Appendix 4.10: Belconnen Town Centre PJR

Revised regulatory proposal for the ACT electricity distribution network 2019–24

November 2018

evoenergy

Project Justification Report

Project name	Supply to Belconnen Town Centre
Expenditure type	Capital Expenditure
Business Group	Asset Strategy
Regulatory Period	1 July 2019 to 30 June 2024
Total Project Cost Estimate	$2,289,050 excluding corporate overheads, excluding contingency, and excluding GST
Five year total spend 2019-24	$2,289,050 excluding corporate overheads, excluding contingency, and excluding GST
CAPEX category	ENAA Distribution
Primary driver	Load growth in Belconnen Town Centre
Project Number	20004446

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1. Executive Summary

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

The maximum demand in the Belconnen Town Centre area is forecast to increase steadily over the next five years with major residential and commercial developments along with development of the University of Canberra campus. The load in this area is typically summer peaking. The new developments are likely to include high energy efficiency and rooftop solar PV generation, and this has been accounted for within the demand forecast.

The forecast load growth will be supplied by existing feeders as much as possible, however these feeders cannot fully meet the forecast demand increase.

This Project Justification Report proposes three new 11 kV feeders from Belconnen Zone Substation to the Belconnen Town Centre area. Spare conduits will be installed along the feeder route to provide for future developments and load growth.

The proposed feeders will inter-tie with existing feeders emanating from Gold Creek, Belconnen and Latham zone substations, and thus enable load to be transferred off highly-loaded feeders.

Other options considered include the installation of feeders from Latham Zone Substation, demand management, and a grid battery. The selected option has the highest (ie least negative) Net Present Cost, and the lowest Capital Cost of all options evaluated.

A preliminary cost estimate for the selected option of installing two new 11 kV feeders from Belconnen Zone Substation to Belconnen Town Centre is **$2,289,050 excluding corporate overheads, contingency and GST**.

This Project Justification Report includes the assessment of risk based on probabilistic principles. The conservatively estimated value of avoided risk exceeds cost of investment. Therefore, Evoenergy considers that proposed investment is prudent and economic.

These works will be carried out during the 2019-24 Regulatory Control Period in two stages, ie first feeder by June 2021, and second feeder by June 2022.

2. Strategic Context and Expenditure Need

There is significant development underway and proposed for the Belconnen Town Centre area, comprising a mixture of multi-storey commercial and residential buildings.

2.1. Existing infrastructure in the Belconnen Town Centre area

There are several 11 kV feeders supplying the Belconnen Town Centre area. These feeders emanate from Belconnen and Latham zone substations.

The maximum load supplied by each 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: Loading of feeders supplying the Belconnen Town Centre area

Feeder Name	Zone Sub	Firm Summer Rating MVA	Thermal Summer Rating MVA	Firm Winter Rating MVA	Thermal Winter Rating MVA	2015		2016		2017		2018
						Summer MD	Winter MD	Summer MD	Winter MD	Summer MD	Winter MD	Summer MD
Aikman	BN	4.2	5.5	4.7	6.2	66%	43%	73%	50%	70%	44%	42%
Benjamin	BN	4.2	5.5	4.7	6.2	66%	41%	78%	54%	83%	45%	72%
Cameron North	BN	4.9	6.5	5.4	7.2	85%	38%	76%	45%	74%	39%	67%
Cameron South	BN	4.2	5.5	4.7	6.2	101%	61%	59%	63%	56%	60%	56%
Chan	BN	4.3	5.7	4.8	6.4	89%	40%	79%	50%	96%	42%	68%
Chandler	BN	4.2	5.5	4.7	6.2	57%	47%	61%	47%	57%	45%	106%
Emu Bank	BN	4.8	6.3	5.3	7.0	59%	40%	59%	43%	62%	47%	56%
Joy Cummins	BN	5.1	7.0	5.8	7.8	42%	30%	34%	47%	20%	47%	22%
Fielder	LA	4.8	6.4	5.9	7.8	96%	94%	108%	94%	105%	78%	99%

2.2. Driving need for infrastructure investment

Forecast additional maximum demand in the Belconnen Town Centre area for the next five years 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.

Customer applications or enquiries for the projects listed in Table 2 are included as attachments in Appendix C.

Table 2: Proposed Developments in the Belconnen area.

Proposed Development and Net Additional Diversified Load in MVA	2019	2020	2021	2022	2023	2024
PN 20002104 Calvary Hospital expansion	1.0					
PN 20000938 University of Canberra Hospital	1.0					
PN 20003743 S48 B8 Residential and commercial	0.5					
PN 20004977 Supply to Cancer Clinic UoC Hospital	0.7					
PN 20003008 S48 B19, Emu Bank, Residential and commercial, Republic Stage 1		1.8				
PN 20005391 S52 B37, Emu Bank, Residential and commercial	1.3					
PN 20005940 S49 B4, Cohen St, Residential development	0.4					
PN 20006035 S200 B2, Emu Bank / Eastern Valley Way, Residential & commercial, Republic Stage 2 & 3		1.2	2.4			
PN 20006119 S32 B16, Ibbott Lane, Commercial development		0.5				
PN 20006170 S32 B12-13 Thynne St, Residential and commercial/retail	0.5	1.0				
Lawson North Village, Defence Housing Australia		1.5				
University of Canberra Residential development 3,300 units			1.8	2.0	2.5	2.0
Belconnen Trades Centre Commercial and light industrial development			1.0	1.0	1.0	1.0
Additional Load (MVA)	**5.4**	**5.0**	**5.2**	**3.0**	**3.5**	**3.0**
Cumulative Additional Forecast Load (MVA)	**5.4**	**10.4**	**15.6**	**18.6**	**22.1**	**25.1**

Table 2 shows that cumulative forecast diversified additional load in the area by 2024 will be approximately 25.1 MVA. The existing feeders (as listed in Table 1) will be configured and spare capacity utilised to supply these additional loads as much as possible. However due to the geographical locations of some loads and high forecast loading of feeders in specific areas, additional feeders will be required.

The proposed residential developments in Belconnen 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, LED 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 solar PV, and to increase energy efficiency by installing building management systems, centralised gas hot-water heating systems, and gas-powered evaporative cooling systems etc.

The *Electricity Distribution (Supply Standards) Code* issued by the ACT Independent Competition and Regulatory Commission (ICRC) sets out certain performance standards for the distribution network in the ACT. A Distribution Network Service Provider (DNSP) 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”. The processes defined in these criteria serve to limit network augmentation expenditure to instances where the increase in demand is clear and above the secure or firm capacity.

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	• 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:

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.

The most expensive credible option exceeds $5 million so this project will be subject to the RIT-D.

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. System planning studies are undertaken to assess the adequacy of the distribution network to meet current and forecast demands whilst meeting the quality of supply criteria stipulated in the NER. The key performance criteria that are addressed are: thermal overloading, voltage performance, supply security and supply reliability. Studies are conducted using Evoenergy's medium growth, 50% PoE demand forecast, plus known customer-initiated point load requests and applications (copies of these point load connection applications are attached in Appendix C).

As a **first step,** Evoenergy applies deterministic planning criteria to identify where existing or emerging constraints exist on the network. The deterministic approach can lead to uneconomic outcomes. For that reason further analysis is performed to confirm whether the investment proposal is justified economically.

Therefore, as a **second step,** Evoenergy applies probabilistic assessment of risk to determine whether network investment is justified. The value of avoided risk is estimated using probabilistic methodology.

Thus, benefit is expressed as avoided risk. The risk may include other components, but typically unserved energy is the dominant risk component for augmentation projects. If avoided risk exceeds the cost of the proposed augmentation, the investment is considered economic. The assessment of risk is based on the probability of a credible contingency event occurring sufficiently frequently, and with such consequences as to justify Evoenergy to take prudent action to mitigate against it. The probability of a credible contingency event occurring at a time when load exceeds firm capacity, is used to calculate unserved energy.

The value of unserved energy compared with the cost of the investment, determines the prudency of the augmentation.

The value of Unserved Energy identified in this PJR (refer Appendix B2) is high due to the fact that forecast demand exceeds the thermal capacity of the existing network.

To meet the forecast demand under the Do Nothing option (ie connecting all new loads to existing feeders only), would require operating some feeders above their thermal ratings. Operating an 11 kV distribution feeder at or above its thermal rating is extremely risky as overheating can lead to conductor annealing and failure, or cause failure of jumpers, clamps, connectors, conductor joints, or other hardware. On overhead lines the conductors may sag below their statutory ground clearance (resulting from a combination of ambient and conductor temperature).

In addition, non-network solutions and demand side management solutions are considered when evaluating project options. To inform Evoenergy's position, as part of this assessment, Evoenergy models various load forecast outcomes using Monte Carlo methodology to select the preferred option. This modelling allows Evoenergy to consider whether a demand side solution is a viable option and should be explored further.

These proposed new feeders to the Belconnen Town Centre have been selected as the preferred option taking into account the available capacity (Table 1), forecast load (Table 2) and the corresponding reduction of risk. It is considered to be a prudent investment, because the avoided risk is higher than the cost of investment. Furthermore, at the time of investment the risk value exceeds the annualized cost of investment.

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 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).

It is noted that the National Electricity Law, Rules, Objectives, Criteria, and the ACT Distribution Code, do not require an assessment of unserved energy to be included in the cost evaluation of major augmentation projects.

4. Options Assessment

Evoenergy has considered five options (plus a do nothing option) to provide additional capacity and security of supply to the Belconnen Town Centre area as listed in Table 4.

Table 4: Options considered for provision of additional capacity and security to Belconnen Town Centre.

Option	Option type	Description	Evaluation
0	Network	Do nothing	Not selected as does not meet minimum requirements
1	**Network**	**Construct two new 11 kV cable feeders from Belconnen Zone Substation to Belconnen Town Centre**	**Selected as higher NPC**
2	Network	Construct two new 11 kV cable feeders from Latham Zone Substation to Belconnen Town Centre	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	Delayed preferred network option using grid battery	Not selected as cost of delay exceeded benefits
5	Non-network	Grid battery only	Not selected due to lower NPC

4.1. Options Description

4.1.1. Do Nothing Option

The ‘Do Nothing’ option requires connecting all new loads to existing feeders in the Belconnen Town Centre area. This would require operating most feeders above their firm rating and operating some feeders up to their thermal limits.

The ‘Do Nothing’ option would result in insufficient network capacity in the area as some feeders would be forced to operate beyond their thermal rating (and would consequently be tripped by over-current protection), and thus would result in Evoenergy breaching its obligations to provide a reliable and secure power supply. This option is not a prudent or acceptable solution as all new loads could not be supplied and would place considerable load at risk in the event of a feeder contingency.

The value of energy at risk under the Do Nothing option is high based on the probability of a contingency event occurring at the same time as demand exceeds firm capacity (refer Appendix B2).

4.1.2. Option 1: Construct two new 11 kV feeders from Belconnen Zone Substation to Belconnen Town Centre

Option 1 considers the installation of two new 11 kV cable feeders from Belconnen Zone Substation to the Belconnen Town Centre area to meet the growing load demand. Each new feeder would provide up to 5.5 MVA firm capacity (summer).

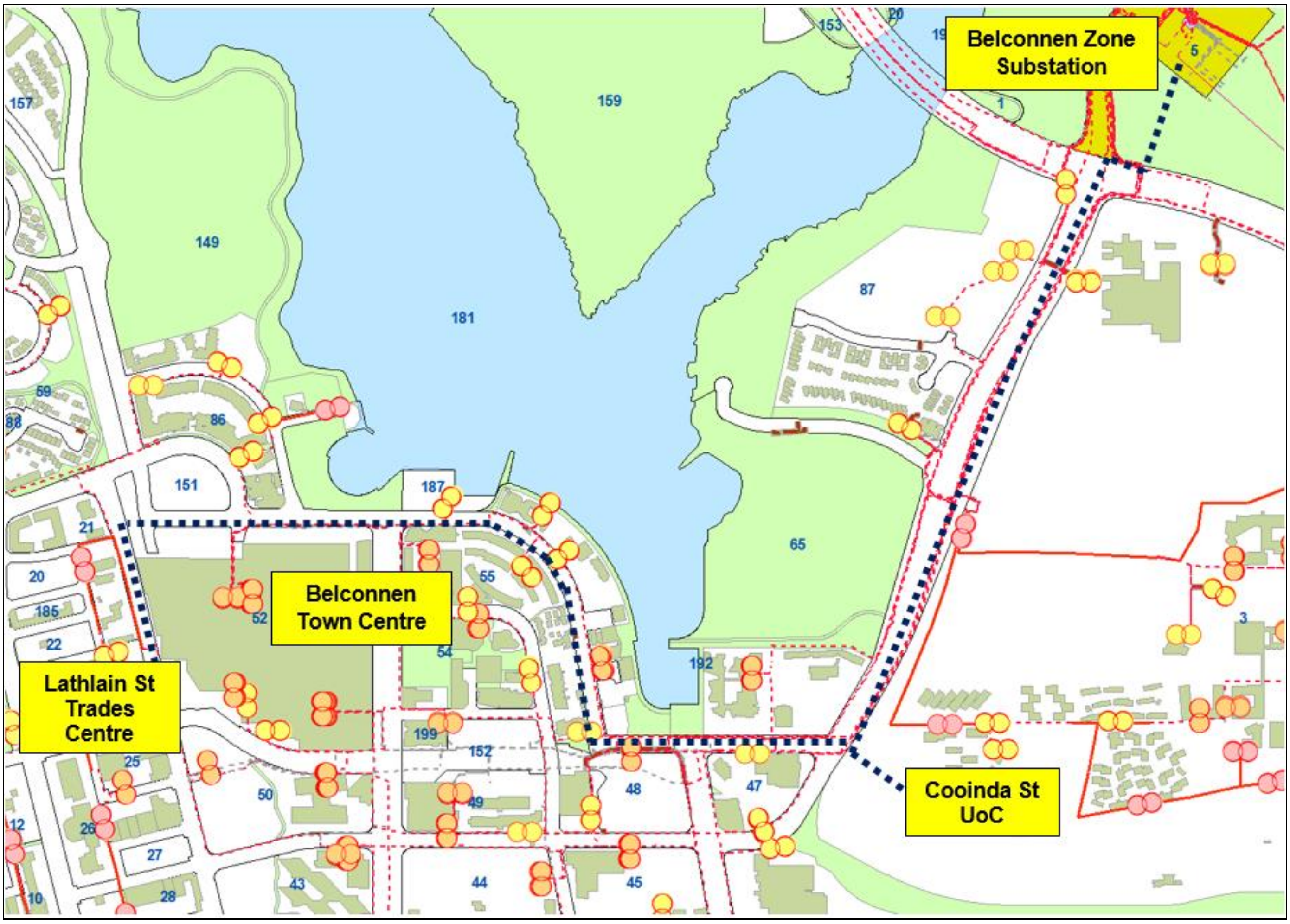
One feeder would be installed to Cooinda St to supply the proposed University of Canberra residential development. This feeder would be known as **Cooinda Feeder**, and would be installed by June 2022. Route length is approximately 2,330m.

The second feeder would be installed to Lathlain St to supply the proposed Belconnen Trades Centre. This feeder would be known as **Lathlain Feeder**, and would be installed by June 2023. Route length is approximately 3,250m.

Cables would be of 11 kV 3c/400mm^2 AL XLPE.

Figure 1 illustrates the proposed cable routes.

Figure 1: Proposed 11 kV cable feeders route Belconnen Zone Substation to Belconnen Town Centre



A preliminary cost estimate for Option 1, the installation of two new feeders from Belconnen Zone Substation to Belconnen Town Centre is **$2,289,050 excluding corporate overheads, contingency and GST**. Refer to cost estimates, cash flows and NPC comparison in Appendices A and B.

Costs for each stage are estimated at: Stage 1 (2022) $1,411,100 and Stage 2 (2023) $877,950 excluding corporate overheads, contingency and GST.

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

4.1.3. Option 2: Demand management

Option 2 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 discussed further within the Demand Management Paper.

To defer the new feeder to the Belconnen Town Centre to the next Regulatory Control Period (ie beyond 2024), it is estimated that non-network solutions would need to provide a maximum demand of approximately 3.5 MVA pa. Latent demand management within the existing customer base was investigated, with a maximum estimated capacity of 0.4 MVA. This does not meet the minimum capacity required of 3.5 MVA by 2020 to enable the first new feeder to be deferred.

These non-network options are summarised in Table 5.

Table 5: Summary of latent demand management

Non-network Option	Cameron South Feeder	Emu Bank Feeder	Total
Customer – owned embedded generation	0.08 MVA	0.07 MVA	**0.15 MVA**
Customer – owned energy storage	0.02 MVA	0.03 MVA	**0.05 MVA**
Load curtailment	0.10 MVA	0.10 MVA	**0.20 MVA**
Total	**0.20 MVA**	**0.20 MVA**	**0.40 MVA**

In summary, a maximum demand reduction of 0.4 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 Belconnen Town Centre it was determined that more than 50% 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.

4.1.4. Option 3: 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 **$4,038,884 excluding corporate overheads, contingency and GST.** Refer to cost estimates, cash flows and NPC comparison in Appendices A and B.

4.1.5. Option 4: Grid battery only

This option utilises 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 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 Belconnen Town Centre however, the grid battery is not economic due to the relative certainty of demand and a preliminary cost estimate of **$69,495,934 excluding corporate overheads, contingency and GST**. Refer to cost estimates, cash flows and NPC comparison in Appendices A and B.

4.1.6. Options Analysis

Table 7 lists the forecast new loads (as per Table 2) and states which feeder Evoenergy proposes to connect and supply each load from. This includes the proposed two new Cooinda and Lathlain feeders from Belconnen Zone Substation.

It should be noted that it is not feasible to utilise all available spare capacity of existing feeders due to their geographic location, inter-connectivity and proximity to new loads. These forecast loads make allowance for predicted penetration of rooftop solar PV and battery storage systems.

Table 6 shows that to meet the forecast load demands through to June 2024, all existing feeders plus the proposed three new feeders from Belconnen Zone Substation are required.

Table 6: Forecast Loads and Proposed Feeder Supplies

Belconnen Town Centre Forecast Load Growth							
Proposed Development and Net Additional Diversified Load in MVA	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**Total**
PN 20002104 Calvary Hospital expansion	1.0						1.0
Proposed feeder to supply above load	Belconnen Way North						
PN 20003016 S52 B34, 167 Emu Bank, Residential and commercial		1.5					1.5
Proposed feeder to supply above load	Emu Bank						
PN 20003743 S48 B8 Residential and commercial	0.5						0.5
Proposed feeder to supply above load	Joy Cummins						
PN 20004977 Supply to Cancer Clinic UoC Hospital	0.7						0.7
Proposed feeder to supply above load	CAE1						
PN 20005317 S48 B19, Emu Bank, Residential and commercial (Republic Stage 1)		1.8					1.8
Proposed feeder to supply above load	Joy Cummins						
PN 20003008 S52 B37, Emu Bank, Residential and commercial	1.3						1.3
Proposed feeder to supply above load	Emu Bank						
PN 20005940 S49 B4, Cohen St, Residential development	0.4						0.4
Proposed feeder to supply above load	Belconnen Way South						
PN 20006035 S200 B2, Emu Bank / Eastern Valley Way, Residential & commercial (Republic Stages 2 & 3)		1.2	2.4				3.6
Proposed feeder to supply above load	Chan						
PN 20006119 S32 B16, Ibbott Lane, Commercial development		0.5					
Proposed feeder to supply above load	Belconnen Way South						
PN 20006170 B12-13 S32 Thynne St, Residential and commercial/retail	0.5	1.0					1.5
Proposed feeder to supply above load	Eardley						
Lawson North Village, Defence Housing Australia		1.5					
Proposed feeder to supply above load	Joy Cummins						
University of Canberra Cooinda St, Residential development 3,300 units			1.8	2.0	2.5	2.0	8.3
Proposed feeder to supply above load	New Cooinda Feeder / Cameron South / Cameron North						
Belconnen Trades Centre Lathlain St, Commercial and light industrial development			1.0	1.0	1.0	1.0	4.0
Proposed feeder to supply above load	New Lathlain Feeder						
Forecast Additional Load pa (MVA)	**5.4**	**5.0**	**5.2**	**3.0**	**3.5**	**3.0**	
Cumulative Forecast Additional Load (MVA)	**5.4**	**10.4**	**15.6**	**18.6**	**22.1**	**25.1**	

Table 7 lists the existing and proposed feeders to the Belconnen Town Centre area with their existing maximum demand, forecast maximum demand at 2024.

Table 7: Belconnen Town Centre area feeders load forecasts (including proposed new feeders)

Feeder	Zone Substation	Firm rating MVA (summer)	Thermal rating MVA (summer)	Existing max demand MVA (summer)	Forecast max demand MVA (summer 2024)
Aikman	**Belconnen**	4.2	5.5	2.9	2.9
Benjamin	**Belconnen**	4.2	5.5	3	4.5
Cameron North	**Belconnen**	4.9	6.5	3.3	4.6
Cameron South	**Belconnen**	4.2	5.5	2.4	4.9
Chan	**Belconnen**	4.3	5.7	2.9	5.0
Chandler	**Belconnen**	4.2	5.5	2.4	2.4
Emu Bank	**Belconnen**	4.8	6.3	2.7	4.0
Joy Cummins	**Belconnen**	5.1	7.0	2.1	5.3
Fielder	**Latham**	4.8	6.4	2.75	4.4
Cooinda Feeder (2021)	**Belconnen**	5.5	7.3	4.7	4.5
Lathlain Feeder (2022)	**Belconnen**	5.5	7.3	–	4.0

Yellow denotes feeder loaded above its firm rating. Orange denotes proposed new feeder.

Loading of feeders to their thermal rating would risk large amounts of unserved energy in the event of a contingency.

4.1.7. Summary of Options Analysis

A summary of the options considered is presented in Table 8.

Table 8: Summary of Options Analysis

Option	Description	Total Capital Cost 2019-39	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 two new 11 kV cable feeders from Belconnen Zone Substation to Belconnen Town Centre**	**$2,289,050**	**$2,289,050**	**-$2,223,058**	**Selected due to higher NPC**
2	Demand side management	N/A	N/A	N/A	Not selected as does not meet need
3	Delayed preferred network option using grid battery	$3,958,554	$3,958,554	-$3,696,207	Not selected as deferral not economic
4	Grid battery only	$69,495,934	$12,974,059	-$37,414,699	Not selected due to lower NPC

4.2. Recommendation

The selected option is Option 1, the construction of two new 11 kV cable feeders from Belconnen Zone Substation, one to Cooinda St and the other to Lathlain St. Cables to be 11 kV 3c/400mm^2 AL XLPE.

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 Evoenergy's regulated asset base. The major assets will have an economic life of 50 years.

The new feeders will provide capacity and security of supply to the new developments proposed for the Belconnen Town Centre area.

The project will be carried out in two stages with completion by June 2023.

The preliminary cost estimate for the selected option is **$2,289,050 excluding overheads, contingency and GST**.

The proposed 11 kV feeders will provide ties to existing feeders from Belconnen and Latham zone substations, and thus provide some backup supply capability and load transfer capability in the future.

Appendix A – Cost Estimates

A.1 Cost Estimate – Option 1: Two 11 kV Feeders from Belconnen Zone Substation to Belconnen Town Centre

Description	Notes	Unit	$/Unit	Stage 1 Quantity	Stage 1 Cost	Stage 2 Quantity	Stage 2 Cost
Belconnen Zone Substation to Belconnen Town area: Two new 11 kV feeders. Stage 1: Cooinda Feeder 2330m (2021); Stage 2 Lathlain Feeder 3250m (2022). Assume 50-50 directional drilling and open trenching.							
Preliminary Estimate ± 30% Accuracy							
Trenching and drilling					$1,084,850		$478,700
Clearing of route where required	Allowance	m2	$10	2330	$23,300	920	$9,200
Directional drilling	Assume drilling with no rock. Assume three 150mm conduits and one 63mm conduit per drill.	m	$600	1165	$699,000	460	$276,000
Open trenching and backfilling	Assume excavation with no rock. Backfill with bedding sand and native soil. Assume three 150mm conduits and one 63mm conduit per trench.	m	$250	1165	$291,250	460	$115,000
Cable jointing and haulage pits	Assume every 500m	ea	$1,000	8	$8,000	6	$6,000
Traffic management		m	$10	2330	$23,300	3250	$32,500
Reinstatement incl revegetation as required		m3	$40	1000	$40,000	1000	$40,000
Cabling works					$179,100		$247,500
11 kV 3c/400mm2 Al XLPE cable		m	$55	2330	$128,150	3250	$178,750
11 kV 3c/300mm2 Al XLPE cable		m	$45	0	$0		$0
11 kV 3c/185mm2 AL XLPE cable		m	$30	0	$0		$0
Throughjoints	Assume every 500m	ea	$1,000	4	$4,000	6	$6,000
Terminations		ea	$1,500	2	$3,000	2	$3,000
Conduit and marker tape	Assume conduit included in trenching and drilling rates	m	$15	0	$0	0	$0
Cable installation labour and plant		m	$15	2330	$34,950	3250	$48,750
Cable jointing labour and plant		ea	$1,000	6	$6,000	8	$8,000
HV Cables and connections Test & Commissioning	Allowance	ea	$3,000	1	$3,000	1	$3,000
Zone Substation Connection					$16,500	1	$16,500
11 kV feeder CB at Belconnen	Assume spare CBs available	ea	$100,000	0	$0	0	$0
11 kV Test & Commissioning	per CB	lot	$2,000	1	$2,000	1	$2,000
P&C equipment and cabling	per feeder panel	ea	$5,000	1	$5,000	1	$5,000
P&C Test & Commission	Allowance	ea	$2,500	1	$2,500	1	$2,500
DC Cabling	per switchgear panel/bay	ea	$5,000	1	$5,000	1	$5,000
DC Test & Commission	Allowance	ea	$2,000	1	$2,000	1	$2,000
SCADA					$15,650		$20,250
SCADA connections	per feeder CB and TPS	ea	$2,000	1	$2,000	1	$2,000
Fibre optic cable		m	$5	2330	$11,650	3250	$16,250
SCADA Test & Commission	Allowance	ea	$2,000	1	$2,000	1	$2,000
Indirect Costs					$115,000		$115,000
Development Application	Allowance	ea	$10,000	1	$10,000	1	$10,000
Contractor's Preliminaries, site establishment and disestablishment	Allowance	ea	$5,000	1	$5,000	1	$5,000
Project management and administration	Allowance	ea	$100,000	1	$100,000	1	$100,000
Stage Sub Total without overheads					**$1,411,100**		**$877,950**
Project Sub Total without overheads							**$2,289,050**
Overheads							
Overheads at average rate 27%	Allowance	27%			$380,997		$237,047
Stage Sub Total with overheads					**$1,792,097**		**$1,114,997**
Project Sub Total with overheads							**$2,907,094**
Contingency							
Contingency at 10%	Allowance	10%			$179,210		$111,500
Stage total wth all overheads and contingency					**$1,971,307**		**$1,226,496**
Project total with all overheads and contingency							**$3,197,803**

Appendix B – Financial Analysis

B.1 Capital Expenditure Cash Flow for Each Option

Financial Year	Option 1	Option 2	Option 3	Option 4
2019-20				
2020-21				
2021-22	$1,411,100	N/A	$1,669,684	$1,669,684
2022-23	$877,950		$1,411,100	$3,768,125
2023-24			$877,950	$3,768,125
2024-25				$3,768,125
2025-26				$3,768,125
2026-27				$3,768,125
2027-28				$3,768,125
2028-29				$3,768,125
2029-30				$3,768,125
2030-31				$3,768,125
2031-32				$3,768,125
2032-33				$3,768,125
2033-34				$3,768,125
2034-35				$3,768,125
2035-36				$3,768,125
2036-37				$3,768,125
2037-38				$3,768,125
2038-39				$3,768,125
Total Cost (20 years)	**$2,289,950**	**N/A**	**$3,958,734**	**$69,495,934**
2019-24 Regulatory Control Period Cost	**$2,289,950**	**N/A**	**$3,958,734**	**$12,974,059**

B2: 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 Belconnen 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 Belconnen Town Centre

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

Options:

One – Two new 11 kV feeders Belconnen Zone Substation to Belconnen Town Centre.
Three – Defer Option 1 with grid battery.
Four – Grid battery only.

RESULTS (Average over 50 simulations):

Option:	One	Three	Four
NPC (2019-2024)	-$2,030,841	-$3,502,990	-$12,954,611
NPC (2019-2039)	-$2,223,058	-$3,696,207	-$37,414,699
Network Option total Capital Cost	$2,289,050	$2,289,050	-
Option Capital Cost (2019-2024)	$2,289,050	$3,958,854	$12,974,059
Option Capital Cost (2019-2039)	$2,289,050	$3,958,854	$69,495,934

Unserved Energy:

The following table estimates the volume of unserved energy (USE) in kWh under the Do Nothing scenario.

Feeder	USE Exceeding	FY 18/19	FY 19/20	FY 20/21	FY 21/22	FY 22/23	FY 23/24
Aikman	Firm	0	0	0	0	0	0
	Thermal	0	0	0	0	0	0
Benjamin	Firm	0	0	33	33	33	33
	Thermal	0	0	727	727	727	727
CAE1	Firm	0	0	1	1	1	1
	Thermal	0	0	2,575	2,575	2,575	2,575
CAE2	Firm	0	0	0	0	0	0
	Thermal	0	0	0	0	0	0
Cameron South	Firm	0	0	0	0	0	6
	Thermal	0	0	0	0	0	41
Cameron North	Firm	0	0	0	0	0	0
	Thermal	0	0	0	0	0	0
Chan	Firm	0	0	2	2	2	2
	Thermal	0	0	0	0	0	0
Fielder	Firm	0	0	0	6	26	81
	Thermal	0	0	0	1,004	11,099	99,215
Joy-Cummings	Firm	0	4	4	4	4	4
	Thermal	0	0	0	0	0	0
Emu bank	Firm	0	0	0	0	0	0
	Thermal	0	0	0	0	0	0
	Total USE	**0**	**4**	**3,342**	**4,351**	**14,467**	**102,684**
	Value of USE	**$0**	**$108**	**$90,000**	**$117,172**	**$658,896**	**$2,765,280**
	Value of USE (V	**$3**	**$142**	**$125,669**	**$163,620**	**$544,022**	**$3,861,385**

Notes:

The amount of load and duration above the firm rating of each existing feeder has been calculated using the actual historical load profile curve for each feeder plus the expected load profile curves of forecast new loads. New loads have been allocated to existing feeders where possible in the most optimal manner to utilise available spare capacity and minimise unserved energy. It is not always possible to utilise available spare capacity because the geographical location of some new loads do not match the geographical location of existing feeders and it is not cost effective to extend such feeders.

Unserved energy = (load above feeder firm rating x probability of an outage occurring at the time of such exceedance x outage duration) + all load above feeder thermal rating (ie when the load exceeds the thermal rating of the feeder, all such energy is assumed to be unserved).

Value of Unserved Energy assumes:

- Value of Customer Reliability = $26.93/kWh. This is the figure published by AEMO in 2014 for Residential Customers. This is a very conservative figure to use as approximately 30% of load in the Belconnen Town Centre area is supplied to Business Customers – AEMO's published VCR for this category of customer is $44.72/kWh.
- CPI = 2% pa.
- Probability of failure of supply to a customer = 6% (= 3% probability of zone transformer failure + 3% probability of feeder failure).
- Probability of failure in any given hour = 6% / (24 x 365).
- Outage duration = 8 hours. This is a conservative figure as cable faults can often take longer than 8 hours to locate and repair.

- Value of unserved energy = Volume of unserved energy x VCR.
- All energy above the thermal rating is not served. This is equivalent to assuming a 100% outage probability for energy above this level.

At the time of investment the value of unserved energy exceeds the annualised cost of this proposed augmentation, so the proposed new feeders to Belconnen Town Centre are considered to be economically justified.

In addition to the value of unserved energy, there are litigation, reputational and other financial risks to be added to the overall risk cost as follows:

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
= Value of unserved energy + $120,000 / event.

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