

Appendix 5.30: Supply to Tuggeranong town centre PJR

**Regulatory proposal for the ACT electricity distribution network 2019-24
January 2018**

Disclaimer: On 1 January 2018, the part of ActewAGL that looks after the electricity network changed its name to Evoenergy. This change has been brought about from a decision by the Australian Energy Regulator. Unless otherwise stated, ActewAGL Distribution branded documents provided with this regulatory proposal are Evoenergy documents.

Project Justification Report

Project name	Supply to Tuggeranong Town Centre
Expenditure type	Capital Expenditure
Business Group	Asset Strategy
Regulatory Period	1 July 2019 to 30 June 2024
Total Project Cost Estimate	\$1,735,700 excluding corporate overheads, excluding contingency, and excluding GST
Five year total spend 2019-24	\$1,735,700 excluding corporate overheads, excluding contingency, and excluding GST
CAPEX category	ENAA Distribution
Primary driver	Load growth in Tuggeranong Town Centre
Project Number	20001370

Contents

Reference documents	3
1. Executive Summary	4
2. Strategic Context and Expenditure Need	5
2.1. Existing infrastructure in the Tuggeranong Town Centre area	5
2.2. Driving need for infrastructure investment	6
3. Objectives	8
3.1. Corporate, asset management and key project objectives	8
3.2. Regulatory Compliance	9
3.2.1. National Electricity Law and National Electricity Rules	9
3.2.2. Capital Expenditure Objectives and Criteria	9
3.2.3. Regulatory Investment Test	10
3.2.4. Utilities Act 2000 (ACT)	10
3.2.5. Evoenergy's Distribution Network Augmentation Standards	10
3.2.6. Cost compliance	11
4. Options Assessment	12
4.1. Options analysis	12
4.1.1. Do Nothing Option	12
4.1.2. Option 1: Construct 11 kV feeder tie between S4451 and S11049 and new feeder from Wanniasa Zone Substation to Greenway East	13
4.1.3. Option 2: Construct 11 kV feeder tie between S4451 and S11049 and new feeder from Theodore Zone Substation to Greenway East	15
4.1.4. Option 3: Demand management	15
4.1.5. Option 4: Grid battery to defer Option 1	16
4.1.6. Option 5: Grid battery only	16
4.1.7. Summary of Options Analysis	17
4.2. Recommendation	17
Appendix A – Preliminary Cost Estimates	18
A.1 Cost Estimate – Option 1	18
A.2 Cost Estimate – Option 2	19
Appendix B – Financial Analysis	20
B.1 Capital Expenditure Cash Flow for Each Option	20
B.2 NPC Analysis	21

Reference documents

Document	Version	Date
National Electricity Rules	102	
National Electricity Law		19.12.13
Utilities Act (ACT)		2000
Utilities (Management of Electricity Network Assets Code) Determination		2013
Evoenergy Maximum Demand Forecast		2017
ActewAGL Annual Planning Report		22.12.17
Distribution Network Augmentation Standard SM1197	1.1	12.5.15
Evoenergy Risk Assessment Tables PR4660.2	1.0	12.1.17
Evoenergy Quality of Supply Strategy SM11150	1.0	8.10.15
Evoenergy Asset Management Strategy SM1192	2.12	22.6.15
Evoenergy Peak Demand Reduction Strategy	2.0t	22.8.17
Evoenergy Electrical Data Manual SM1183	5.0	22.6.17
Augmentation NPV Model Methodology	1.0	29.9.17

1. Executive Summary

This Project Justification Report addresses the growth of electricity demand in the Tuggeranong Town Centre area.

The maximum demand in the Tuggeranong Town Centre area is forecast to increase by approximately 8 MVA by 2020 with the development of a number of mixed-use residential and commercial buildings adjacent to Lake Tuggeranong (4.35 MVA) and in the West Greenway area (3.66 MVA).

The 11 kV feeders supplying the developments in the West Greenway area have sufficient spare capacity available to meet this demand.

The 11 kV feeders supplying the developments around Lake Tuggeranong do not have sufficient spare capacity available to meet this forecast additional demand. Short term load transfers have been arranged to free up spare capacity on the Matthews feeder however further network augmentation will be required.

The selected option is as follows:

Stage 1 (2019): Construct an 11 kV cable feeder tie between distribution substation S4451 (Sternberg feeder) and distribution substation S11049 (Matthews feeder).

Stage 2 (2020): Construct a new 11 kV feeder from Wanniasa Zone Substation to Tuggeranong Town Centre. A spare 150mm diameter conduit has been installed as part of the Sternberg feeder replacement project – this spare conduit will be utilised for the proposed new feeder cable.

Other options considered include the construction of a new 11 kV cable feeder from Theodore Zone Substation to Tuggeranong Town Centre, demand management, and a grid battery. The additional feeder was excluded due to a high net present cost (compared to the preferred option). Demand management was not considered feasible due to the existing feeders already exceeding their firm ratings such that there is a requirement for greater than 100% of new demand to be offset. The grid battery was excluded due to a higher net present cost and the relative certainty of the demand increase (noting grid batteries and other modular solutions deliver a higher options value in the context of uncertain demand).

A preliminary cost estimate for the selected option is **\$1,735,700 excluding corporate overheads, excluding contingency and excluding GST**.

These works will be carried out during the 2019-24 Regulatory Control Period, with proposed completion by December 2020.

A staged approach to this project is selected to minimise the initial capital expenditure and construct only what is required to meet the forecasted load growth.

There is significant development underway and planned for the Tuggeranong Town Centre area. Existing infrastructure has insufficient capacity to cater for the additional demand associated with the development.

There are six 11 kV feeders supplying the Tuggeranong Town Centre. These are Fincham, Matthews, Erindale, Sternberg, Pitman and Rowland. The existing feeder network is illustrated in Figure 1.

Project Justification Report
Supply to Tuggeranong Town Centre
Rev 0.4 20-Jan-18

Table 1: Tuggeranong Town Centre Feeder Loadings

Feeder Name	Zone	Feeder Rating (MVA)				2015		2016		2017	Spare capacity MVA
		Firm Summer Rating	Thermal Summer Rating	Firm Winter Rating	Thermal Winter Rating	Percent Loaded Summer	Percent Loaded Winter	Percent Loaded Summer	Percent Loaded Winter	Percent Loaded Summer	
Greenway East – adjacent to Lake Tuggeranong											
Fincham	WAN	4.7	6.2	5.2	7.0	82%	46%	82%	50%	118%	-0.85
Matthews	WAN	4.7	6.2	5.2	7.0	85%	89%	88%	88%	82%	0.81
Total											-0.04
Greenway Central Shopping Area											
Erindale	WAN	4.5	5.9	5.0	6.6	75%	53%	75%	65%	66%	0.15
Sternberg	WAN	5.6	7.5	6.3	8.5	74%	53%	71%	48%	52%	2.67
Total											2.83
Greenway West											
Pitman	WAN	4.8	6.3	5.3	7.0	50%	35%	54%	31%	59%	1.94
Rowland	WAN	4.8	6.3	5.3	7.0	50%	35%	55%	34%	60%	1.88
Total											3.82

2.2. Driving need for infrastructure investment

Forecast additional maximum demand in the Greenway East and Greenway West areas is indicated in Table 2. This has been based on an assessment of known developments (either at application or Preliminary Network Advice stage) proposed for these areas. Some of these developments are either under construction or currently being designed. There is a high degree of certainty (> 80%) that these developments will proceed. In addition there are several potential smaller load increases.

Pitman and Rowland feeders supply the Greenway West area and have combined available spare capacity of 3.82 MVA. The forecast load of Tuggeranong Office Park (Athllon Drive) that is nearing completion and the proposed Avani townhouse development (Athllon Drive) is 3.66 MVA. Pitman and Rowland feeders have sufficient capacity to meet this demand.

Matthews and Fincham feeders supply the Greenway East area adjacent to Lake Tuggeranong and have no combined spare capacity. Load transfers have been arranged to free up spare capacity on Matthews feeder however further network augmentation will be required.

The Sternberg feeder, which also emanates from Wanniasa Zone Substation, supplies the northern part of Tuggeranong Town Centre. A section of this feeder from Wanniasa Zone Substation to distribution substation S 4451 has recently been replaced and upgraded under a condition-based asset replacement project. This upgrade will enable load to be transferred from the Matthews feeder to the Sternberg feeder to provide some capacity to meet the demand of the apartment building developments adjacent to Lake Tuggeranong.

Table 2: Proposed Developments in Greenway East and West

Greenway East (adjacent to Lake Tuggeranong)				
Proposed Development and Net Additional Diversified Load in MVA	2017	2018	2019	2020
B1, S78 - Anketell St / Oakden St, residential apartment development (PN 20004401)			0.5	0.5
B1 S74 – Anketell St / Limburg Way, residential apartment development (PN 20002416)	0.3			
B1 S79 – Cynthia Teague Cres – residential apartment development (PN 20003467)			1	0.5
B4 S57 – Anketell St / Limburg Way, mixed-use development (PN 20001885)		1		
B1 S76 – Anketell St / Oakden St mixed-use development (PN 20000880)	0.5	0.6		
Additional Load (MVA)	0.8	1.6	1.5	1.0
Cumulative additional forecast load (MVA)	0.8	2.4	3.9	4.9
Spare capacity of existing feeders to Greenway East (MVA)	2.03	0.43	-1.07	-2.07

Greenway West				
Proposed Development and Net Additional Diversified Load in MVA	2017	2018	2019	2020
B2 S14 – Athllon Dr, office building development (PN 2000413)		1	1	0.9
B5 S13 – Athllon Dr, residential townhouse development (PN 20001780)	0.4	0.4		
Additional Load (MVA)	0.4	1.4	1	0.9
Cumulative additional forecast load (MVA)	0.4	1.8	2.8	3.7
Spare capacity of existing feeder to Greenway East (MVA)	3.42	2.02	1.02	0.12

To enable load to be transferred from the Matthews feeder to the Sternberg feeder will require an 11 kV 3c/400mm² AL XLPE cable to be installed as an HV tie between distribution substation S4451 on Sternberg feeder to distribution substation S11049 on Matthews feeder via a 3-way HV switching station. The route length of this HV tie is approximately 500m. This augmentation would provide approximately 1.5 MVA capacity to meet the demand of the apartment building developments adjacent to Lake Tuggeranong. This feeder tie is required to be completed by the end of 2019.

The proposed developments shown in Table 2 indicate there will be no spare capacity available from winter 2019 to supply the load growth in the Greenway east area unless demand side management initiatives can avoid this.

A new 11 kV feeder to Tuggeranong Town Centre will be required to be constructed by the end of 2020 to meet the additional load demand.

3. Objectives

3.1. Corporate, asset management and key project objectives

The corporate, asset management and related key project objectives are shown in Table 3 below. These objectives are used to assess the relative risk of options.

Table 3: Corporate, asset management and key project objectives

Corporate objectives	Asset management objectives	Key project objectives
Responsible	<ul style="list-style-type: none"> Achieve zero deaths or injuries to employees or the public. Maintain a good reputation within the community. Minimise environmental impacts, for example bushfire mitigation. Meet all requirements of regulatory authorities, such as the AER as outlined in the NER, and the ACT Utilities (Technical Regulations) Act 2014. 	The selected option must ensure environment and safety standards will be met.
Reliable	<ul style="list-style-type: none"> Tailor maintenance and renewal programs for each asset class based on real time modelling of asset health and risk. Meet network SAIDI and SAIFI KPIs. Record failure modes of the most common asset failures in the network. Successfully deliver the asset class Program of Work (PoW) to ensure that the protection operates correctly to disconnect faulty sections in accordance with the NER. 	<p>Options evaluations to consider the value of customer reliability (VCR).</p> <p>In accordance with regulated requirements, the selected option must ensure access to an electricity supply.</p>
Sustainable	<ul style="list-style-type: none"> Enhance asset condition and risk modelling to optimise and implement maintenance and renewal programs tailored to the assets' needs. Make prudent commercial investment decisions to manage assets at the lowest lifecycle cost. Integrate primary assets with protection and automation systems in accordance with current and future best practice industry standards Deliver the asset class PoW within budget. 	<p>Options evaluations to consider the cost effectiveness of the solution.</p> <p>In accordance with regulated requirements, the selected option must be the most prudent and efficient.</p> <p>Non-network options will be evaluated on equal merit with network solutions.</p>
People	<ul style="list-style-type: none"> Proactively seek continual improvement in asset management capability and competencies of maintenance personnel. 	A post implementation review to incorporate learnings through the asset management system.

The project objectives are consistent with Evoenergy's regulatory requirements described below.

3.2. Regulatory Compliance

3.2.1. National Electricity Law and National Electricity Rules

Evoenergy is subject to the National Electricity Law (NEL) and the National Electricity Regulations (NER) which regulate the National Electricity Market (NEM). Evoenergy operates in the NEM as both a Transmission Network Service Provider (TNSP) and a Distribution Network Service Provider (DNSP).

The National Electricity Objective (NEO), as stated in the NEL is to:

“...promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to:

- a) price, quality, safety, reliability and security of supply of electricity; and*
- b) the reliability, safety and security of the national electricity system.”*

This objective requires Registered NEM participants to balance the costs and risks associated with electricity supply.

The planning and development process for distribution and transmission networks is carried out in accordance with the National Electricity Rules (NER) Chapter 5 Part B Network Planning and Expansion.

The primary objective of planning is to ensure that customers are able to receive a sufficient and reliable supply of electricity now and into the future.

3.2.2. Capital Expenditure Objectives and Criteria

The NER provides further guidance in terms of allowable capital expenditure via the capital expenditure objectives and criteria for standard control services. These capital expenditure objectives, specified in clause 6.5.6(a) and 6.5.7(a) of the NER describe the outcomes or outputs to be achieved by the expenditure. The objectives include:

- 1) Meet or manage the expected demand for standard control services*
- 2) Comply with all applicable regulatory obligations or requirements associated with the provision of standard control services*
- 3) To the extent that there is no applicable regulatory obligation or requirement in relation to the quality, reliability or security of supply of standard control services; or the reliability or security of the distribution system through the supply of standard control services, to the relevant extent:*
 - a) Maintain the quality, reliability and security of supply of standard control services*
 - b) Maintain the reliability and security of the distribution system through the supply of standard control services*
- 4) Maintain the safety of the distribution system through the supply of standard control services.*

The expenditure criteria, set out in Section 6.5.6(c) and Section 6.5.7(c) of the NER, further outline requirements for the way in which expenditure must be set to achieve the objectives above. These include:

- 1) The efficient costs of achieving the expenditure objectives*
- 2) The costs that a prudent operator would require to achieve the expenditure objectives; and*
- 3) A realistic expectation of the demand forecast and cost inputs required to achieve the expenditure objectives.*

The above criteria therefore imply that the capital expenditure, determined in line with the expenditure objectives, must be met via prudent and efficient expenditure, is to be achieved at least cost.

3.2.3. Regulatory Investment Test

Section 5.16 of the NER describes the Regulatory Investment Test for Transmission (RIT-T) and Section 5.17 describes the Regulatory Investment Test for Distribution (RIT-D). These tests must be carried out for any proposed investment where the augmentation or replacement cost of the most expensive credible option exceeds \$5 million.

The regulatory investment tests provide the opportunity for external parties to submit alternative proposals to the Network Service Provider, who is obliged to consider any credible proposal objectively.

Since the required investment is greater than \$5million the project is subject to the RIT-D. Evoenergy commenced RIT-D process in 2014 with publication of a Project Specification Consultation Report, but has yet to complete the RIT-D process (ie publication of Draft Project Assessment Report and Final Project Assessment Report). These reports will need to be prepared as part of the development of this project. The initial RIT-D consultation paper published in 2014 recommended establishing a new zone substation at the Arboretum site (comprising two transformers and two switchboards) by 2017-18, but lower load growth rate has enabled this to be deferred to 2021-22.

3.2.4. Utilities Act 2000 (ACT)

Evoenergy has an obligation to comply with the Utilities Act 2000 (ACT) which imposes specific technical, safety and reliability obligations via the Management of Electricity Network Assets Code and the Electricity Distribution Supply Standards Code.

The Electricity Distribution Supply Standards Code (August 2013) sets out performance standards for Evoenergy's distribution network. Evoenergy is required to take all reasonable steps to ensure that its Electricity Network will have sufficient capacity to make an agreed level of supply available.

This local jurisdictional code specifies reliability standards that Evoenergy must endeavour to meet when planning, operating and maintaining the distribution network. It also specifies power quality parameters that must be met including limits on voltage flicker, voltage dips, switching transients, earth potential rise voltage unbalance, harmonics and direct current content.

The Management of Electricity Network Assets Code requires electricity distributors to protect integrity and reliability of the electricity network and to ensure the safe management of the electricity network without injury to any person or damage to property and the environment.

3.2.5. Evoenergy's Distribution Network Augmentation Standards

Evoenergy's distribution network augmentation standards are set to ensure compliance with the relevant regulatory instruments as described above.

Evoenergy's planning standards are determined on an economic basis but expressed deterministically so that peak demand can be met with an appropriate level of backup should a credible contingency event occur. A credible contingency event is the loss of a single network element, which occurs sufficiently frequently, and has such consequences, as to justify Evoenergy to take prudent precautions to mitigate. This is commonly referred to as an N-1 event.

Zone substation capacity must be augmented if the forecast zone substation maximum demand based on 50% PoE under N-1 conditions exceeds the two-hour emergency rating.

Major zone substation augmentation such as the installation of an additional transformer will not be considered until all other options such as load transfer to adjacent zone substations and non-network options have been fully explored and implemented.

For high voltage (11kV) distribution feeders in urban areas Evoenergy specifies that there should be a minimum of two effective feeder ties to meet two-for-three arrangement where it is economically viable, i.e. two feeders able to supply the load normally supplied by three feeders. A firm rating is assigned to each feeder based on its thermal rating and the number of feeder ties available.

Distribution high voltage feeder capacity must be augmented or demand management solutions provided if the forecast 50% PoE feeder maximum demand exceeds the firm ratings as given in Table 4.

Table 4: Feeder Firm Rating standard

Feeder configuration	Firm rating as percentage of thermal capacity
Two or more feeder ties	75%
One feeder tie	50%
Feeders operating in parallel	$\{(N-1)/N\}\%^1$
Partial feeder tie	100% or less ²
No feeder tie	100%

3.2.6. Cost compliance

Cost compliance is achieved by proactively pursuing the philosophy of compliance with the national electricity objective by fully exploring and evaluating all options technically and commercially so as to seek approval for a solution that provides sound grounds for an efficient investment while meeting the long term interests of the consumers.

The investment value has been determined using 2016-17 market prices. The methodology and estimated costs used for this project are developed through the application of industry knowledge and Good Engineering Operating Practices based on historical similar projects. This approach complies with paragraphs 6 & 7 of the National Electricity Law (NEL).

¹ “N” represents the number of feeders operating in parallel.

² A partial feeder tie refers to a tie with limited back feeding capacity. The firm capacity of a feeder with a partial feeder tie may be set below 100% its thermal capacity.

4. Options Assessment

Evoenergy has considered five options to provide additional capacity to Greenway East as listed in Table 5.

Table 5: Options considered for provision of additional capacity to Greenway East

Option	Option type	Description	Evaluation
0	Network	Do nothing	Not selected as does not meet minimum requirements
1	Network	Stage 1: Construct a new 11 kV feeder tie between S4451 and S11049 by the end of 2019. Stage 2: Construct a new 11 kV cable feeder from Wanniasa Zone Substation to Greenway East by the end of 2020.	Selected as higher NPC
2	Network	Stage 1: Construct a new 11 kV feeder tie between S4451 and S11049 by the end of 2019. Stage 2: Construct a new 11 kV cable feeder from Theodore Zone Substation to Greenway East by the end of 2020.	Not selected due to lower NPC
3	Non-network	Demand side management	Not selected as does not meet minimum requirements and lower NPC
4	Mixed	Grid battery to defer Option 1	Not selected as cost of delay exceeded benefits
5	Non-network	Grid battery only	Not selected due to lower NPC

4.1. Options analysis

4.1.1. Do Nothing Option

The 'Do Nothing' option would result in insufficient network capacity in the area to meet demand during a contingency event.

The value of energy at risk is estimated to be approximately \$24.1m over a five year period based on the current assets exceeding their thermal limits by 2020 resulting in a large value of unserved energy.

The Do Nothing option would result in Evoenergy breaching its Distribution Network Augmentation Standards and thus its obligation to provide a reliable and secure power supply

4.1.2. Option 1: Construct 11 kV feeder tie between S4451 and S11049 and new feeder from Wanniasa Zone Substation to Greenway East

Option 1 considers providing the required additional capacity to the Tuggeranong Town Centre in two stages as follows:

Stage 1: Install an 11 kV feeder cable tie between S4451 and S11049 to provide additional capacity of approximately 1.5 MVA to Greenway East. The route length of the 11 kV feeder tie is approximately 500m. This would be directionally drilled or trenched where possible from a new 3-way RMU (to be installed in chamber substation S4451 upstream of switch 8EC) along Soward Way, Anketell St, to S11049 (spare switch 8FL) on Limburg Way. This will provide an 11 kV tie between the Sternberg and Matthews feeder and enable 1.5 MVA of load to be transferred from Matthews to Sternberg feeder. 11 kV cable to be 3c/400mm² AL XLPE.

A preliminary estimated cost for Stage 1, for the installation of a new 11 kV tie between Sternberg and Matthews feeders is **\$537,000 excluding corporate overheads, contingency and GST**. Refer to cost estimate in Appendix A.

Stage 1 would be completed by the end of 2019.

Figure 1 illustrates the proposed cable route of the new feeder tie.

Figure 1: Proposed 11 kV feeder cable route from S4451 to S11049



Stage 2: Install a new 11 kV feeder cable from Wanniasa Zone Substation to Greenway East to provide additional capacity of approximately 5.5 MVA to Greenway East. The route length of the new 11 kV feeder is approximately 7.2km. The proposed route runs from Wanniasa Zone Substation along Sulwood Drive, Erindale Drive, Reed St South to S9957 (spare switch 8FL) on Limburg Way.

A spare conduit that is currently being installed for the Sternberg feeder replacement project would be utilised. This conduit runs from Wanniasa Zone Substation to Soward Way, a distance of approximately 6.9km. The remaining 300m route would be directionally drilled or trenched where possible. 11 kV cable to be 3c/400mm² AL XLPE.

Project Justification Report – Supply to Tuggeranong Town Centre

A preliminary estimated cost for Stage 2, for the installation of a new 11 kV feeder cable from Wanniasa Substation to Greenway East is **\$1,198,700**

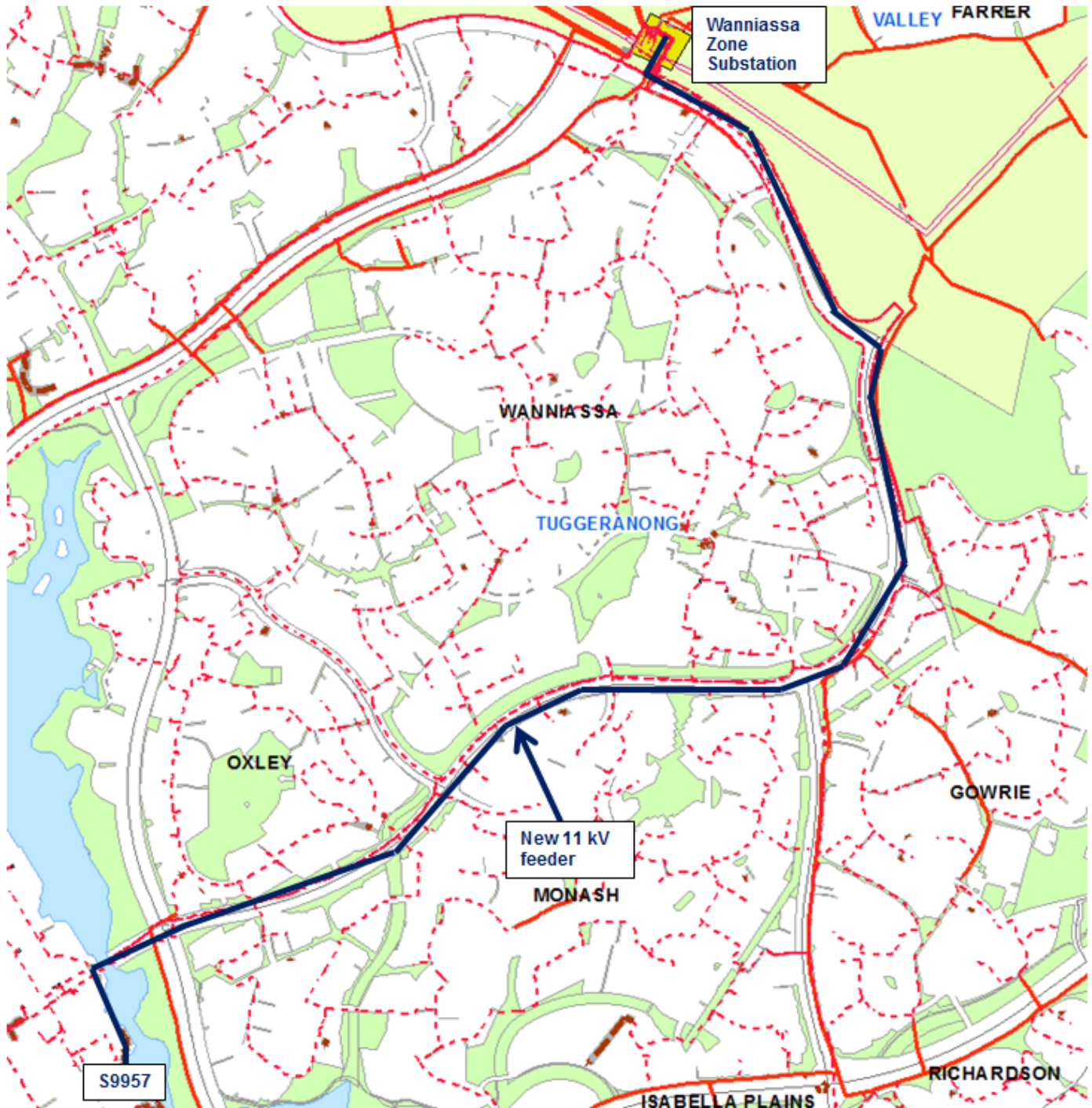
Stage 2 would be completed by the end of 2020.

Thus total estimated cost for Option 1 is **\$1,735,700 excluding corporate overheads, contingency and GST.**

Option 1 is selected due to its higher (ie least negative) net present cost (NPC).

Figure 2 illustrates the proposed cable route of the new feeder.

Figure 2: Proposed 11 kV feeder cable route from Wanniasa Zone Substation to S9957



4.1.3. Option 2: Construct 11 kV feeder tie between S4451 and S11049 and new feeder from Theodore Zone Substation to Greenway East

Option 2 considers providing the required additional capacity to the Tuggeranong Town Centre in two stages as follows:

Stage 1: Install an 11 kV feeder cable tie between S4451 and S11049 to provide additional capacity of approximately 1.5 MVA to Greenway East. The route length of the 11 kV feeder tie is approximately 500m. This would be directionally drilled or trenched where possible from a new 3-way RMU (to be installed in chamber substation S4451 upstream of switch 8EC) along Soward Way, Anketell St, to S11049 (spare switch 8FL) on Limburg Way. This will provide an 11 kV tie between the Sternberg and Matthews feeder and enable 1.5 MVA of load to be transferred from Matthews to Sternberg feeder. 11 kV cable to be 3c/400mm² AL XLPE.

A preliminary estimated cost for Stage 1, for the installation of a new 11 kV tie between Sternberg and Matthews feeders is **\$537,000 excluding corporate overheads, contingency and GST**. Refer to cost estimate in Appendix A.

Stage 1 would be completed by the end of 2019.

Stage 2: Install a new 11 kV feeder cable from Theodore Zone Substation to Greenway East to provide additional capacity of approximately 5.5 MVA to Greenway East. The route length of the new 11 kV feeder is approximately 8.1km. The proposed route runs from Theodore Zone Substation along Callister Cres, Chippidall Cct, Louis Loder St, Tharwa Dr, Drakeford Dr, Athllon Dr, Anketell St to S9957 (spare switch 8FL) on Limburg Way. Connection at Theodore would be to an existing spare feeder circuit breaker.

There are no spare conduits on this route. It would necessary to trench or directional drill the entire route length of 8.1km. 11 kV cable to be 3c/400mm² AL XLPE.

A preliminary estimated cost for Stage 2, for the installation of a new 11 kV feeder cable from Theodore Zone Substation to Greenway East is **\$4,793,100**

Stage 2 would be completed by the end of 2020.

Thus total estimated cost for Option 2 is **\$5,330,100 excluding corporate overheads, contingency and GST**.

Option 2 is not selected due to its lower net present cost (NPC).

4.1.4. Option 3: Demand management

Option 3 considers non-network initiatives including:

- Incentives to realise the potential of latent demand management within the customer base
- Incentives to encourage the uptake of additional demand management within the customer base

These options are further discussed within the Demand Management Paper.

To defer the Tuggeranong Town Centre feeder to the next regulatory control period (beyond 2024), it is estimated that non-network solutions would need to provide a maximum demand of approximately 4.0 MVA pa.

Latent demand management within the existing customer base was investigated, with a maximum estimated capacity of 0.6 MVA. This does not meet the minimum capacity required to enable the new feeder to be deferred.

These non-network options are summarised in Table 6.

Table 6: Summary of latent demand management

Non-network Option	Matthews Feeder	Fincham Feeder	Total
Customer – owned embedded generation	0.25 MVA	0.25 MVA	0.5 MVA
Customer – owned energy storage	0.03 MVA	0.05 MVA	0.08 MVA
Load curtailment	0.01 MVA	0.01 MVA	0.02 MVA
Totals	0.29 MVA	0.31 MVA	0.6 MVA

Third party non-network proposals have been requested in ActewAGL's 2017 Annual Planning Report and via Evoenergy's website demand management portal and may identify additional opportunities.

Where there is insufficient latent demand management within the customer base, there is further opportunity to incentivise customers to adopt additional technologies to reduce demand. This includes opportunities to permanently reduce demand (such as energy efficiency technology or power factor correction) as well as opportunities to adopt technology to enable participation in demand response markets (such as embedded generation, battery storage, building management systems). For the purposes of the evaluation, it is assumed that no more than 30% of demand growth can be offset using additional demand management.

For Tuggeranong Town Centre it was determined that more than 100% of demand growth would need to be offset by demand management to enable the project to be deferred, implying that new demand management is unlikely to defer investment.

4.1.5. Option 4: Grid battery to defer Option 1

This option utilises a grid battery to enable Option 1 to be deferred. This option has the advantage of deferring the investment until greater certainty in future demand is known. However, given the relatively high certainty of future demand for this project and the relatively high cost of the grid battery, this option was assessed as higher cost than the network Option 1 with a preliminary cost estimate of **\$2,867,080 excluding corporate overheads, contingency and GST**. Refer to cost estimates, cash flows and NPC comparison in Appendices A and B.

4.1.6. Option 5: Grid battery only

This option utilises a grid battery only. A grid battery, although more expensive than a traditional network solution on a per MVA basis, has advantages over a traditional network solution. A grid battery is modular and also able to be redeployed, meaning it can represent a more economic option in an environment of demand uncertainty or where demand is expected to increase for a short period and then decline.

In the case of Tuggeranong Town Centre however, the grid battery was not economic due to the relative certainty of demand with a preliminary cost estimate of **\$16,473,031 excluding corporate overheads, contingency and GST**. Refer to cost estimates, cash flows and NPC comparison in Appendices A and B.

4.1.7. Summary of Options Analysis

Table 7: Summary of Options

Option	Description	Total Capital Cost 2019-2039	Capital Cost 2019-24	20 year Net Present Cost	Outcome
0	Do nothing	\$0	\$0	\$0	Not selected as does not meet need
1	Stage 1: Construct a new 11 kV feeder tie between S4451 and S11049 by the end of 2019. Stage 2: Construct a new 11 kV cable feeder from Wanniasa Zone Substation to Greenway East by the end of 2020.	\$1,735,700	\$1,735,700	-\$1,758,412	Selected due to higher NPC
2	Stage 1: Construct a new 11 kV feeder tie between S4451 and S11049 by the end of 2019. Stage 2: Construct a new 11 kV cable feeder from Theodore Zone Substation to Greenway East by the end of 2020.	\$5,330,100	\$5,330,100	-\$5,399,845	Not selected due to lower NPC
3	Demand side management	N/A	N/A	N/A	Not selected as does not meet need
4	Grid battery to defer option 1	\$2,867,080	\$2,867,080	-\$2,649,894	Not selected as deferral not economic
5	Grid battery only	\$16,473,031	\$4,361,201	-\$8,729,916	Not selected due to lower NPC

4.2. Recommendation

The selected option is Option 1, the installation of a new 11 kV cable feeder tie (Stage 1) from S4451 Soward Way to S11049 Limburg Way, followed by the installation of a new 11 kV cable feeder (Stage 2) from Wanniasa Zone Substation to S9957 Limburg Way.

Financial analysis shows Option 1 to be the best option due to its higher (ie least negative) NPC. It also has the lowest capital cost. Refer to cost estimates, cash flows and NPC comparison in Appendices A and B. It can be implemented in time to meet the project needs as identified and will add to ActewAGL's regulated asset base. The major assets will have an economic life of 50 years.

The new feeder and feeder tie will provide capacity and security of supply to the new developments in the Tuggeranong Town Centre.

Timing is scheduled for completion of Stage 1 by December 2019 and completion of Stage 2 by December 2020. Future additional feeder cables will be installed as the load growth and demand increases with further development of Tuggeranong Town Centre and surrounding areas.

The preliminary cost estimate of the selected option is \$1,735,700 excluding overheads, contingency and GST.

The proposed 11 kV feeder and feeder tie will provide ties to existing feeders in the Tuggeranong Town Centre area, and thus provide some backup supply capability and load transfer capability in the future.

Appendix A – Preliminary Cost Estimates

A.1 Cost Estimate – Option 1

Stage 1: Construct a new 11 kV feeder tie between S4451 and S11049 by the end of 2019. Stage 2: Construct a new 11 kV cable feeder from Wanniasa Zone Substation to Greenway East by the end of 2020.							
Preliminary Estimate ± 30% Accuracy							
Description	Notes	Unit	\$/Unit	Stage 1 Quantity	Stage 1 Cost	Stage 2 Quantity	Stage 2 Cost
Trenching and drilling					\$337,500		\$281,000
Clearing of route where required	Allowance	m2	\$10	300	\$3,000	300	\$3,000
Directional drilling	Assume drilling with no rock. Assume three conduits per drill. Spare conduit available for 6.9 km of Stage 1.	m	\$600	500	\$300,000	300	\$180,000
Open trenching and backfilling	Assume excavation with no rock. Backfill with bedding sand and native soil. Assume conduits in one trench.	m	\$300		\$0		\$0
Cable jointing and haulage pits	Assume every 500m	ea	\$3,000	4	\$12,000	14	\$42,000
Traffic management		m	\$5	500	\$2,500	7200	\$36,000
Reinstatement incl revegetation as required	Allowance	m3	\$40	500	\$20,000	500	\$20,000
Cabling works					\$62,000		\$574,200
11 kV 3c/400mm2 Al XLPE cable		m	\$56	500	\$28,000	7200	\$403,200
Throughjoins	Assume every 500m	ea	\$1,000	1	\$1,000	13	\$13,000
Terminations	Terminations at feeder CB and dist sub	ea	\$1,500	4	\$6,000	2	\$3,000
Conduit and marker tape	Allowance for 3 conduit	m	\$10	1500	\$15,000	900	\$9,000
HV Cables Test & Commissioning	Allowance	ea	\$2,000	1	\$2,000	1	\$2,000
Cable installation labour and plant		m	\$20	500	\$10,000	7200	\$144,000
11 kV Switchgear					\$52,500		\$27,500
11 kV 3-way RMU	Assume space in S4451 chamber sub	m	\$50,000	1	\$50,000		\$0
11 kV feeder CB panels	Double up feeders at Wanniasa	ea	\$25,000		\$0	1	\$25,000
11 kV Test & Commissioning	per CB	ea	\$2,500	1	\$2,500	1	\$2,500
Electrical (Secondary System)					\$5,000		\$12,000
Protection & Control					\$5,000		\$5,000
P&C Secondary Cabling	per feeder panel	ea	\$2,500	1	\$2,500	1	\$2,500
P&C Test & Commission	Allowance	ea	\$2,500	1	\$2,500	1	\$2,500
DC Supply System					\$0		\$7,000
DC Cabling	per switchgear panel/bay	ea	\$5,000		\$0	1	\$5,000
DC Test & Commission	Allowance	ea	\$2,000		\$0	1	\$2,000
SCADA					\$0		\$4,000
SCADA connections for new feeder panels		ea	\$2,000		\$0	1	\$2,000
Test & Commissioning	Allowance	ea	\$2,000		\$0	1	\$2,000
Indirect Costs					\$80,000		\$300,000
Development Application	Allowance	ea	\$100,000	0.5	\$50,000	1	\$100,000
Contractor's Preliminaries, site establishment and disestablishment	Allowance	ea	\$100,000	0.1	\$10,000	1	\$100,000
Project management and administration	Allowance	ea	\$100,000	0.2	\$20,000	1	\$100,000
Stage Sub Total without overheads					\$537,000		\$1,198,700
Project Sub Total without overheads							\$1,735,700
Overheads							
Overall average overhead rate	Allowance	27%		1	\$144,990	1	\$323,649
Stage Sub Total with overheads					\$681,990		\$1,522,349
Project Sub Total with overheads							\$2,204,339
Contingency							
All project works	Preliminary allowance	10%		1	\$68,199.00	1	\$152,234.90
Stage total with all overheads and contingency					\$750,189		\$1,674,584
Project total with all overheads and contingency							\$2,424,773

Project Justification Report – Supply to Tuggeranong Town Centre

A.2 Cost Estimate – Option 2

Stage 1: Construct a new 11 kV feeder tie between S4451 and S11049 by the end of 2019.							
Stage 2: Construct a new 11 kV cable feeder from Theodore Zone Substation to Greenway East by the end of 2020.							
Preliminary Estimate ± 30% Accuracy							
Description	Notes	Unit	\$/Unit	Stage 1 Quantity	Stage 1 Cost	Stage 2 Quantity	Stage 2 Cost
Trenching and drilling					\$337,500		\$3,758,000
Clearing of route where required	Allowance	m2	\$10	300	\$3,000	1000	\$10,000
Directional drilling	Assume drilling with no rock. Assume three conduits per drill. Spare conduit available for 6.9 km of Stage 1.	m	\$600	500	\$300,000	4000	\$2,400,000
Open trenching and backfilling	Assume excavation with no rock. Backfill with bedding sand and native soil. Assume conduits in one trench.	m	\$300		\$0	4100	\$1,230,000
Cable jointing and haulage pits	Assume every 500m	ea	\$3,000	4	\$12,000	14	\$42,000
Traffic management		m	\$5	500	\$2,500	7200	\$36,000
Reinstatement incl revegetation as required	Allowance	m3	\$40	500	\$20,000	1000	\$40,000
Cabling works					\$62,000		\$716,600
11 kV 3c/400mm2 Al XLPE cable		m	\$56	500	\$28,000	8100	\$453,600
Throughjoints	Assume every 500m	ea	\$1,000	1	\$1,000	15	\$15,000
Terminations	Terminations at feeder CB and dist sub	ea	\$1,500	4	\$6,000	2	\$3,000
Conduit and marker tape	Allowance for 3 conduit	m	\$10	1500	\$15,000	8100	\$81,000
HV Cables Test & Commissioning	Allowance	ea	\$2,000	1	\$2,000	1	\$2,000
Cable installation labour and plant		m	\$20	500	\$10,000	8100	\$162,000
11 kV Switchgear					\$52,500		\$2,500
11 kV 3-way RMU	Assume space in S4451 chamber sub	m	\$50,000	1	\$50,000		\$0
11 kV feeder CB panels	Double up feeders at Wanniasa	ea	\$25,000		\$0		\$0
11 kV Test & Commissioning	per CB	ea	\$2,500	1	\$2,500	1	\$2,500
Electrical (Secondary System)					\$5,000		\$12,000
Protection & Control					\$5,000		\$5,000
P&C Secondary Cabling	per feeder panel	ea	\$2,500	1	\$2,500	1	\$2,500
P&C Test & Commission	Allowance	ea	\$2,500	1	\$2,500	1	\$2,500
DC Supply System					\$0		\$7,000
DC Cabling	per switchgear panel/bay	ea	\$5,000		\$0	1	\$5,000
DC Test & Commission	Allowance	ea	\$2,000		\$0	1	\$2,000
SCADA					\$0		\$4,000
SCADA connections for new feeder panels		ea	\$2,000		\$0	1	\$2,000
Test & Commissioning	Allowance	ea	\$2,000		\$0	1	\$2,000
Indirect Costs					\$80,000		\$300,000
Development Application	Allowance	ea	\$100,000	0.5	\$50,000	1	\$100,000
Contractor's Preliminaries, site establishment and disestablishment	Allowance	ea	\$100,000	0.1	\$10,000	1	\$100,000
Project management and administration	Allowance	ea	\$100,000	0.2	\$20,000	1	\$100,000
Stage Sub Total without overheads					\$537,000		\$4,793,100
Project Sub Total without overheads							\$5,330,100
Overheads							
Overall average overhead rate	Allowance	27%		1	\$144,990	1	\$1,294,137
Stage Sub Total with overheads					\$681,990		\$6,087,237
Project Sub Total with overheads							\$6,769,227
Contingency							
All project works	Preliminary allowance	10%		1	\$68,199.00	1	\$608,723.70
Stage total with all overheads and contingency					\$750,189		\$6,695,961
Project total with all overheads and contingency							\$7,446,150

Appendix B – Financial Analysis

B.1 Capital Expenditure Cash Flow for Each Option

Financial Year	Option 1	Option 2	Option 3	Option 4	Option 5
2019/20	\$1,735,700	\$5,330,100		\$1,131,380	\$1,131,380
2020/21				\$1,735,700	\$807,455
2021/22					\$807,455
2022/23					\$807,455
2023/24					\$807,455
2024/25					\$807,455
2025/26					\$807,455
2026/27					\$807,455
2027/28					\$807,455
2028/29					\$807,455
2029/30					\$807,455
2030/31					\$807,455
2031/32					\$807,455
2032/33					\$807,455
2033/34					\$807,455
2034/35					\$807,455
2035/36					\$807,455
2036/37					\$807,455
2037/38					\$807,455
2038/39					\$807,455
Total Cost (20 yr)	\$1,735,700	\$5,330,100	N/A	\$2,867,080	\$4,361,201
2019-24 Regulatory Control Period Cost	\$1,735,700	\$5,330,100	N/A	\$2,867,080	\$16,473,031

B.2 NPC Analysis

The Net Present Cost (NPC) was calculated using a Monte-Carlo simulation model. The simulation randomly selects a peak demand growth rate for each year that is within $\pm 10\%$ of the forecasted spot loads expected in the Tuggeranong Town Centre. The use of a Monte-Carlo simulation results in selection of the best option that is robust to uncertain peak demand growth forecasts.

Investment within the simulation is dynamic – investment decisions change based on the randomly selected growth rates from previous years. Investment occurs automatically when the firm rating is breached so the value of energy at risk is always zero. In options where multiple investments are available the cheapest is selected.

Summary Financial Analysis Results for Supply to Tuggeranong Town Centre

The summary below shows the average values for the selected characteristics after 50 simulations.

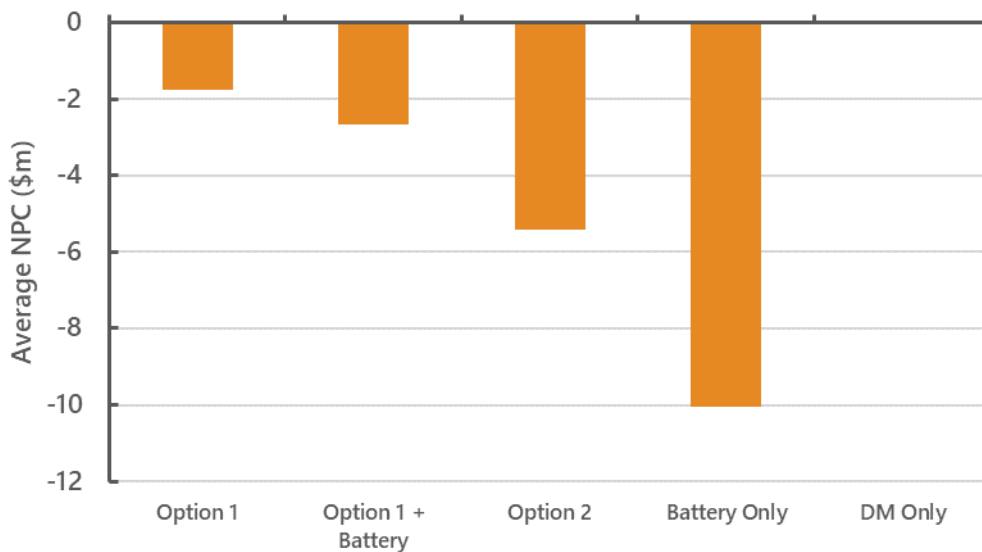
Options:

- One – one new 11 kV feeder from Wanniasa Zone Substation
- Two – one new 11 kV feeder from Theodore Zone Substation
- Three – demand management
- Four – grid battery to defer Option 1
- Five – grid battery only

RESULTS (Average over 50 simulations):

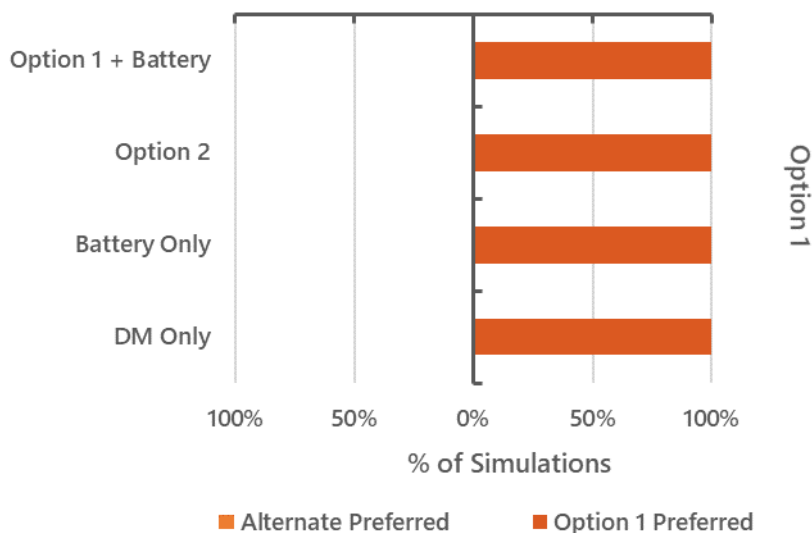
Option:	One	Two	Three	Four	Five
NPC (2019-2024)	-\$1,608,701	-\$4,940,102	N/A	-\$2,500,183	-\$3,450,760
NPC (2019-2039)	-\$1,758,412	-\$5,399,845	N/A	-\$2,649,894	-\$8,729,916
Network Option total Capital Cost	\$1,735,700	\$5,330,100	N/A	\$1,735,700	-
Option Capital Cost (2019-2024)	\$1,735,700	\$5,330,100	N/A	\$2,867,080	\$4,361,201
Option Capital Cost (2019-2039)	\$1,735,700	\$5,330,100	N/A	\$2,867,080	\$16,473,031

Average Net Present Cost for Each Network / Non-Network Combination:



Multiple combinations of network options, demand management and network batteries were tested using the Monte-Carlo model. The preferred option was selected on the basis of minimising the Net Present Cost.

Percentage of Simulations where the Selected Option had a Lower Cost than Other Options:



The random variation in peak demand growth in the Monte-Carlo model means that different options may be preferred in some simulations. The above chart shows that Option 1 was the preferred option in 100% of simulations.

Value of Risk:

Year	Volume of Energy at Risk (kWh)	Value of Energy at Risk (\$)
2020	586,280	4,726,928
2021	586,280	4,726,928
2022	586,280	4,726,928
2023	586,280	4,726,928
2024	586,280	4,726,928

Notes:

Energy at risk is the volume of energy served above the firm rating each year. An indicative load duration curve has been used to determine the relationship between peak demand, firm rating and volume of energy in kWh.

Value at risk assumes:

Value of Customer Reliability = \$26.93/kWh

Probability of Failure = 6% (3% annual probability of transformer failure + 3% probability of feeder failure)

Outage duration = 8 hours

Probability of failure in any given hour: $6\% \times 8 / 24 / 365$

Value above firm rating = VCR * probability * volume of energy

All energy above the emergency rating is not served. This is equivalent to assuming a 100% outage probability for energy above this level.

In addition to the VCR cost, there are litigation, reputational and other financial risks that are included in the total:

Litigation costs = \$100,000 / event

Reputational risk cost = external consultations and communications costs = \$10,000 / event.

Financial risk cost = internal investigation costs = \$10,000 / event.

Total risk cost = Reliability risk cost + Litigation + Reputational risk cost + Financial risk cost
= VCR / kWh + \$120,000 / event.