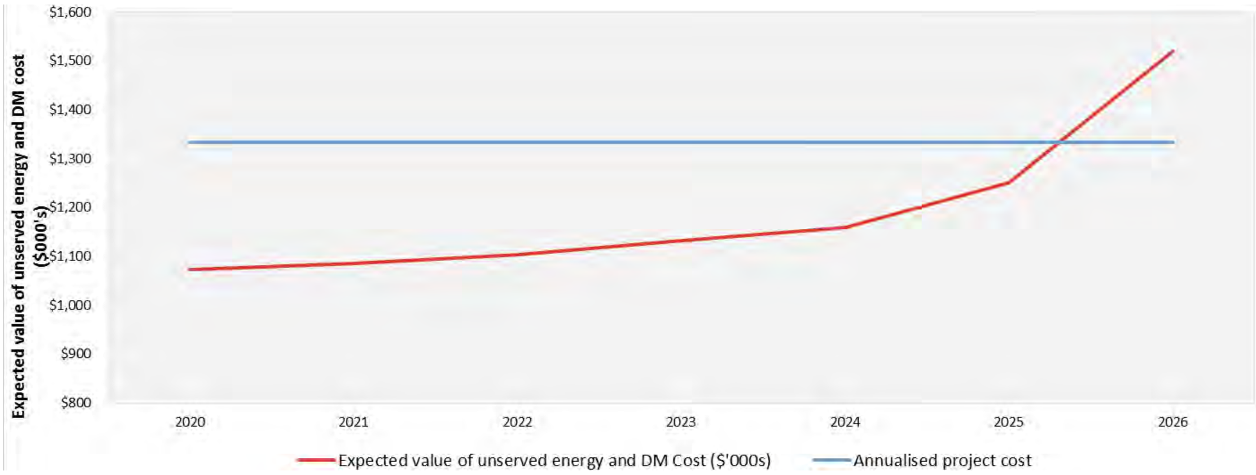
Source: United Energy

5 Recommendation

The preferred overall solution is to obtain four years of non-network support beginning in summer 2021/22 followed by installation of a fourth transformer at CBTS before summer 2025/26. The required changes at CBTS are shown in appendix B.

An economic assessment was performed to evaluate the optimum timing of the preferred overall solution. With the non-network support in place the cost of the demand management solution combined with the residual energy at risk exceed the annualised cost of the fourth transformer at CBTS in 2026. This demonstrates that the optimal timing for commissioning of the commissioning of the fourth transformer and the end of the non-network support is in 2025.

Figure 4 Timing assessment of the preferred option: NPV of net market benefits ($ 000, 2019)



Source: United Energy

The forecast capital cost of the CBTS fourth transformer project is $25.7 million with the bulk of this comprising of transmission connection asset costs. The operating expenditure requirements for United Energy and AusNet in the 2021–2026 regulatory period to fund the non-network solution to defer the CBTS fourth transformer are outlined in table 8.

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

Expenditure forecast	2021/22	2022/23	2023/24	2024/25	2025/26	Total
Operating expenditure (AusNet and United Energy)	0.97	0.97	0.97	0.97	0.13	4.00

Source: United Energy

As the terminal station services both AusNet and United Energy distribution supply areas, the costs will be shared. The operating expenditure for the non-network solution will be shared between AusNet and us with a split of 62% and 38% respectively, reflecting the energy consumption for each distributor within the shared transmission station supply area. The forecast operating expenditure requirements for our 38% of the preferred option are outlined in table 9.

Table 9 Expenditure forecasts for preferred option ($ million, 2019)

Expenditure forecast	2021/22	2022/23	2023/24	2024/25	2025/26	Total
Operating expenditure (United Energy portion)	0.37	0.37	0.37	0.37	-	1.47

Source: United Energy

A CBTS area demand growth

Substantial residential development has taken place in the CBTS supply area over the past years, especially around the Cranbourne, Clyde and Berwick. These growth activities are forecast to continue given the vacant land still available for further development.

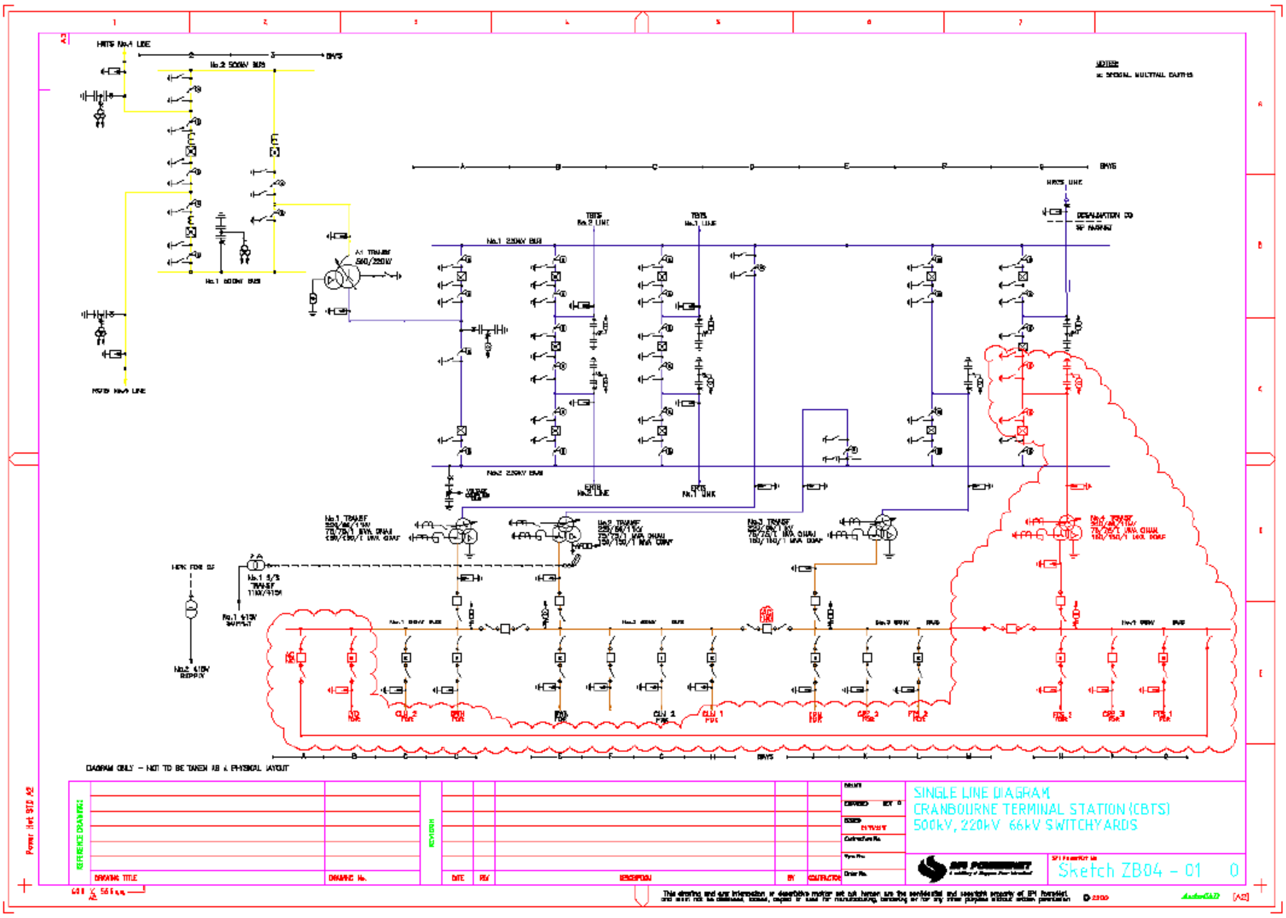
The growth in the area from 2009 is illustrated in figure 5.

Figure 5 Growth in the CBTS supply area

Source: United Energy

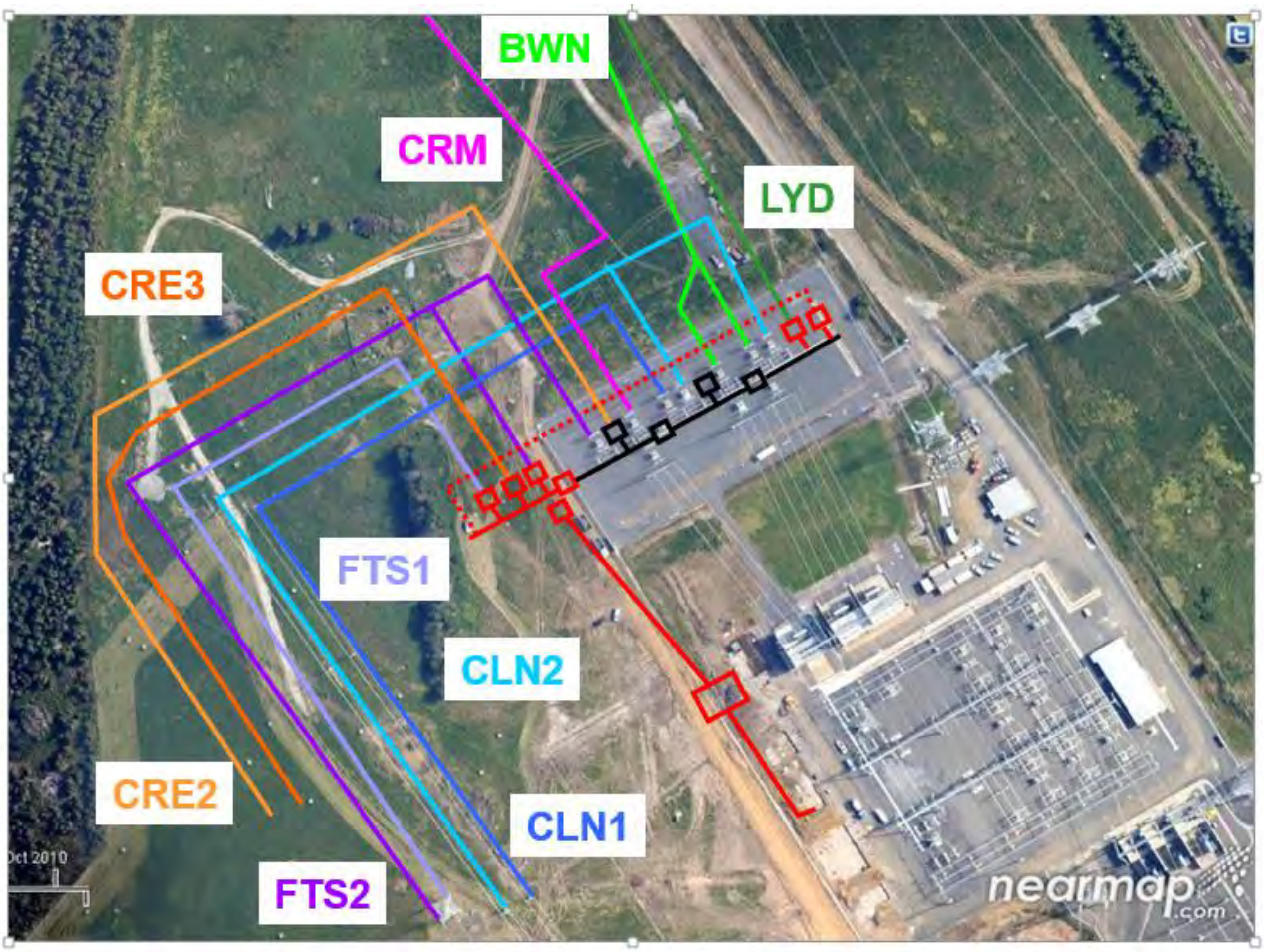
B Design of fourth transformer for preferred network option

Figure 6 Proposed CBTS arrangement



Source: United Energy

Figure 7 Proposed location for CBTS fourth transformer



Source: United Energy