Ensuring reliability requirements in the Flemington load area

NOTICE ON SCREENING FOR NON-NETWORK OPTIONS REPORT

MAY 2018

Ausgrid

Addressing reliability requirements in the Flemington substation load area

Notice on screening for non-network options – May 2018

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1 Introduction

The suburb of Lidcombe is located at the western end of the Inner West area of Sydney. The suburb and surrounding area is served by the Flemington 132/11kV zone substation, which was first commissioned in 1973. A critical component in the Flemington zone substation is the 11kV switchgear, of which there are two types: compound insulated and air insulated. Compound insulated switchgear exhibits failures that have led to consequences ranging from simple equipment failures to large fires where entire switch rooms were burnt down. Although a range of measures have been implemented to mitigate these consequences, 11kV switchgear themselves are beyond its design life with continued service resulting in continuing condition deterioration. Consequently, Ausgrid has prioritized the retirement and replacement of compound insulated switchgear across the network.

The main issue for the Flemington zone substation relate to asset condition and safety concerns stemming from obsolete compound filled switchgear that if left unaddressed are likely to become less reliable, which could expose customers in the Flemington load area to a supply risk that exceeds allowable levels under the applicable reliability standards. Ausgrid considers that reliability correction action is required for the Flemington zone substation to comply with its electricity distribution license reliability and performance standards.

Rule changes to the National Electricity Rules (NER) in July 2017 has meant that replacement capital expenditure, such as the one proposed in this DPAR, is now subject to the Regulatory Investment Test for Distribution (RIT-D). Accordingly, Ausgrid has initiated this RIT-D for the Flemington zone substation project in order to identify a preferred option that would ensure Ausgrid is able to satisfy its reliability and performance standards in supplying the Flemington zone substation load area.

A discussion of asset conditions and the identified need can be found in the Draft Project Assessment Report (DPAR) for addressing reliability requirements in the Flemington zone substation.

This notice has been prepared under cl. 5.17.4(d) of the NER and summarises Ausgrid’s determination that no non-network option is, or forms a significant part of, any potential credible option for this RIT-D. In particular, it sets out the reasons for Ausgrid’s determination, including the methodologies and assumptions used.

2 Forecast load and capacity

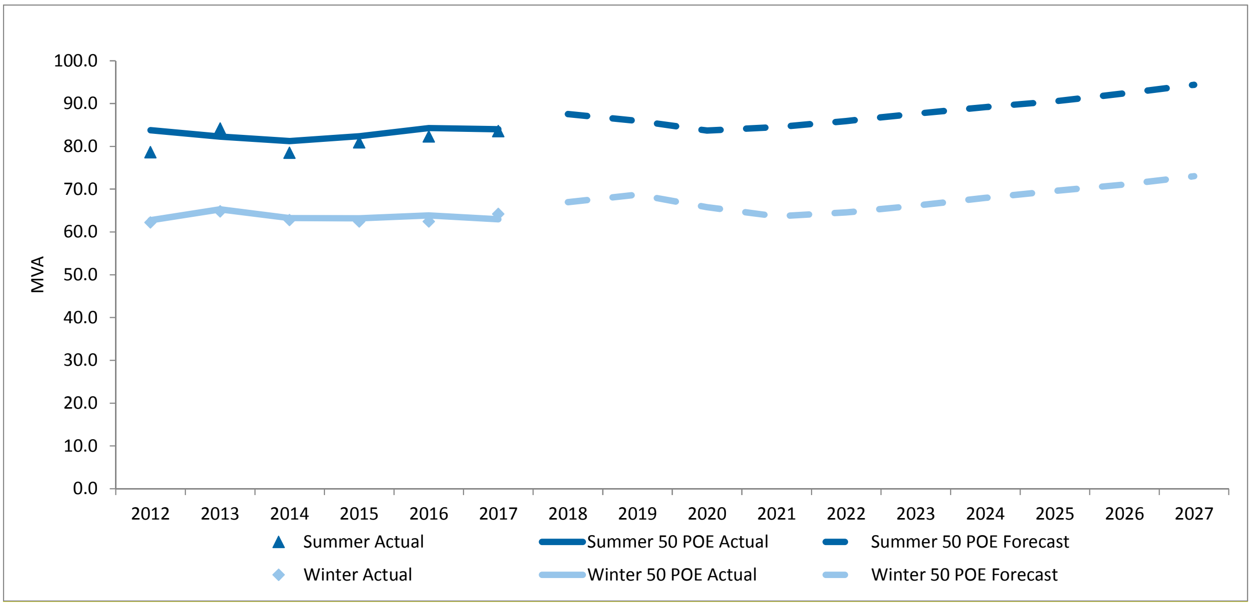
2.1 Load forecast

Figure 1 below shows the historical actual demand, the 50% Probability of Exceedance level (50 POE) weather corrected historical actual demand and the 50 POE forecast demand for both winter and summer for Flemington zone substation.

The Flemington zone substation has a total capacity of 152.4 MVA and a firm capacity of 98.7 MVA. In 2016/17, the maximum demand on the zone substation was 83.5 MVA at 2:45pm AEDT on 10 February 2017. The weather corrected demand at the 50 POE level was 84.0 MVA. The power factor at the time of summer maximum demand was 0.95.

The 50 POE forecast 7 years compound annual growth rate (CAGR) to 2023/24 for maximum demand is 0.86% for summer and 1.10% for winter.

Figure 1 – Maximum demand forecast at Flemington zone substation



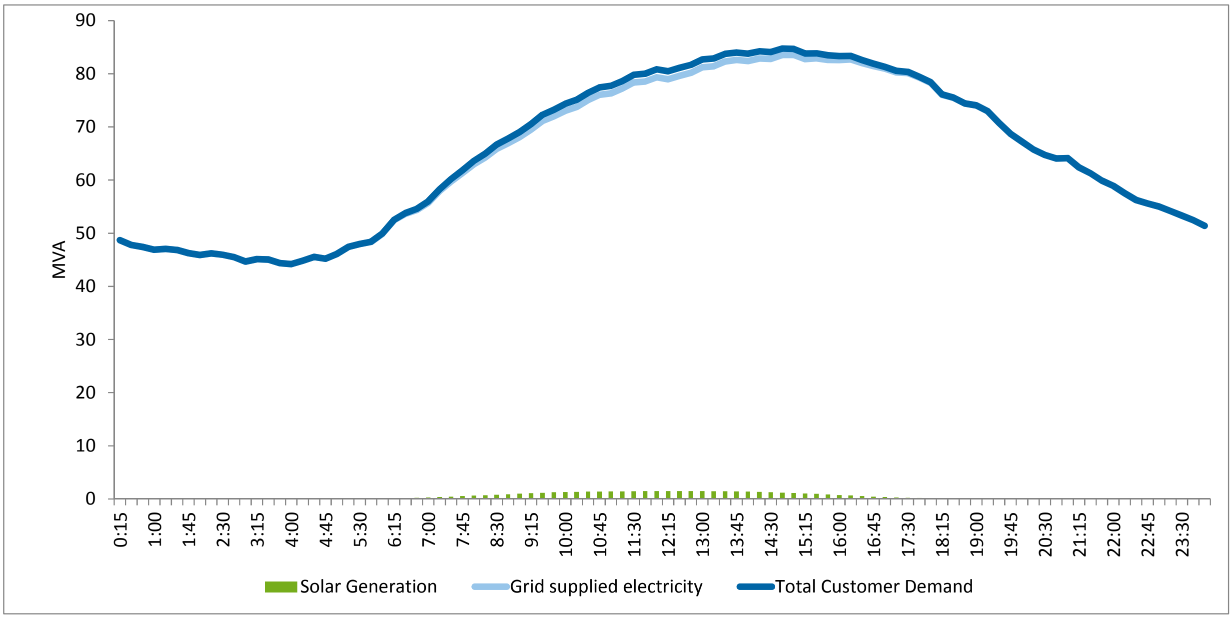
2.2 Pattern of use

Summer peak electricity demand at Flemington zone substation occurs on hotter days driven predominantly by commercial loads.

Over the past 7 years, and where peak annual demand occurs in summer, the time of peak has typically occurred between 1:00pm and 4:15pm AEDT. As noted above, the most recent summer maximum demand occurred at 2:45pm AEDT.

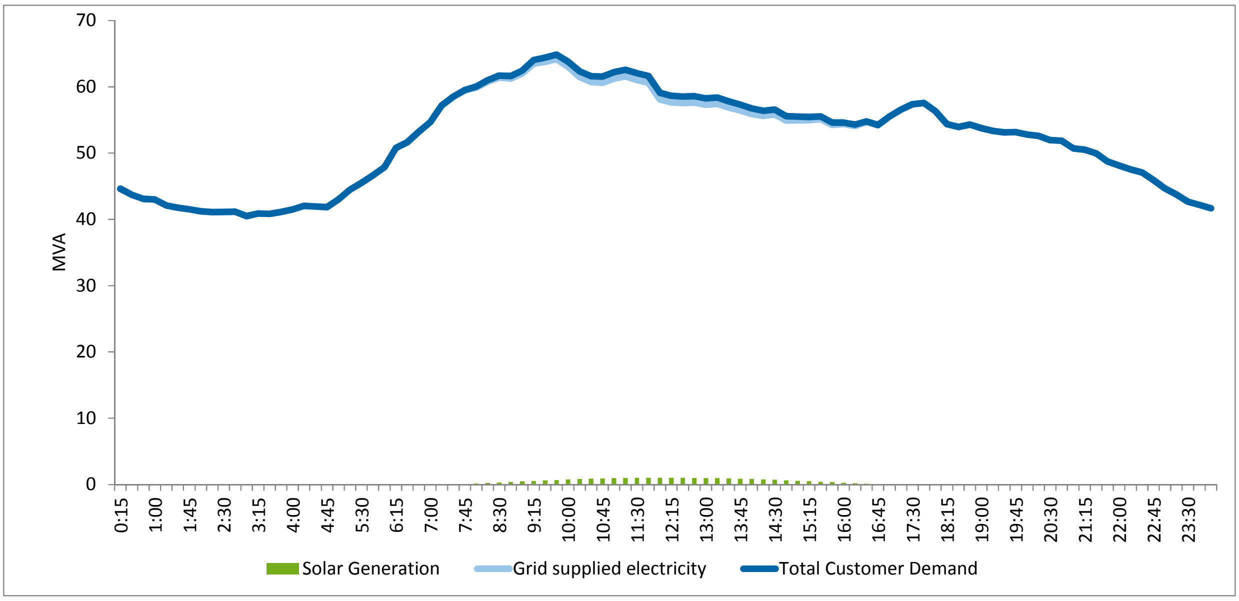
There is a total capacity of about 2.3 MW of solar PV connected to the zone substation. At the peak time on 10 February 2017, these PV systems supplied about 1.2 MW of the customer load. Figure 2 below shows the load profile for the 10 February 2017 maximum demand day including the contribution from customer installed solar power systems.

Figure 2 – Summer maximum demand profile at Flemington zone substation (10 February 2017)



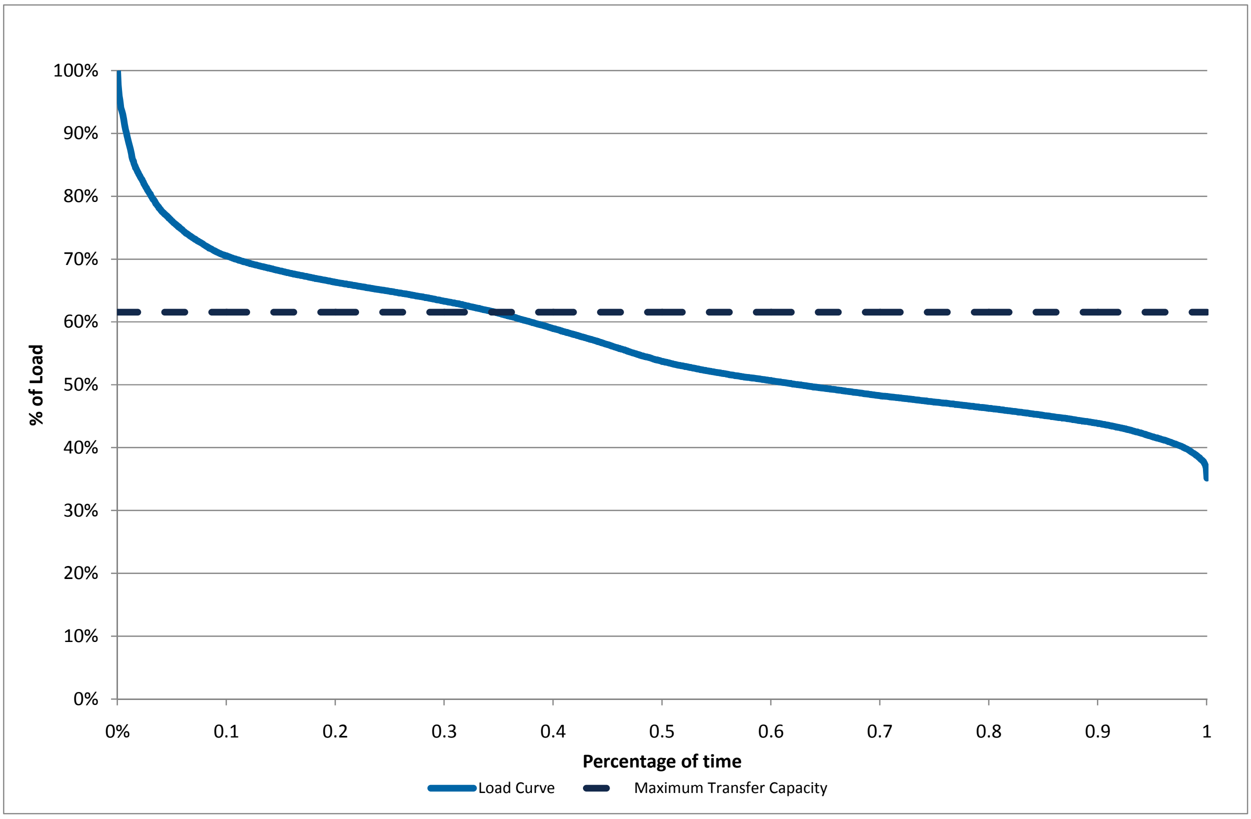
Winter peak electricity demand at Flemington zone substation typically occurs in the early morning. Over the past 7 years, the time of winter peak has typically occurred between 9:15 am and 2:45pm AEST. Figure 3 below shows the load profile for the 5 July 2016 peak demand day including the contribution from customer installed solar power systems.

Figure 3 – Winter maximum demand profile at Flemington zone substation (5 July 2016)



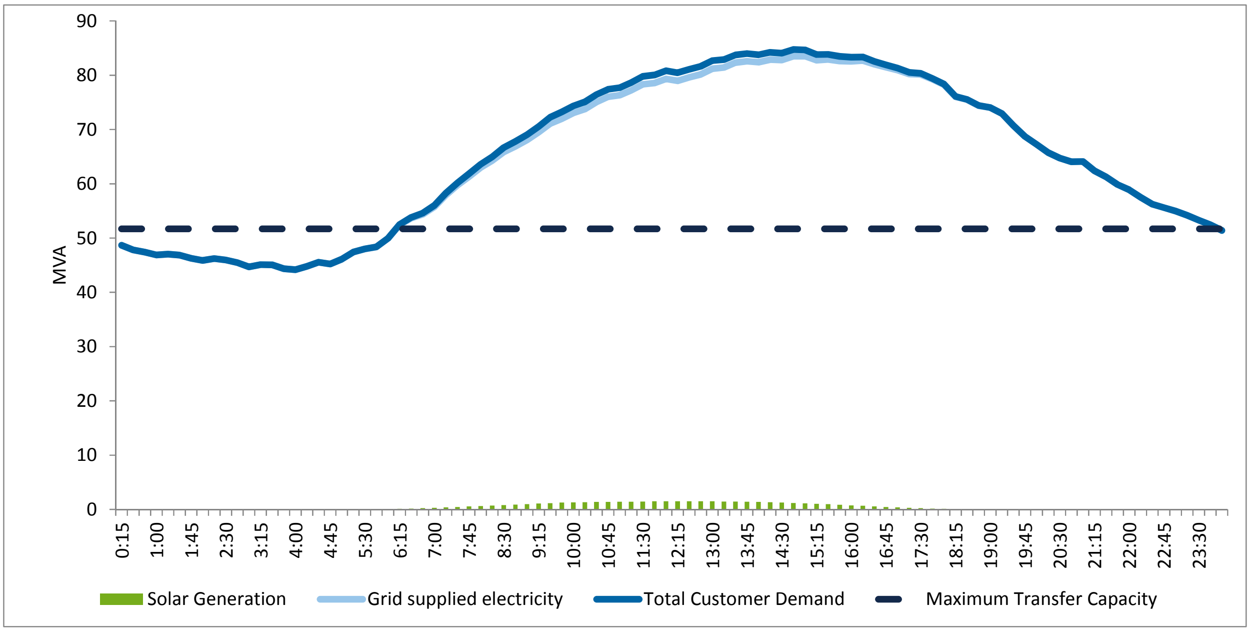
The Flemington zone substation has a current load transfer capacity of 51.7 MVA or about 61.9% of the most recent actual maximum summer demand and 80.6% of most recent actual maximum winter demand. Based upon the data period from May 2016 to April 2017, electricity demand for Flemington zone substation exceeds the transfer capacity for about 256 days and 2,949 hours per year (33.7% of total hours). Over this period there is a total of about 18,644MWh of energy above the transfer transport from Flemington zone substation. The load duration curve for the period from May 2016 to April 2017, noting the transfer capacity, is shown below in Figure 4.

Figure 4 – Flemington Zone Substation Load Duration Curve (May 2016 to April 2017)



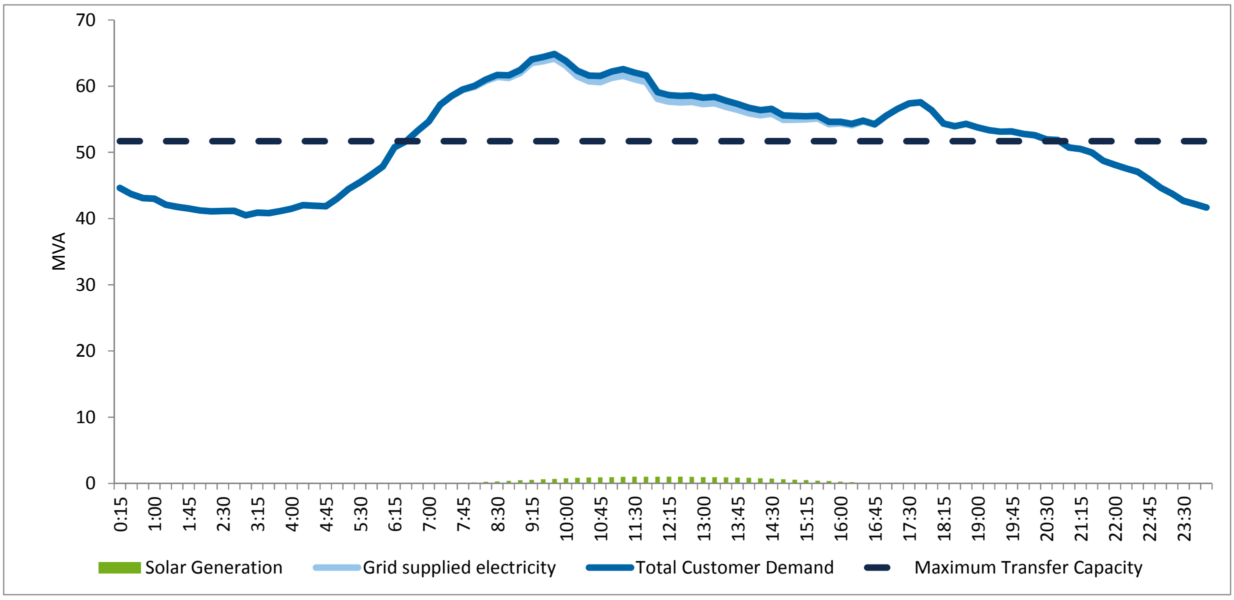
In the event of a network outage on a maximum summer peak demand day, after use of the maximum transfer capacity in an emergency switching of the network, there is a shortfall of network supply from 6:15am to 11:45pm. The maximum shortfall in network supply on 10 February 2017 would have been 31.8 MVA at peak time. See Figure 5 below.

Figure 5 – Summer maximum demand profile at Flemington zone substation with maximum load transfer



Similarly for a winter peak demand day, the shortfall in network supply would be from 6:45am to 8:45pm. The maximum shortfall in network supply on 5 July 2016 would have been 12.5 MVA at peak time. See Figure 6 below.

Figure 6 – Winter maximum demand profile at Flemington zone substation with maximum load transfer



2.3 Customer characteristics

Flemington zone substation serves a mixture of residential and non-residential customers with over 87.0% of annual electricity consumption from non-residential customers. A breakdown of the customer characteristics for the 2016/17 period is as follows:

Table 1 – Customer characteristics – Flemington

Item	Residential	Small Non-Residential	Large Non-Residential	Total
Number of Customers	10,945	1,495	208	12,648
% of Customers	87%	12%	2%	
Annual Consumption (MWh)	49,732	43,919	288,404	382,055
% of Annual Consumption	13.0%	11.5%	75.5%	
Number of Solar Customers	467	41	9	517
Average Annual Consumption (MWh per customer)	4.5	29	1,387	

About 31% of residential customers live in detached homes with an average usage of about 6.7 MWh per year. Households living in apartments, townhouses and flats have an average usage of about 3.6 MWh per year.

2.4 Key assumptions underpinning the identified need

The need to undertake action is predicated on the deteriorating condition of assets at the Flemington zone substation, and the characteristics of any resultant outages, as well as the fact that maintaining technologies present heightened maintenance and asset failure risks.

This section summarises the key assumptions underpinning the identified need for this RIT-D. Section 3 provides additional detail on assumptions used, and methodologies applied, to estimate the costs and market benefits as part of this RIT-D.

The key assumption underpinning this RIT-D project is that the condition of the 11kV switchgear at Flemington zone substation is such that there is a significant risk of Ausgrid not being able to maintain its required levels of reliability.

There are two types of switchgear installed in the Flemington zone substation: compound insulated and air insulated switchgear. While the air insulated switchgear appears to be in good condition, compound insulated switchgear has bituminous compound insulation busbars (switchboard) and oil-filled circuit breakers, which may result in significant consequential damage in the event of failure. A range of measures have been implemented to mitigate risks presented by compound insulated switchgear, however the switchgear itself is considered to be beyond its design life.

In the past, there have been a considerable amount of 11kV switchgear failures which have resulted in a range of adverse consequences from single equipment failures to multiple equipment failures impacting on the operation of the entire sub-station. Consequently, Ausgrid has assumed that aging assets (i.e. compound insulated switchgear) at the Flemington zone substation have an increasing likelihood of failure and involuntary load shedding.

2.5 Load transfer capacity and supply restoration

Flemington zone substation load area is classified as urban and has potential 11kV interconnection with Homebush Bay, Auburn, Lidcombe, Croydon and Burwood zone substations. In the event of a total loss of supply to Flemington zone substation, approximately 51.7MVA of peak load can be recovered within days via the load transfer capacity of the existing network.

In the event of an equipment outage, the network may be returned to a normal configuration by one of the following actions:

- repairing the failed equipment
- initiating a contingency plan
- replacing the failed equipment with spares.

The assumed supply restoration actions and the time taken to implement the action are detailed in the Table 2 below. These actions are the most likely actions for the contingencies considered in this planning study.

Table 2: Equipment outage assumptions

Equipment outage	Action	Outage duration (Days)
Transformer/Feeder Panel	Time between failure and access	1
	Time to undertake causal analysis	1
	Time to engineer solution (T&D Engineering)	1
	Time to manufacturer/repair engineered solution	6
	Time to implement engineered solution	6
	Ancillary Work - testing etc.	2
	Total - MAJOR FAILURE	**17**
	Total - MINOR FAILURE	**8.5**

3 Proposed preferred network option

Ausgrid has elected to assess three alternative future scenarios – namely:

- Low benefit scenario - Ausgrid has adopted several assumptions that give rise to a lower bound NPV estimate for each credible option, in order to represent a conservative future state of the world with respect to potential market benefits that could be realised under each credible option;
- Baseline scenario - the baseline scenario consists of assumptions that reflect Ausgrid's central set of variable estimates, which, in Ausgrid's opinion, provides the most likely scenario; and
- High benefit scenario - this scenario reflects an optimistic set of assumptions, which have been selected to investigate an upper bound on reasonably expected potential market benefits.

A summary of each scenario and the sets of variable values adopted are presented in Table 3 below.

Table 3 – Summary of the three scenarios investigated

Variable	Baseline scenario	Low benefits scenario	High benefits scenario
Capital cost	100 per cent of capital cost estimate	125 per cent of capital cost estimate	75 per cent of capital cost estimate
Unplanned corrective maintenance cost	100 per cent of baseline corrective maintenance cost estimates	70 per cent of baseline corrective maintenance cost estimates	130 per cent of baseline corrective maintenance cost estimates
Demand	POE50	POE90	POE10
VCR	$40/kWh	$23/kWh	$90/kWh
Discount rate	6.13 per cent	8.07 per cent	4.19 per cent

Preferred option at this draft stage

Details of the network options considered can be found in Ausgrid's Draft Project Assessment Report. After options analysis only one credible option was identified which involves transfer works for load served by Group 1 switchgear and transformer relocation works. In particular, the scope of works of the preferred option consists of:

- installation of two sets of six conduit banks from Olympic Park zone substation through Sarah Durack Ave and Edwin Flack Ave to the corner of Shane Gould Ave to allow for the laying of ten new 11kV feeders;
- installation of a new 11kV feeder from Olympic Park zone substation to Figtree Drive through Australia Ave utilising a proposed conduit;
- transfer of Flemington zone substation 11kV switchgear Group 1 (approximately 42MVA) to Olympic Park zone substation and Auburn zone substation via the works above;
- decommissioning of existing Group 2 switchgear at Flemington zone substation;
- decommissioning Transformer 1 at Flemington zone substation;
- decommissioning Transformer 2 at Flemington zone substation and replacing it with Transformer 3 by physically relocating Transformer 3 to transformer bay number 2, and connecting Transformer 3 to 11kV switchgear Group 2;
- replacing Transformer 4 at Flemington zone substation with Clovelly zone substation Transformer 1 and connect it to 11kV switchgear Group 2.[1]

Construction of the preferred option is scheduled to occur during 2018/19, with commissioning in 2019/20 at which point benefits from unserved energy and lower operating costs will start to accrue. Ausgrid estimates undiscounted capital costs are $8.0 million. Incremental operating costs (i.e. maintenance cost) for the preferred option is assumed to be minimal given that it is expected new duct banks would incur immaterial levels of maintenance over the 20-year analysis period.

[1] The replacement and relocation of these two transformers serves a different need from the project presented in this DPAR. However, Ausgrid considers undertaking the proposed project and address transformer asset conditions concurrently is the most efficient use of project planning and delivery resources.

4 Assessment of non-network options

4.1 Required demand management characteristics

A viable demand management solution must be capable of reducing the load on Flemington zone substation sufficiently to retain supply to customers over the required time for restoration of supply in the event of an unplanned equipment failure. This reduction in supply can be permanent or temporary but must:

- offer support in both summer and winter and other times of the year,
- align with the load profiles after emergency load transfer and
- be cost effective in comparison with the preferred network alternative.

Due to the scale of the shortfall in electricity supply one third of the year, we consider that a combination of permanent and temporary demand reductions would offer the most plausible scenario for a possible cost effective non-network alternative. Refer to Section 2 for details on the load profiles, demand forecasts, emergency load transfer capacities and customer characteristics.

A detailed assessment of the load profile for Flemington zone substation over the May 2016 to April 2017 period shows that the shortfall in supply after emergency load transfers have been implemented is significant. Refer to Table 4 below for details on the network support requirements for the years from 2019/20 to 2021/22.

Table 4 – Network support required at Flemington zone substation

Year	Days/ year	Hours/ year	Maximum demand (MW)	Daily suppy shortfall after transfer capacity (MWh/day)			Total MWh per year
				Min.	Max.	Average	
2019/20	256	2,894	32	0	340	70	18,000
2020/21	256	3,022	33	0	350	77	19,600
2021/22	260	3,216	34	0	370	87	22,700

To be considered a feasible option, any demand management solution must be technically feasible, commercially feasible; and able to be implemented in sufficient time to satisfy the identified need in 2019/20 and/or 2021/22 for deferral of the network investment.

4.2 Demand management value

Ausgrid has assessed potential demand management options to achieve the required demand reduction to make the project deferral technically and economically viable. Table 5 indicates the available funds that can be spent to achieve a 1, 2, 3 year deferral of network option expressed both as an overall cost and on a $/MWh basis.

We have expressed the available funds on an energy basis as the demand management support is principally related to the risks of involuntary customer load shedding due to an unplanned equipment failure and the value of unserved energy associated with this failure rather than a shortfall in peak demand capacity.

Table 5 – Funds available for demand management

Deferral benefits	Average % Total risk reduction per year	Available funds in 2021/22,2022/2023, & 2023/2024	Peak Load Reduction required (MW) per year	Total MWh in 2021/22,2022/2023, & 2023/2024	Available $ per MWh
1 yr deferral	47%	$51,150	33	18,000	$2.8
2 yr deferral	47%	$42,900	33	19,600	$2.2
3 yr deferral	49%	$43,750	35	22,700	$1.9

4.3 Demand management options considered

Ausgrid has considered a number of demand management technologies to determine their commercial and technical feasibility to assist with the identified need at the Flemington zone substation. Each of the demand management technologies considered is summarised below.

4.3.1 Customer power factor correction

While this option is technically feasible and offers permanent reductions sufficient to cover the large number of unmet load hours, there are many customers on a kVA demand tariff supplied from Flemington zone substations. Of the 12,648 customers connected to Flemington zone substation, only 208 are on a kVA demand tariff. Analysis of customer interval data indicates a technical potential of only about 2.3 MVA. Commercial potential is likely to range from 1.5 to 1.9 MVA. At a likely cost of about $25-50 per kVA, this solution is likely to be cost effective, but is estimated to contribute less than 6.4% of the requirement.

4.3.2 Customer solar power systems

While this option is technically feasible and offers permanent reductions, solar power systems are not estimated to offer a material reduction in grid supplied demand during the period when there is a shortfall in grid supply.

Analysis of interval data for Flemington zone substation show that solar generation is greater than about 30% of maximum panel capacity for 69% of unmet load hours in winter, 81% of unmet load hours in summer and about 77% of overall unmet load hours. This is principally due to the early afternoon time of peak in summer and in winter.

At present there are 1.5MW of solar connected to Flemington zone substation. A 300% increase in installed solar power systems above the current projected trend (75% additional) is estimated to contribute only about 11% of the network support requirement. There is no indication that a material share of the unmet load could be reduced through an increase in the take-up of new solar power systems in the area.

4.3.3 Customer energy efficiency

While this option is technically feasible and offers permanent reductions, improvements to customer energy efficiency are not estimated to offer a sufficiently cost efficient alternative, nor potentially a sufficiently material reduction in grid supplied demand during the period when there is a shortfall in grid supply. Assuming modest incentives of 10-15% of customer investment cost could encourage customers to install a greater scale of energy efficiency improvements than would otherwise occur, we estimate an average cost of about $1000-2000 per MWh depending upon the level of additionality and coincidence with the demand shortfall. At about 4 to 8 times the available funds, this solution is not likely to offer a cost competitive alternative.

4.3.4 Demand response (curtailment of load)

Customer curtailment of load is a common and effective technique for deferring network investment where the need is for short time periods and few days but has not been shown to be viable for the extensive hours and consecutive days of network support required for the network issue at Flemington zone substation.

Large customer demand response has historically been priced at $75-150 per kVA for 20-60 hours of dispatch per season while residential air conditioner demand response has been shown to be acceptable to small customers at incentive payment levels of about $150 to $250 per kVA for 20-30 hours of dispatch per season (excluding acquisition costs). Considering the costs of acquisition and requirement for support in two seasons each year, we would estimate the average cost for demand response to be about $2000 to $3000 per MWh for large customer demand response and greater than $5000 per MWh for small customer demand response. At a cost many times the available funds, this solution is not likely to offer a cost competitive alternative.

4.3.5 Dispatchable generation

Dispatchable generation is another common and effective technique for deferring network investment where the need is for short time periods and few days but has not been shown to be viable for the extensive hours and consecutive days of network support required for the network issue at Flemington zone substation.

Large customer dispatchable generation has historically been priced at $50-150 per kVA for 20-60 hours of dispatch per season. Considering the costs of acquisition and requirement for support in two seasons each year, we would estimate the average cost for this form of demand response to be well in excess of the available funds. Furthermore, as this solution commonly sources existing standby diesel generators; environmental compliance issues are likely to constrain the number of available operating hours.

4.3.6 Large customer energy storage

While this option is technically feasible and offers a viable form of demand response, current and near term pricing of commercial scale battery storage solutions are unlikely to result in a material take-up of these systems by large customers. Recent surveys by Ausgrid of medium and large customers on issues related to investments in solar power, battery storage and energy efficiency has shown that these customers expect a return on investment which is not projected to be available for some time.

5 Conclusion

Based on the demand management options considered in Section 4, it is not considered possible that sufficient demand management measures could be feasibly implemented to achieve the required demand reduction to make project deferral technically and economically viable.

Consequently, a Non-Network Options Report has not been prepared in accordance with rule 5.17.4(c) of the National Electricity Rules as we determine that no non-network option is, or forms a significant part of, any potential credible option for this RIT-D.

Ausgrid