Appendix 5.33: Supply to Gungahlin town centre PJR

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

evoenergy

Project Justification Report

Project name	**Supply to Gungahlin Town Centre – Valley Feeder**
Expenditure type	Capital Expenditure
Business Group	Asset Strategy
Regulatory Period	1 July 2019 to 30 June 2024
Total Project Cost Estimate	$2,808,250 excluding corporate overheads, excluding contingency, and excluding GST
Five year total spend 2019-24	$2,808,250 excluding corporate overheads, excluding contingency, and excluding GST
CAPEX category	ENAA Distribution
Primary driver	Load growth in Gungahlin Town Centre
Project Number	20003951

Contents

Reference documents

Document	Version	Date
National Electricity Rules	101	
National Electricity Law		19.12.13
Utilities Act (ACT)		2000
Utilities (Management of Electricity Network Assets Code) Determination		2013
Electricity Distribution Supply Standards Code		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
Suburban Land Agency Indicative Land Release Program 2017-21		2017
Evoenergy Peak Demand Reduction Strategy	2.0	22.8.17
CutlerMerz Augex Uncertainty Risk Appraisal (AURA) Model Methodology	1.0	Nov 2017
Various Network Alteration Proposals (20004060, 20003574, 20004591)		2017

1. Executive Summary

This Project Justification Report addresses the growth of electricity demand in the Gungahlin Town Centre and evaluates options re how Evoenergy can meet these needs.

The maximum demand in Gungahlin Town Centre area is forecast to increase by approximately 16.2 MVA by winter 2020 with the continued development of new residential suburbs at Throsby and Kenny, along with commercial and residential developments in the Gungahlin Town Centre precinct, including the Gungahlin Cinema, Capital Metro Traction Power Station (TPS1), medical centre, and other mixed use buildings.

Approximately 13.3 MVA of this load can be met by fully utilising the existing 11 kV network in the area, transferring loads between feeders and between zone substations, and by the new Hamer feeder which is due to be installed by December 2017 and the Flemington feeder which is scheduled to be installed by June 2019. The forecast load growth in this area indicates the available spare capacity will be fully utilised by 2020 and approximately 2.9 MVA supply capacity will be non-firm by 2020.

The preferred option to meet the new demand is a new 11 kV feeder from Gold Creek Zone Substation to Valley Ave to supply growing load demand as existing feeders supplying the Gungahlin Town Centre area near firm capacity loading.

The proposed new 11 kV feeder from Gold Creek Zone Substation will inter-tie with other 11 kV feeders from Gold Creek and Belconnen Zone Substations to provide backup security of supply in the event of a feeder outage.

Other options considered include a feeder from Belconnen Zone Substation, demand management, and a grid battery. The feeder from Belconnen was excluded due to its high net present cost (compared with the preferred option). Demand management was not considered feasible due to the insufficient capacity available to be met by winter 2020. 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 preferred option is **$2,808,250 excluding corporate overheads, contingency and GST**.

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

2. Strategic Context and Expenditure Need

Significant residential and commercial development has taken place over recent years and is forecast to continue in the future in the Gungahlin District. New residential suburbs have been established and are continuing to be developed by the Suburban Land Agency (SLA) including Ngunnawal, Lawson, Casey, Moncrieff, Taylor, Throsby, Jacka and Kenny. Commercial development is continuing in the Gungahlin Town Centre area with the development of several multi-storey apartment buildings, office blocks, shopping centres, cinema, and the Capital Metro light rail system.

2.1. Existing infrastructure in the Gungahlin Town Centre East area

Six existing feeders run south-east from Gold Creek Zone Substation down Mirrabei Drive, Gundaroo Drive, and then run in different directions to supply various parts of Gungahlin including Gungahlin Town Centre West, Franklin and Harrison.

The suburbs of Franklin, Harrison and Throsby are supplied through three 11 kV feeders – West, Nona and Anthony Rolfe.

The Gungahlin Town Centre West and surrounding areas are supplied through three 11 kV feeders – Gribble, Riley and Boulevard.

The suburbs of Casey, Ngunnawal, Moncrieff, Taylor and Jacka are supplied through three 11 kV feeders that run north from Gold Creek Zone Substation - Birrigai, Magenta and Saunders.

There are two spare 11 kV circuit breakers presently available at Gold Creek Zone Substation for connecting new 11 kV feeders. One has been allocated to the proposed Flemington feeder, so there will be one left for the Valley feeder.

The maximum load supplied by each existing feeder as a percentage of its firm rating, is shown in Table 1 for summer and winter. Yellow denotes load above 80% of the firm rating, red denotes load above firm rating. Firm rating of an 11 kV feeder is dictated by the number of inter-connections it has to other 11 kV feeders in order to provide full back-up capacity in the event of a contingency. Thus a feeder that is inter-connected to one other feeder may be loaded to 50% of its thermal capacity, and a feeder that is inter-connected to two other feeders may be loaded to 75% of its thermal capacity. 100% firm rating should not be exceeded as this places load at risk in the event of a contingency.

Table 1: Gungahlin East Feeder Loadings (all feeders from Gold Creek Zone Substation)

Feeder	Feeder Rating (MVA)		2014		2015		2016		2017		Post Hamer; Post transfer to BZS; Pre-two new feeders	
	Firm Summer Rating	Firm Winter Rating	% Load Summer	% Load Winter	% Load Summer	% Load Winter	% Load Summer	% Load Winter	% Load Summer	% Load Winter		
Anthony Rolfe	5.9	6.6	97%	94%	92%	100%	111%	110%	132%	-	98%	-
Boulevard	5.0	5.6	25%	22%	24%	22%	29%	23%	31%	-	31%	-
Gribble	5.0	5.6	73%	51%	68%	58%	93%	63%	96%	-	96%	-
Nona	5.5	6.2	77%	78%	70%	90%	85%	94%	105%	-	123%	-
Riley	5.5	6.2	55%	57%	51%	49%	55%	51%	73%	-	134%	-
West	5.5	6.2	87%	84%	77%	90%	88%	89%	127%	-	70%	-

2.2. Driving need for infrastructure investment

Forecast additional maximum demand in the Gungahlin Town Centre area 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 the area. 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.

Table 2: Proposed Developments in Gungahlin Town Centre

Proposed Development and Net Additional Diversified Load in MVA	2018-19	2019-20
Throsby Residential Estate (SLA)	1.5	0.3
Kenny Residential Estate (SLA)		0.5
Gungahlin Town Centre East commercial and residential development (SLA)	1	1.5
Capital Metro TPS 1 – Flemington Rd (PN 20001420)	5.5*	
Infinity Apartment Building – B2 S209 (PN20003635)	1.6	
Commercial development – B799 (PN20003512)	0.3	
Mixed use development – B5 S209 (PN20003805)		1.1
Eastlake Football Club commercial development – B1 S227 (PN20004060)		0.5
Cinema and retail development – B1 S12 (PN20003574)		1.9
Medical centre, commercial and residential development – B1 S246 (PN20004591)		0.5
Additional Load (MVA)	9.9	6.3
Cumulative Additional Forecast Load (MVA)	9.9	16.2

* The peak power demand for Capital Metro Traction Power Station TPS 1 is estimated at 5.5 MW for an emergency N-1 scenario where TPS 4 is offline. The average power demand is expected to be approximately 2.64 MW and it is noted that an rms calculation of the instantaneous 1 second power demand over a 15 minute cycle will not exceed 3 MW.

Table 2 shows that cumulative additional load in the area will exceed the available spare firm capacity by winter 2019-20.

The proposed residential developments in the Gungahlin Town Centre are primarily multi-storey apartment buildings. To date these have tended to be all-electric and built without solar PV or battery energy storage facilities. Although the buildings themselves and installed appliances (reverse cycle heat pumps, lighting etc) are energy efficient, an after diversity maximum demand (ADMD) figure of 2.5 kVA per unit has been assumed. This allows for current energy efficiency measures and will allow for the expected uptake of electric vehicle charging facilities and instantaneous hot-water heating systems in the future. A concerted effort is proposed by Evoenergy as part of its Demand Side Management initiative, to work with developers and their designers at an early stage, to consider alternative energy sources such as gas, and to increase electrical energy efficiency (building management systems, centralised gas hot-water heating systems etc).

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.

Table 3: Corporate, asset management and key project objectives

Corporate objectives	Asset management objectives	Key project objectives
Responsible	- 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	- 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.	Options evaluations to consider the value of customer reliability (VCR). In accordance with regulated requirements, the selected option must ensure access to an electricity supply.
Sustainable	- 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.	Options evaluations to consider the cost effectiveness of the solution. In accordance with regulated requirements, the selected option must be the most prudent and efficient. Non-network options will be evaluated on equal merit with network solutions.
People	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: *Meet or manage the expected demand for standard control services*

1) *Comply with all applicable regulatory obligations or requirements associated with the provision of standard control services*

2) *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*

3) *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.

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.

For high voltage (11 kV) 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).

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[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 six options (plus a do nothing option) to provide additional capacity to Gungahlin Town Centre as listed in Table 5.

Table 5: Options considered for provision of additional capacity to Gungahlin Town Centre

Option	Option type	Description	Evaluation
0	Network	Do nothing	Not selected as does not meet minimum requirements
1	**Network**	**Construct new 11 kV cable feeder from Gold Creek Zone Substation to Valley Ave via Mirrabei Drive**	**Selected as higher NPC**
2	Network	Construct new 11 kV cable feeder from Gold Creek Zone Substation to Valley Ave via Gungahlin Lakes Golf Course	Not selected due to lower NPC
3	Network	Construct new 11 kV cable feeder from Belconnen Zone Substation to Valley Ave	Not selected due to lower NPC
4	Non-network	Demand side management	Not selected as does not meet minimum requirements and lower NPC
5	Non-network	Grid battery	Not selected due to lower NPC
6	Mixed	Delay preferred network option 1 using network battery	Not selected as cost of delay exceeds benefits

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 $40 over a five year period based on the probability of a contingency event at the same time as demand exceeding firm capacity.

Despite, the relatively low value of energy at risk, the Do Nothing option would result in ActewAGL breaching its Distribution Network Augmentation Standards and thus its obligation to provide a reliable and secure power supply.

4.1.2.   Option 1: Construct new 11 kV cable feeder from Gold Creek Zone Substation to Valley Ave via Mirrabei Drive

Option 1 considers the installation of a new 11 kV cable feeder from Gold Creek Zone Substation to Valley Ave to meet the growing load demand. The cable would be connected to an existing spare 11 kV feeder circuit breaker at Gold Creek. The feeder would provide firm capacity of 5.5 MVA (summer) and 6.2 MVA (winter).

Gold Creek Zone Substation is the nearest zone substation to the Gungahlin Town Centre. There is spare capacity available at Gold Creek to meet this demand, though a third 132/11 kV transformer is forecast to be required approximately 2025-26.

The Valley feeder would be run via a new 3-way switching station to be installed at the intersection of Hinder St and The Valley Ave to existing distribution substation S9386. A cable would be installed from this new switching station to

distribution substation S11048 to provide a link between the new feeder and Gribble feeder. New loads (refer Table 1) would be connected to this feeder as required. Its route would be from Gold Creek Zone Substation via Mirrabei Drive, Anthony Rolfe Ave, Gozzard St, The Valley Ave, Manning Clark Cres, Barbara Jefferis St, Elizabeth Jolley Cres to Henry Kendall St (S9386). Route length is approximately 5.3 km. The route length of the link from the new RMU to S11048 is approximately 160m.

Figure 1 illustrates the proposed cable route for Option 1.

Figure 1: Option 1 proposed feeder route from Gold Creek Zone Substation
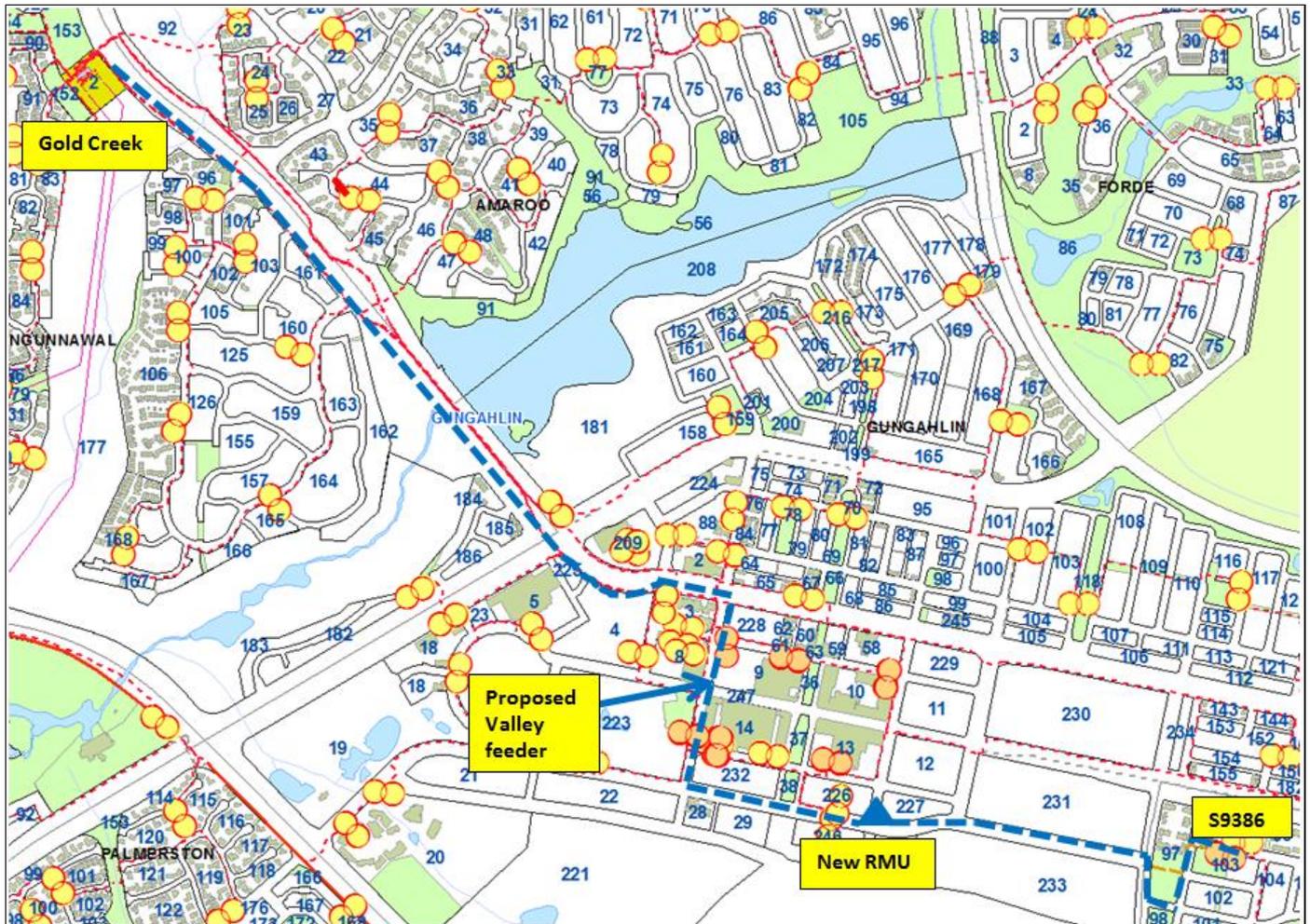
A preliminary estimated cost for Option 1, for the installation of two new feeders from Gold Creek Zone Substation to Gungahlin Town Centre via Mirrabei Drive is **$2,808,250 excluding corporate overheads, contingency and GST**. Refer to cost estimates, cash flows and NPC comparison in Appendices A and B. Proposed project completion is June 2020.

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

4.1.3. Option 2: Construct new 11 kV cable feeder from Gold Creek Zone Substation to Valley Ave via Gungahlin Lakes Golf Course.

Option 2 is similar to Option 1 in that it considers the installation of a new 11 kV cable feeder from Gold Creek Zone Substation to Valley Ave to meet the growing load demand.

The proposed route for this option is from Gold Creek Zone Substation to the corner of Gundaroo Drive / Anthony Rolfe Ave via the Gungahlin Lakes Golf Course, Gungahlin Drive and Gundaroo Drive. From there the route is the same as per Option 1. Figure 2 illustrates the proposed cable route for Option 2.

Figure 2: Option 2 proposed feeder route from Gold Creek Zone Substation
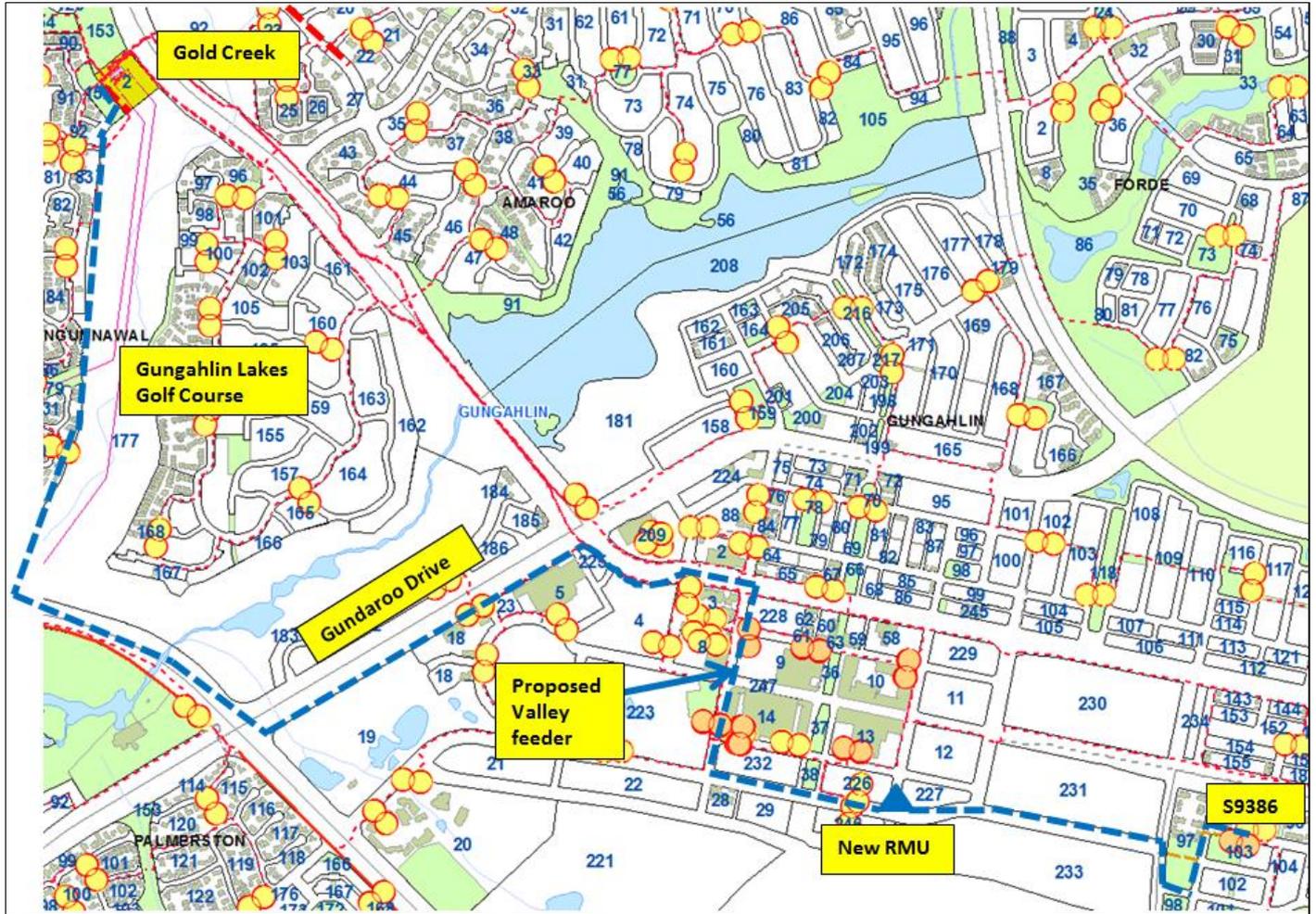
A preliminary estimated cost for Option 2, for the installation of a new feeder from Gold Creek Zone Substation to Gungahlin Town Centre via Gungahlin Lakes Golf Course is **$4,769,000 excluding corporate overheads, contingency and GST**. Refer to cost estimates, cash flows and NPC comparison in Appendices A and B. Proposed project completion is June 2018.

Option 2 is not selected due to its lower NPC.

4.1.4. Option 3: Construct 11 kV cable feeder from Belconnen Zone Substation to Valley Ave.

Belconnen Zone Substation is not the closest zone substation to Gungahlin Town Centre. The route length of a new 11 kV feeder from Belconnen Zone Substation to Valley Ave. Gungahlin is approx 12.3 km. There are no spare conduits available along this route.

A preliminary cost estimate for Option 3, the installation of a new feeder from Belconnen Zone Substation to Gungahlin Town Centre, is **$4,049,250 excluding corporate overheads, contingency and GST**. Refer to cost estimates and NPC comparison in Appendices A and B.

Option 3 is not selected due to its lower NPC.

4.1.5. Option 4: Demand Management

Option 4 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 new feeder to Gungahlin Town Centre to the next regulatory control period (beyond 2024), it is estimated that non-network solutions would need to provide a maximum demand of approximately 3.6 MVA within the next two years.

Latent demand management within the existing customer base was investigated, with a maximum estimated capacity of 1.61 MVA. This does not meet the minimum capacity required of 3.6 MVA by July 2020 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	DM	Gungahlin Town Centre East 11 kV feeders						Total
		A Rolfe	Gribble	Nona	Riley	West	Hamer	
Customer – owned embedded generation	MVA	0.3	0.2	0.2	0.1	0.2	0.2	**1.200**
Customer – owned energy storage	MVA	0.05	0.02	0.04	0.02	0.05	0.015	**0.195**
Load curtailment	MVA	0.05	0.04	0.04	0.02	0.05	0.015	**0.215**
Totals	**MVA**	**0.365**	**0.33**	**0.435**	**0.14**	**0.455**	**0.147**	**1.61**

In summary, a maximum demand reduction of 1.61 MVA could be achieved if all the above non-network options were implemented. This is not sufficient to defer the new feeder.

Third party non-network proposals will be requested in Evoenergy's 2018 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 the Gungahlin Town Centre it was determined that more than 40% 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.

4.1.6. Option 5: Grid battery to defer Option 1

A further option to adopt a grid battery to defer Option 1 was also explored. 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 **$3,401,327 excluding corporate overheads, contingency and GST.** Refer to cost estimates and NPC comparison in Appendices A and B.

4.1.7. Option 6: Grid battery only

The final option explored the use of a grid battery only. A grid battery, although more expensive that a traditional network solution on a per MVA basis, has advantages over a traditional network solution. A network 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 the Gungahlin Town Centre however, the grid battery was not economic due to the relative certainty of demand with a preliminary cost estimate of **$5,706,960 excluding corporate overheads, contingency and GST**. Refer to cost estimates, cash flows and NPV comparison in Appendices A and B.

4.1.8. 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	**Construct new 11 kV cable feeder from Gold Creek Zone Substation to Valley Ave via Mirrabei Drive**	**$2,808,250**	**$2,808,250**	**-$3,227,846**	**Selected due to higher NPC**
2	Construct new 11 kV cable feeder from Gold Creek Zone Substation to Valley Ave via Gungahlin Lakes Golf Course	$4,769,000	$4,769,000	-$5,562,022	Not selected due to lower NPC
3	Construct new 11 kV cable feeder from Belconnen Zone Substation to Valley Ave	$4,049,250	$4,049,250	-$4,654,271	Not selected due to lower NPC
4	Demand management	N/A	N/A	N/A	Not selected as does not meet need
5	Grid battery to defer Option 1	$3,401,327	$3,401,327	-$3,909,538	Not selected as deferral not economic
6	Grid battery only	$5,706,960	$1,669,684	-$6,145,116	Not selected due to lower NPC

4.2. Recommendation

The selected option is Option 1, the installation of a new 11 kV cable feeder from Gold Creek Zone Substation to Valley Ave to meet the growing load demand in the Gungahlin Town Centre.

Financial analysis (refer Appendix B) shows Option 1 to be the best option due to its higher (i.e. 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 Evoenergy's regulated asset base. The major assets will have an economic life of 50 years.

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

Timing is scheduled for completion by June 2020.

The preliminary cost estimate of the selected option is **$2,808,250 excluding overheads, contingency and GST**.

The proposed 11 kV feeder will provide ties to existing feeders from Gold Creek and Belconnen zone substations, 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

One new feeder from Gold Creek to Gungahlin Town Centre East via Mirrabei Drive. Valley feeder 5.3 km. Assume no spare conduit available					
Preliminary Estimate ± 30% Accuracy					
Description	**Notes**	**Unit**	**$/Unit**	**Quantity**	**Cost**
Trenching and drilling					$2,062,500
Clearing of route where required	Allowance	m2	$10		$0
Directional drilling - Mirrabei Drive	Refer quoted cost for Hamer Feeder project 20004647	ea	$1,200,000	1	$1,200,000
Directional drilling - remaining cable routes	Assume drilling with no rock. Assume one150mm conduit only.	m	$350	2100	$735,000
Open trenching and backfilling	Assume excavation with no rock. Backfill with bedding sand and native soil. Assume one conduit only	m	$150	100	$15,000
Cable jointing and haulage pits	Assume every 500m	ea	$3,000	12	$36,000
Communications pits	Assume every 200m	ea	$1,500		$0
Traffic management	Allowance	m	$5	5300	$26,500
Reinstatement incl revegetation as required	Allowance	m3	$100	500	$50,000
Cabling works					$581,000
11 kV 3c/400mm2 XLPE cable	Assume OJAS cable	m	$50	9900	$495,000
11 kV 3c/240mm2 XLPE cable		m	$35		$0
Throughjoints	Assume every 500m	ea	$1,000	12	$12,000
Terminations		ea	$2,500	6	$15,000
Conduit and marker tape	Assume conduits included in trenching and drilling rates	m	$10		$0
Cable installation labour and plant		m	$10	5300	$53,000
HV Cables and connections Test & Commissioning	Allowance	ea	$3,000	2	$6,000
11 kV Switchgear					$79,000
11 kV feeder CB	Assume spare CBs availbale at Gold Creek	ea	$120,000		$0
11 kV 3-way RMU	Valley Feeder corner Valley Ave / Hinder St	ea	$75,000	1	$75,000
11 kV Test & Commissioning	per CB and RMU	lot	$2,000	2	$4,000
Electrical (Secondary System)					$11,750
Protection & Control					$4,750
P&C Secondary Cabling	per feeder panel	ea	$2,250	1	$2,250
P&C Test & Commission	Allowance	ea	$2,500	1	$2,500
DC Supply System					$7,000
DC Cabling	per switchgear panel/bay	ea	$5,000	1	$5,000
DC Test & Commission	Allowance	ea	$2,000	1	$2,000
SCADA					$4,000
SCADA connections for new feeder panels		ea	$2,000	1	$2,000
Test & Commissioning	Allowance	ea	$2,000	1	$2,000
Indirect Costs					$70,000
Development Application	Allowance	ea	$10,000	1	$10,000
Contractor's Preliminaries, site establishment and disestablishment	Allowance	ea	$10,000	1	$10,000
Project management and administration	Allowance	ea	$50,000	1	$50,000
Project Sub Total without overheads					**$2,808,250**
Overheads					
Overall average overhead rate	Allowance	27%			$758,228
Project Sub Total with overheads					**$3,566,478**

A.2 Cost Estimate – Option 2

Description	Notes	Unit	$/Unit	Quantity	Cost
One new feeder from Gold Creek to Gungahlin Town Centre East via Gungahlin Lakes Golf Course. Valley feeder 6.7 km.					
Preliminary Estimate ± 30% Accuracy					
Trenching and drilling					**$3,800,000**
Clearing of route where required	Allowance	m2	$10	5000	$50,000
Directional drilling - Golf Course	Refer quoted cost for Hamer Feeder project 20004647	ea	$1,600,000	1	$1,600,000
Directional drilling - remaining cable routes	Assume drilling with no rock. Assume two 150mm conduits per drill.	m	$350	4200	$1,470,000
Open trenching and backfilling	Assume excavation with no rock. Backfill with bedding sand and native soil. Assume two conduits per trench.	m	$150	3400	$510,000
Cable jointing and haulage pits	Assume every 500m	ea	$3,000	25	$75,000
Communications pits	Assume every 200m	ea	$1,500		$0
Traffic management	Allowance	m	$5	9000	$45,000
Reinstatement incl revegetation as required	Allowance - especially golf course	m3	$100	500	$50,000
Cabling works					**$818,000**
11 kV 3c/400mm2 XLPE cable	Assume OJAS cable	m	$50	12700	$635,000
11 kV 3c/240mm2 XLPE cable		m	$35		$0
Throughjoints	Assume every 500m	ea	$1,000	25	$25,000
Terminations		ea	$2,500	10	$25,000
Conduit and marker tape	Assume conduits included in trenching and drilling rates	m	$10		$0
Cable installation labour and plant		m	$10	12700	$127,000
HV Cables and connections Test & Commissioning	Allowance	ea	$3,000	2	$6,000
11 kV Switchgear					**$81,000**
11 kV feeder CB	Assume spare CBs availbale at Gold Creek	ea	$120,000		$0
11 kV 3-way RMU	Valley Feeder corner Valley Ave / Hinder St	ea	$75,000	1	$75,000
11 kV Test & Commissioning	per CB and RMU	lot	$2,000	3	$6,000
Electrical (Secondary System)					**$0**
Protection & Control					$0
P&C Secondary Cabling	per feeder panel	ea	$2,250		$0
P&C Test & Commission	Allowance	ea	$2,500		$0
DC Supply System					$0
DC Cabling	per switchgear panel/bay	ea	$5,000		$0
DC Test & Commission	Allowance	ea	$2,000		$0
SCADA					**$0**
SCADA connections for new feeder panels		ea	$2,000		$0
Test & Commissioning	Allowance	ea	$2,000		$0
Indirect Costs					**$70,000**
Development Application	Allowance	ea	$10,000	1	$10,000
Contractor's Preliminaries, site establishment and disestablishment	Allowance	ea	$10,000	1	$10,000
Project management and administration	Allowance	ea	$50,000	1	$50,000
Project Sub Total without overheads					**$4,769,000**
Overheads					
Overall average overhead rate	Allowance	27%			$1,287,630
Project Sub Total with overheads					**$6,056,630**

A.3 Cost Estimate – Option 3

One new feeder from Belconnen to Gungahlin Town Centre East. Valley feeder 12.3 km.					
Preliminary Estimate ± 30% Accuracy					
Description	**Notes**	**Unit**	**$/Unit**	**Quantity**	**Cost**
Trenching and drilling					$2,981,500
Clearing of route where required	Allowance	m2	$10	5000	$50,000
Directional drilling	Assume drilling with no rock. Assume two 150mm conduits per drill.	m	$350	4300	$1,505,000
Open trenching and backfilling	Assume excavation with no rock. Backfill with bedding sand and native soil. Assume two conduits per trench.	m	$150	8000	$1,200,000
Cable jointing and haulage pits	Assume every 500m	ea	$3,000	30	$90,000
Communications pits	Assume every 200m	ea	$1,500		$0
Traffic management	Allowance	m	$5	12300	$61,500
Reinstatement incl revegetation as required	Allowance - especially golf course	m3	$100	750	$75,000
Cabling works					$783,000
11 kV 3c/400mm2 XLPE cable	Assume OJAS cable	m	$50	12300	$615,000
11 kV 3c/240mm2 XLPE cable		m	$35		$0
Throughjoints	Assume every 500m	ea	$1,000	24	$24,000
Terminations		ea	$2,500	6	$15,000
Conduit and marker tape	Assume conduits included in trenching and drilling rates	m	$10		$0
Cable installation labour and plant		m	$10	12300	$123,000
HV Cables and connections Test & Commissioning	Allowance	ea	$3,000	2	$6,000
11 kV Switchgear					$199,000
11 kV feeder CB	Assume spare CBs availbale at Gold Creek	ea	$120,000	1	$120,000
11 kV 3-way RMU	Valley Feeder corner Valley Ave / Hinder St	ea	$75,000	1	$75,000
11 kV Test & Commissioning	per CB and RMU	lot	$2,000	2	$4,000
Electrical (Secondary System)					$11,750
Protection & Control					$4,750
P&C Secondary Cabling	per feeder panel	ea	$2,250	1	$2,250
P&C Test & Commission	Allowance	ea	$2,500	1	$2,500
DC Supply System					$7,000
DC Cabling	per switchgear panel/bay	ea	$5,000	1	$5,000
DC Test & Commission	Allowance	ea	$2,000	1	$2,000
SCADA					$4,000
SCADA connections for new feeder panels		ea	$2,000	1	$2,000
Test & Commissioning	Allowance	ea	$2,000	1	$2,000
Indirect Costs					$70,000
Development Application	Allowance	ea	$10,000	1	$10,000
Contractor's Preliminaries, site establishment and disestablishment	Allowance	ea	$10,000	1	$10,000
Project management and administration	Allowance	ea	$50,000	1	$50,000
Project Sub Total without overheads					**$4,049,250**
Overheads					
Overall average overhead rate	Allowance	27%			$1,093,298
Project Sub Total with overheads					**$5,142,548**

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	Option 6
2019-20	$2,808,250	$4,769,000	$4,049,250	N/A	$593,077	$593,077
2020-21					$2,808,250	$269,152
2021-22						$269,152
2022-23						$269,152
2023-24						$269,152
2024-25						$269,152
2025-26						$269,152
2026-27						$269,152
2027-28						$269,152
2028-29						$269,152
2029-30						$269,152
2030-31						$269,152
2031-32						$269,152
2032-33						$269,152
2033-34						$269,152
2034-35						$269,152
2035-36						$269,152
2036-37						$269,152
2037-38						$269,152
2038-39						$269,152
Total Cost (20 years)	**$2,808,250**	**$4,769,000**	**$4,049,250**	**N/A**	**$3,401,327**	**$5,706,965**
2019-24 Regulatory Control Period Cost	**$2,808,250**	**$4,769,000**	**$4,049,250**	**N/A**	**$3,401,327**	**$1,669,685**

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 ± 10% of the forecasted spot loads expected in the Gungahlin 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 Gungahlin Town Centre

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

Options:

1. Construct new 11 kV feeder from Gold Creek Zone Substation to Valley Ave via Mirrabei Drive.
2. Construct new 11 kV cable feeder from Gold Creek Zone Substation to Valley Ave via Gungahlin Lakes Golf Course.
3. Construct new 11 kV cable feeder from Belconnen Zone Substation to Valley Ave.
4. Non-network option (demand management).
5. Best mixed network and non-network combination (Option 1 plus grid battery).
6. Non-network option (network battery).

Results (Average over 50 simulations):

Option:	One	Two	Three	Four	Five	Six
NPC (2019-2024)	-$2,602,773	-$4,484,935	-$3,752,971	N/A	-$3,208,937	-$2,482,028
NPC (2019-2039)	-$2,844,996	-$4,902,319	-$4,102,235	N/A	-$3,451,160	-$6,145,116
Network Option total Capital Cost	$2,808,250	$4,839,000	$4,049,250	N/A	$2,808,250	-
Option Capital Cost (2019-2024)	$2,808,250	$4,839,000	$4,049,250	N/A	$3,401,327	$1,669,685
Option Capital Cost (2019-2039)	$2,808,250	$4,839,000	$4,049,250	N/A	$3,401,327	$5,706,965

Average Net Present Cost for Each Network / Non-Network Combination:
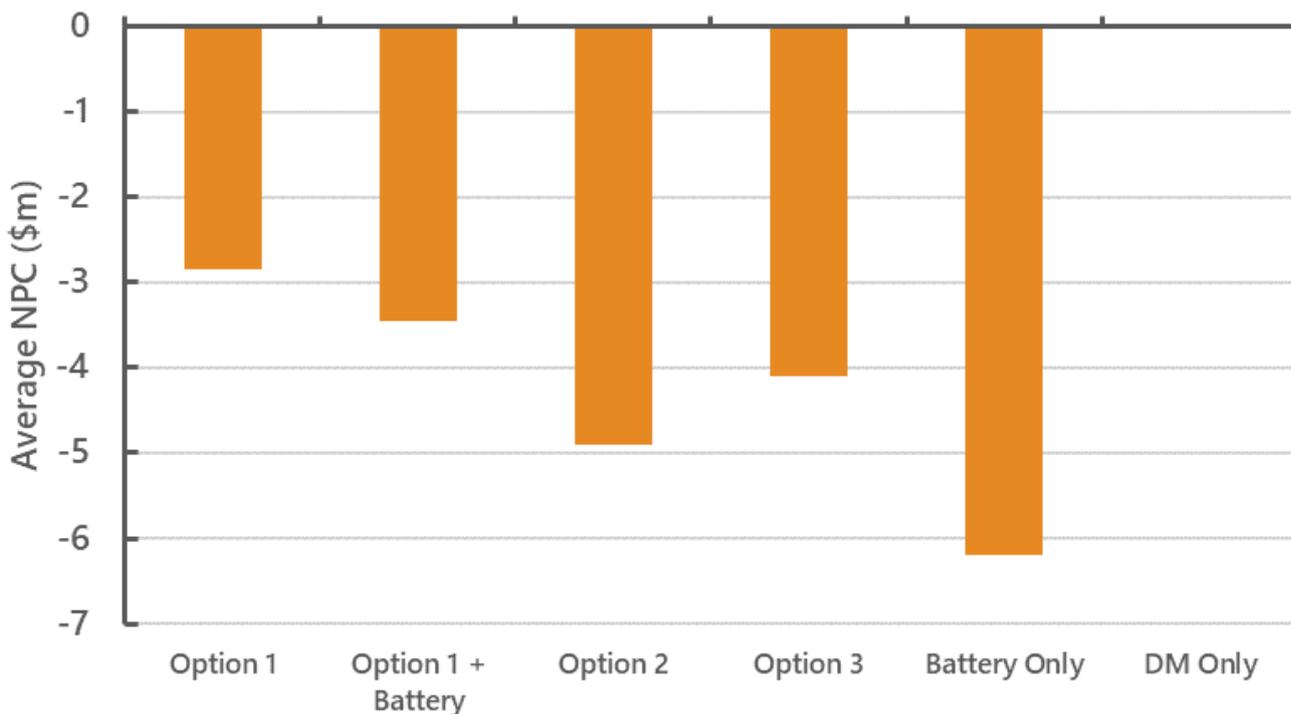
Multiple combinations of network options, demand management and network batteries were tested using the Monte-Carlo model. The preferred option was selected on the basis of minimising the Net Present Cost.

Percentage of Simulations where the Selected Option had a Lower Cost than Other Options:
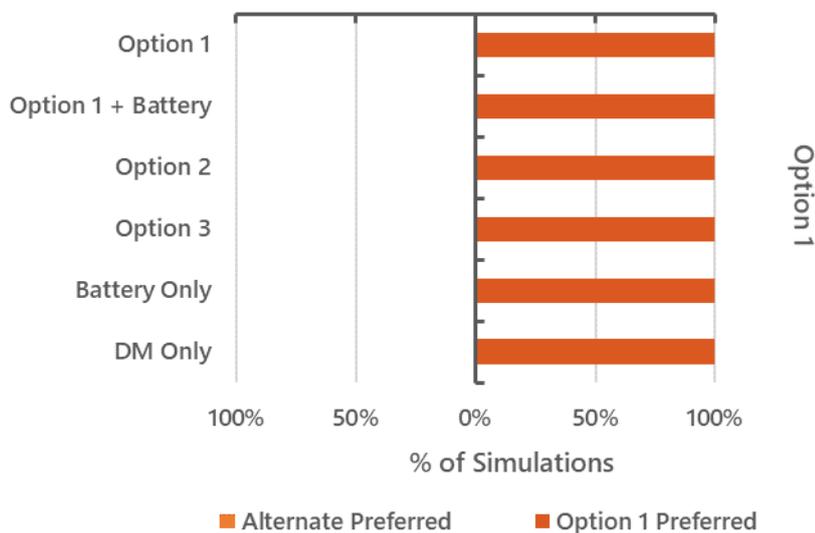
The random variation in peak demand growth in the Monte-Carlo model means that different options may be preferred in some simulations. The above chart shows that Option 1 was the preferred option in 100% of simulations.

Value of Risk:

Year	Volume of Energy at Risk (kWh)	Value of Energy at Risk ($)
2020	2,737	8
2021	2,737	8
2022	2,737	8
2023	2,737	8
2024	2,737	8

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% * 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.