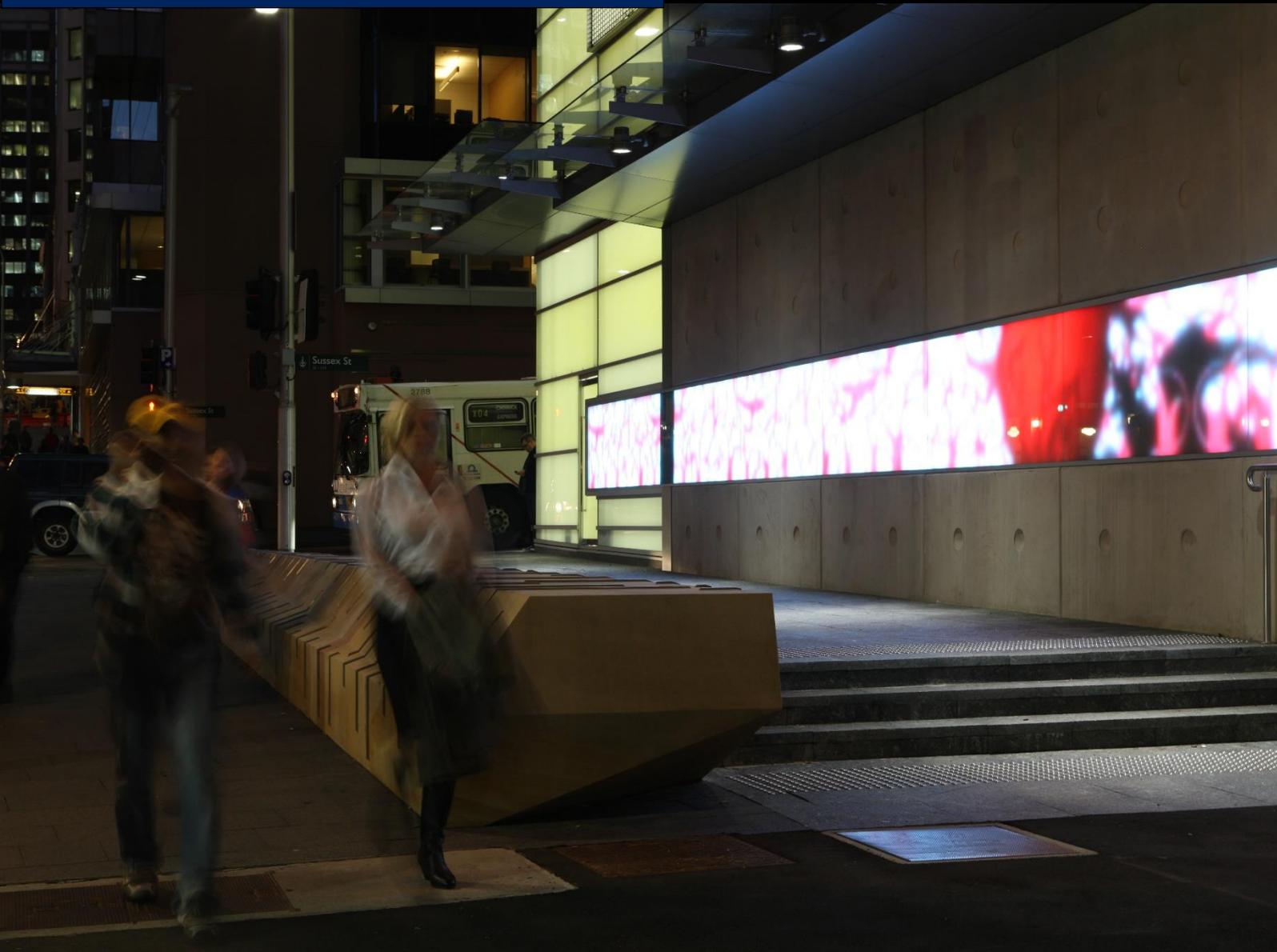


Network Investment Committed Projects, 2020



Committed projects in 2020

1. Committed network investments

Ausgrid has identified all committed refurbishment or replacement investments with an estimated capital cost of \$2 million or more. Capital cost estimates are shown in nominal dollars and excludes contingency costs.

1.1. Refurbishment, replacement or augmentations – Distribution

Load Area	Committed Refurbishment or Replacement Investment – Distribution	Expected Project Completion	Estimated Cost (nominal \$m)
Camperdown and Blackwattle Bay	Convert Blackwattle Bay load from 5kV to 11kV and load transfer and retire 33/5kV Blackwattle Bay ZS	May-22	16.5
Inner West	11kV Load Transfer to enable retirement of Flemington ZS 11kV switchgear Group 1	Nov-20	7.5
Canterbury - Bankstown	New 132/11kV Greenacre ZS & decommission Greenacre Park ZS	Nov-20	29.7
Eastern Suburbs	Matraville ZS 11kV switchgear Groups 1, 2 and 4 replacement	Feb-21	14.2
Eastern Suburbs	Surry Hills ZS 11kV switchgear replacement	Jul-22	18.1
Eastern Suburbs	Decommission Darlinghurst 33/11kV ZS – Stage 1	Mar-22	3.9
Inner West	Lidcombe 33/11kV ZS 11kV switchgear Group 2 replacement	Oct-21	6.7
Inner West	Decommission 132/33kV Strathfield STS	Apr-21	9.3
Inner West	New Summer Hill 33/11kV ZS and associated 33kV feeders and decommission Dulwich Hill 33/11kV ZS	Feb-21	40.9
Inner West	Rozelle STS new 33kV switchgear	Mar-22	22.7
Inner West	Replace 33kV feeders – Homebush STS to Lidcombe ZS and Auburn ZS	Jul-23	31.3
Lower North Shore	Willoughby to Mosman 132kV Feeders Replacement	Feb-21	35.4
Newcastle Ports	Waratah 132/33kV STS refurbishment	Jun-22	17.0
St George	Peakhurst STS 33kV switchgear replacement	Jun-22	25.0
Sydney CBD	11kV Load Transfers from Dalley St ZS to City North ZS	Jun-21	18.9
Eastern Suburbs	Ensuring reliable supply for the Sydney Airport network area	Jan-24	8.6
Port Stephens	Stockton ZS 11kV switchgear replacement	Jul-21	5.5
Upper Hunter	Muswellbrook ZS Refurbishment	Dec-21	3.3
Upper Hunter	Muswellbrook STS Refurbishment	Dec-21	5.6

1.1.1 Convert Blackwattle Bay load from 5kV to 11kV and load transfers and retire Blackwattle Bay ZS

Key project milestones:

- Project initiated in November 2015.
- Project expenditure authorised by Ausgrid Board in June 2017.
- Project completion is expected by May 2022.

Options Analysis

Three network options were considered to resolve the above issues:

Option 1 - Commission the 4th transformer at Camperdown zone substation and transfer Blackwattle Bay load to Camperdown zone substation

This option involves:

- 2016/17 – Surry Hills to Camperdown zone substation 11kV load transfer to facilitate 11kV switchgear replacement at Surry Hills zone substation;
- 2017 – Commission the 4th transformer and associated 33kV feeder and install 11kV switchgear at Camperdown zone substation;
- 2018 – Convert Blackwattle Bay zone substation load from 5kV to 11kV and transfer load to Camperdown zone substation; and
- Three minor 11kV load transfer projects post 2028.

The total Net Present Cost (NPC) of this option is \$19.0 million.

Option 2 - Transfer Blackwattle Bay load to Camperdown and Darling Harbour zone substations

This option involves:

- 2016/17 – Surry Hills to Campbell St zone substation 11kV load transfer to facilitate 11kV switchgear replacement at Surry Hills zone substation;
- 2018 – Convert Blackwattle Bay zone substation load from 5kV to 11kV and transfer to Camperdown and Darling Harbour zone substations;
- 2022 - Commission the 4th transformer and associated 33kV feeder and install 11kV switchgear at Camperdown zone substation;
- 2022 – 10MVA 11kV load transfer Darling Harbour to Camperdown zone substation; and
- Three minor 11kV load transfer projects post 2027.

The total NPC of this option is \$20.2 million.

Option 3 – Transfer Camperdown load to Leichhardt zone substation and transfer Blackwattle Bay load to Camperdown and Darling Harbour zone substations

This option involves:

- 2016/17 – Surry Hills to Camperdown zone substation 11kV load transfer to facilitate 11kV switchgear replacement at Surry Hills zone substation;
- 2018 – 8MVA load transfer from Camperdown to Leichhardt zone substation via switching;
- 2018 – Convert Blackwattle Bay zone substation load from 5kV to 11kV and transfer load to Camperdown and Darling Harbour zone substations;
- 2020 – 4MVA 11kV load transfer from Darling Harbour to Camperdown zone substation;
- 2023 - Commission the 4th transformer and associated 33kV feeder and install 11kV switchgear at Camperdown zone substation;
- 2023 – 8MVA 11kV load transfer Darling Harbour to Camperdown zone substation; and
- Three minor 11kV load transfer projects post 2027.

The total NPC of this option is \$19.8 million.

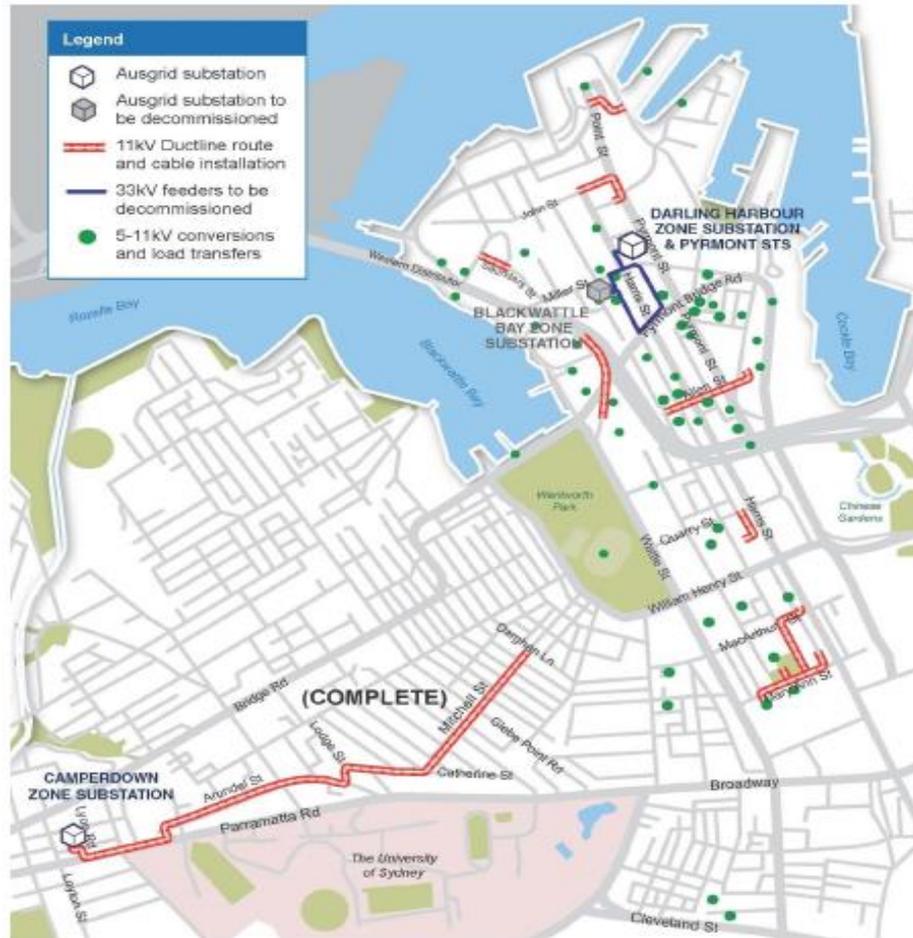
Given the low deferral value available for reducing demand and the scale of load reduction required it was determined that non-network options could not form part of a credible option for this replacement investment.

The NPC results of the network options are considered equivalent given the accuracy of planning estimates. Option 3 is the recommended solution because it provides greater flexibility to address future growth in the Blackwattle Bay area, as several commercial and residential developments are likely to occur. In addition, it defers the need for the additional transformer at Camperdown zone substation until 2023.

The project was approved by Ausgrid Board on 20/06/2017, at a total cost of \$18.1 million (\$16.5 million excluding contingency).

The original completion date of the 11kV load transfers was September 2018, with decommissioning of Blackwattle Bay 33/5kV zone substation targeted for March 2019. Project complexities associated with staging/planning customer outages, night works and increased cable testing requirements have led to extend the project construction timeframe.

Geographical view of works required in Blackwattle Bay project



1.1.2 11kV Load Transfers to enable retirement of Flemington ZS 11kV switchgear Group 1

Key project milestones:

- Project initiated in June 2017.
- Project expenditure authorised by Ausgrid Chief Executive Officer in August 2018.
- Project completion is expected by November 2020.

Options Analysis

The 11kV switchgear at Flemington zone substation consists of both compound and air insulated types. Group 1 of 11kV switchgear at Flemington ZS uses bituminous compound insulation busbars (switchboard) and oil-filled circuit breakers. The presence of both oil and insulating compound creates a heightened fire risk in the event of failure and therefore this is regarded as obsolete technology. Three options have been considered to address issues with Flemington zone substation:

Option 1 – Refurbishment of Flemington Zone Substation

This option involves refurbishing Flemington zone substation, utilising the existing switchroom building. The 11kV loads would need to be transferred to other zone substations to allow the refurbishment work to take place.

The Net Present Cost of this option is \$23.6 million.

Option 2 – Retirement of compound-filled 11kV switchgear at Flemington zone substation and replacement of Transformer 4

This option proposes the transfer of all Group 1 load at Flemington zone substation (approximately 42MVA) to adjacent Olympic Park zone substation and Auburn zone substation. Flemington zone substation 11kV switchgear Group 2 is to remain in operation and Tx3 will continue to be used in service but be physically moved to Flemington Tx2 bay, while Tx4 is to be replaced by a transformer made surplus by the reconfiguration of Clovelly zone substation.

The Net Present Cost of this option is \$7.7 million.

Option 3 – Replacement of Flemington compound-filled 11kV switchgear and Transformers 2 and 4

This option involves replacement of compound filled 11kV switchgear and transformers 2 and 4, using a new switchroom. 11kV loads will need to be transferred to other zone substations to enable these replacements.

The Net Present Cost of this option is \$17.5 million.

The preferred option is Option 1 as it is the least cost option. Options 2 and 3 were considered but not progressed, because their costs are significantly higher than Option 1 and do not provide a corresponding increase in benefits. A RIT-D assessment was completed for this project in 2018.

The project was approved by the Chief Executive Officer on 21/08/2018, at a total cost of \$9.4 million (\$7.5 million excluding contingency).

1.1.3 New 132/11kV Greenacre Park ZS and decommission zone substation

Key project milestones:

- Project initiated in November 2013.
- Project expenditure authorised by Ausgrid Board in June 2017.
- Project completion is expected by November 2020.

Options Analysis

Nine options were investigated in detail. These options were costed using high level estimates following completion of concept drawings, development of staging and identification of risks.

Option Description	Cost
1 New Greenacre Zone (2x50MVA and 3x132kV bus sections)	\$33.6M
2 Brownfield 11kV Switchgear + Greenfield Indoor 132kV GIS and new transformers	\$59.9M
3 Brownfield 11kV Switchgear + Greenfield Outdoor 132kV GIS and new transformers	\$56.1M
4 Brownfield using out 132kV Hybrid GIS and new transformers	\$50.8M
5 Brownfield using out 132kV Hybrid GIS using existing transformers	\$43.6M
6 Brownfield with tail ended 132kV using existing transformers	\$34.6M
7 Brownfield with DCB's using existing transformers	\$35.2M
8 Greenfield Substation 2x132kV bus sections and new transformers	\$32.7M
9 Greenfield 132kV Hybrid GIS, Brownfield 11kV switchgear using existing transformers	\$48.2M

Option 8 was discounted due to the additional network risk associated with having two rather than three bus sections and Option 6 was not considered an acceptable solution due to the reduced flexibility and network security of the tail ended arrangement.

Consideration was also given to the possibility of decommissioning the existing Greenacre Park zone substation by transferring all 11kV loads to Bankstown zone substation. This option was not progressed because it requires extensive 11kV connections, as well as an additional 132/11kV 50MVA transformer; associated 132kV feeder and 11kV switchgear to be installed at Bankstown zone substation. The estimated cost of this option exceeded \$44 million.

The two remaining lowest cost alternatives (Options 1 and 7) have been analysed and compared in greater detail, with consideration given to construction time, staging, technical issues/constraints and costs including property resale.

Option 1 – New Greenacre 132/11kV zone substation (2x50MVA)

- New Greenacre zone substation adjacent to existing Greenacre Park zone substation. The existing substation would be decommissioned and the land would be available for sale.
- Current forecasts indicate a load constraint in 2032 however the design can incorporate potential future expansion to meet this load.

Option 7 - Greenacre Park Brownfield with DCBs (4x37.5MVA)

- Staged Brownfield 11kV switchgear replacement within existing 11kV switchroom. Use of 11kV mobile switchroom to facilitate staging.
- Replacement of existing control room and staged outdoor 132kV Isolators & Earthing Switches replacement with hybrid disconnecter-circuit breakers.
- Remediation of existing 11kV switch room building required to address condition issues.
- Structural modification to the existing switchroom floor structural beam to accommodate replacement of 11kV switchgear and complete 11kV equipping.
- Multiple 11kV load transfers required as part of the electrical staging.
- Enables property sale of 222-230 Hume Highway, Greenacre.

Option 1 delivers a completely new 2x50MVA zone substation. The capacity of Option 1 would be less than Option 7 however expansion to meet potential future demands can be catered for. The purchase price of \$3.9 million for the new site and an allowance of \$1.5 million for the potential sale of the existing site have been included in the cost estimate of \$33.6 million.

Option 7 retains the existing 4 x 37.5MVA transformers arrangement and involves a staged 11kV switchgear replacement in the existing building plus a new control room. Implementation of this option is expected to take at least two years longer than Option 1. This option provides less network flexibility as no 132kV feeder circuit breakers would be installed and a mobile switchroom would need to be deployed at this location for several years. Pricing assumes internal delivery. The cost for this option is \$35.2million and includes \$3.9 million for the sale of the purchased site.

Decommissioning of the 132kV feeders 291/1 and 292 has not been included, as this work is common to both options.

Given the low deferral value available for reducing demand and the scale of load reduction required it was determined that non-network options could not form part of a credible option for this replacement investment.

Option 1 is preferred because it has the lowest cost and can be delivered in a shorter timeframe than the refurbishment option. In addition, the new zone substation can achieve higher network reliability by providing increased switching flexibility than a brownfield development of the site.

The project was approved by Ausgrid Board on 20/06/2017, at a total cost of \$31.8 million (\$29.7 million excluding contingency).

This project was initiated in 2013 with a view to complete the works by December 2017. The project was delayed because a staged brownfield construction was identified during project development activities as a feasible alternative. A more detailed options analysis was then conducted and investigations were completed in early 2016, confirming the new zone substation as the preferred option.

Plan view of the proposed Greenacre zone substation adjacent to the existing Greenacre Park ZS



1.1.4 Matraville 11kV switchgear Groups 1, 2 and 4 replacement

Key project milestones:

- Project initiated in May 2010.
- Project expenditure authorised by Ausgrid Board in March 2017.
- Project completion is expected by February 2021.

Options Analysis

Three options have been considered to address issues at Matraville zone substation:

Option 1 – Retire Matraville via a new zone substation

This option involves purchasing a site and greenfield construction of a new Matraville 33/11kV zone substation. Load would be transferred from the existing Matraville to the new zone substation. New 33kV feeders would need to be run from Bunnerong STS to allow retirement of the existing aged 33kV feeders.

The estimated cost of this option is \$39 million. The Net Present Cost (NPC) is \$37 million.

Option 2 – Retire Matraville via 11kV load transfer to surrounding zone substations

This option involves transferring all loads to Port Botany and Maroubra zone substations to enable the retirement of Matraville ZS.

The estimated cost of this option is \$26 million and the NPC is \$25 million.

Option 3 – Replace Matraville 11kV switchgear and 33kV feeders

This option involves staged replacement of the aged 11kV switchgear with fixed-pattern single bus switchgear. Transformer 3 will be permanently decommissioned due to their poor condition. In this option, the replacement of the 33kV feeders supplying Matraville zone substation as well as Group 3 11kV switchgear can be deferred to be completed by mid 2020s.

The estimated cost of this option is \$32 million. The NPC is \$27 million.

Although Option 2 has the lowest NPC, Option 3 is still preferred because:

- It provides greater network flexibility than Option 2, as the load transfers required under the latter would leave no spare 11kV panels at Maroubra zone substation; and
- There is greater risk due to the magnitude of 11kV cable works required and confidence in the supporting cost estimates.

Given the low deferral value available for reducing demand and the scale of load reduction required it was determined that non-network options could not form part of a credible option for this replacement investment.

The project was approved by Ausgrid Board on 28/03/2017, at a total cost of \$15.4 million (\$14.2 million excluding contingency).

This project is a complex brownfield substation refurbishment, which led to experienced significant delays at development stage.

1.1.5 Surry Hills 11kV switchgear replacement

Key project milestones:

- Project initiated in June 2011.
- Project expenditure authorised by Ausgrid Board in February 2015.
- Project completion is expected by July 2022.

Options Analysis

Three network options were considered to address identified issues at Surry Hills ZS:

Option 1 – Retire Surry Hills zone substation via 11kV load transfers to surrounding zone substations

Campbell St is the only zone substation near Surry Hills with significant spare capacity and potential for expansion; however, even if augmented to its potential three-transformer arrangement it will not have enough spare capacity to absorb the load required to allow full retirement of Surry Hills ZS. Campbell St ZS is forecast to have around 30MVA of spare capacity at the end of the planning period in its augmented arrangement, while Surry Hills ZS load is forecast to be over 55MVA.

This option is therefore not considered technically feasible.

Option 2 – New Surry Hills zone substation

Surry Hills ZS is located in a dense urban area with narrow, busy streets and sensitive residents and businesses. As such, an appropriate site for a replacement zone for Surry Hills would likely be prohibitively expensive. Egress of transmission and distribution cables would likely be difficult, and the cost of transferring load from the old zone to the new zone would likely be more than replacing the switchgear in the existing Surry Hills switch-room. This option would not only resolve issues with the 11kV switchgear, but also resolve condition issues with the 33kV gas pressure cables supplying Surry Hills ZS.

The estimated cost of this option is \$43 million. The Net Present Cost of this option is \$39 million.

Option 3 – Replace Surry Hills 11kV switchgear and 33kV feeders

In this option, 11kV load is to be transferred from Surry Hills ZS to Campbell St and Camperdown zone substations, allowing staged replacement of the aged 11kV switchgear with fixed-pattern single bus switchgear. The 33kV feeders from Surry Hills STS to Surry Hills ZS would be replaced with modern equivalent technology by 2024.

The Net Present Cost of this option is \$25 million.

Given the low deferral value available for reducing demand and the scale of load reduction required it was determined that non-network options could not form part of a credible option for this replacement investment.

Option 2 is significantly more expensive than Option 3, and Option 1 is not technically feasible. As a result, the proposal to replace Surry Hills ZS 11kV switchgear and 33kV feeders (Option 3) is shortlisted as the preferred solution.

The project was approved by Ausgrid Board on 25/02/2015, at a total cost of \$19.1 million (\$18.1 million excluding contingency).

1.1.6 Decommission Darlinghurst 33/11kV ZS – Stage 1

Key project milestones:

- Project initiated in February 2018
- Project expenditure authorised by the Ausgrid Chief Operating Officer in June 2019 (Stage 1)
- Project completion is expected by March 2022

Options Analysis

Two network options were considered to address identified asset condition issues at Darlinghurst ZS:

Option 1 – Staged retirement by staged transfer of load

This strategy involves transferring the existing load on Darlinghurst ZS to adjacent zone substations in two stages. The first stage allows for the retirement of the highest risk switchgear with compound insulated busbars, and deferral of the remaining switchgear with air insulated busbars until a later time.

The Net Present Cost of this option was \$2.8 million (Stage 1 only).

Option 2 – Single-staged retirement by transfer of all load

This strategy involves transferring all of the existing load on Darlinghurst ZS to adjacent zone substations in one project and allows for the earlier decommissioning of Darlinghurst ZS. There is no cost deferral benefit with this approach.

Option 2 was ultimately disregarded because it costs three times more than Option 1 and the fact that replacement of the 11kV air insulated switchgear is not required in the short term. In addition, Option 2 does not provide a corresponding increase in benefits.

Given the low deferral value available for reducing demand and the scale of load reduction required it was determined that non-network options could not form part of a credible option for this replacement investment.

The project was approved by Ausgrid Chief Operating Officer on 27/06/2019, at a total cost of \$4.2 million (\$3.9 million excluding contingency).

1.1.7 Lidcombe 33/11kV Zone Substation Group 2 11kV Switchgear Replacement

Key project milestones:

- Project initiated in September 2014.
- Project expenditure authorised by Ausgrid Board in December 2017.
- Project completion is expected by October 2021.

Options Analysis

The options analysis was initiated in 2013 and further reviewed in 2014 and 2015. The network options considered solutions to address condition issues with 11kV compound insulated switchgear at Lidcombe ZS and 33kV supply to both Auburn and Lidcombe zone substations. The options explored reconfiguration of the existing zone substations as well as the transition towards a 132kV supply.

These options and their corresponding net present costs (NPC) in \$ million are listed below:

Option Description	NPC
1 Uprate Auburn and retire Lidcombe	\$68.5M
2 Auburn 132kV conversion and retire Lidcombe (not feasible)	N/A
3 Replace both Auburn and Lidcombe with a new 132/11kV zone substation	\$57.8M
4 Replace 33kV feeders like-for-like and refurbish Lidcombe	\$72.5M
5 Replace 33kV feeders from Homebush STS to Auburn and reconfigure Lidcombe	\$58.2M
6 Replace 33kV feeders from Camellia Substation and reconfigure Lidcombe	\$48.5M
7 Replace Lidcombe with new 132/11kV substation and reconfigure Auburn 33kV feeders	\$51.9M
8 Replace 33kV feeders from Camellia Substation and reconfigure both substations	\$42.0M

Given the low deferral value available for reducing demand and the scale of load reduction required it was determined that non-network options could not form part of a credible option for this replacement investment.

Option 8 has the lowest NPC and the least risk. It is therefore the preferred option.

Further development of this option identified opportunities to defer the replacement of Group 1 switchgear at Lidcombe zone substation, which have been replaced with vacuum trucks. As a result, the scope and cost of the preferred option has been reduced as it considers replacing the 11kV switchgear (Group 2 only) at Lidcombe zone substation now and the remaining switchgroup at a later date. The NPC of the enhanced Option 8 was further reduced to \$40.2 million, of which \$9.1 million is the contribution of replacing the 11kV compound insulated switchgear (Group 2).

This project experienced significant delays because it is developed in combination with the replacement of 33kV feeders supplying Auburn and Lidcombe zone substations. Extensive community consultation on the feeders and coordination issues with the project that involves the widening of the M4 Motorway (part of the WestConnex development) have caused such delays.

The project was approved by Ausgrid Board on 14/12/2017, at a total cost of \$9.1 million (\$6.7 million excluding contingency).

1.1.8 Decommission Strathfield STS

Key project milestones:

- Project initiated in August 2015.
- Project expenditure authorised by Ausgrid Chief Executive Officer in June 2017.
- Project completion is expected by April 2021.

Options Analysis

Two network options to address the asset condition issues at Strathfield STS were considered:

Option 1 – Decommissioning of Strathfield STS

This option involves transferring the Sydney Trains Strathfield Substation load from Strathfield STS to Homebush STS by installing two new 33kV feeders. Modifications will need to be made to protection elements and 132kV connections as part of the decommissioning works at Strathfield STS. The transfer of Sydney Trains load will enable the decommissioning of Strathfield STS.

132kV feeders 923 and 924 would need to be modified at the Strathfield STS point along the feeder to become a transition point so that load continues to pass from Mason Park STSS to Burwood zone substation. The cost of this option is approximately \$11 million.

Option 2 – Refurbishment of Strathfield STS

This option involves the like for like replacement of six 33kV circuit breakers and four 132kV isolators at Strathfield STS. In the initial analysis, it was assumed that other secondary issues could be addressed by various replacement sub-programmes at minimal costs. However; additional condition issues have been identified at Strathfield STS and it was discovered that such issues could not be easily addressed via like for like replacement.

A refurbishment of the STS would be a complex task that will require extensive staging, since there is limited space available at the Strathfield STS site. This option is estimated to cost in excess of \$20 million.

Given the low deferral value available for reducing demand and the scale of load reduction required it was determined that non-network options could not form part of a credible option for this replacement investment.

Option 1 is preferred because it has the lowest cost and can be delivered in a shorter timeframe than the refurbishment option.

The project was approved by the Chief Executive Officer on 21/06/2017, at a total cost of \$10.5 million (\$9.3 million excluding contingency).

1.1.9 New Summer Hill 33/11kV ZS and decommission Dulwich Hill 33/11kV ZS

Key project milestones:

- Project initiated in March 2012.
- Project expenditure authorised by Ausgrid Board in May 2017.
- Project completion is expected by February 2021.

Options Analysis

Three strategies were considered to address issues in the Canterbury Bankstown network area. Each strategy integrates solutions to issues at Enfield, Campsie and Dulwich Hill zone substations.

Strategy 1 – Enfield 132/11kV zone substation and Dulwich Hill 33/11kV replacement

This strategy involves replacement of the existing 33/11kV Enfield with a new Strathfield South 132/11kV ZS, establishment of a new 33/11kV Dulwich Hill ZS adjacent to the existing zone site and load transfers from Campsie to Enfield to facilitate the switchgear replacement at Campsie ZS. The Net Present Cost (NPC) of this strategy is \$62.2 million.

Strategy 2 – Replace Enfield and Dulwich Hill zone with new Ashbury 132/11kV zone

This strategy involves construction of a new Ashbury 132/11kV ZS and decommissioning of 33/11kV Enfield ZS and Dulwich Hill ZS by transferring all existing load to the new Ashbury ZS. This would be followed by the installation of an additional 132/11kV transformer at Ashbury ZS and load transfers from Campsie ZS to Ashbury to facilitate the switchgear replacement at Campsie ZS. The NPC of this strategy is \$61.0 million.

Strategy 3 – Dulwich Hill and Enfield zone substation replacement

This strategy involves 11kV switchgear and 33kV feeder replacement at Dulwich Hill and Enfield ZS's, with the installation of an additional transformer at Canterbury STS. Another transformer would then be installed at Enfield ZS and load transferred from Campsie to Enfield to facilitate the switchgear replacement at Campsie ZS. The NPC of this Strategy is \$80.1 million.

Given the low deferral value available for reducing demand and the scale of load reduction required it was determined that non-network options could not form part of a credible option for this replacement investment.

Ausgrid's preferred strategy for Canterbury Bankstown area is Strategy 1, which involves replacing Dulwich Hill Zone substation with a new 33/11kV zone substation. This strategy is preferred because:

- Strategies 1 and 2 have NPC estimates that are considered equivalent (within the level of accuracy of the estimate) and materially lower costs than Strategy 3.
- Considering the location and characteristics of loads in the area, extensive 11kV work would be required to connect all 11kV feeders to the single point of supply proposed under Strategy 2. 11kV development costs often vary greatly as a result of issues encountered during the construction phase compared to pre-project estimates. Hence, there is less uncertainty in cost estimates for Strategy 1.
- Strategy 1 provides greater system flexibility and better coverage of the surrounding 11kV networks than Strategy 2, especially for some load areas (e.g. Belfield, Strathfield and Strathfield South).

Additional investigations were carried out to determine the viability of a conversion to 132kV operation, as well as the most ideal location of the new Dulwich Hill ZS.

The conversion of Dulwich Hill to 132kV operation was rejected due to the high costs associated with achieving 132kV feeder connections. Although 132kV supply in the area is currently available via feeders 92C, 92X, 91X or 91Y, all these fluid filled cables are targeted for retirement within the next 10 years. Any other 132kV supply to connect a new 132/11kV zone substation at this location would need to originate from Chullora STS (approximately 7km long), looping into the existing 132kV overhead feeders 910/911 via an underground connection (approximately 3km long), or an underground connection from Marrickville zone substation (approximately 4km long). In all these cases, the installation of 132kV switchgear at the Dulwich Hill end will be required.

The area to the south of the existing site is the preferred location as it provides one street frontage for 33kV cable replacement and two street frontages for 11kV feeder crossover. In addition, it reduces community impact as works will not be adjacent to residential properties. An aerial view of Dulwich Hill ZS and its proposed replacement is included in the figure below.

Existing and proposed substation sites for Dulwich Hill and Summer Hill ZS's



The project was approved by Ausgrid Board on 01/05/2017, at a total cost of \$43.9 million (\$40.9 million excluding contingency). A prolonged development time was experienced as the scope of the project was refined to reduce project costs.

1.1.10 Rozelle STS new 33kV busbar

Key project milestones:

- Project initiated in September 2017
- Project expenditure authorised by Ausgrid Board at a meeting in March 2019
- Project completion is expected by March 2022

Options Analysis

Sydney Motorway Corporation has submitted a connection request for a supply of 38MVA for the Main Tunnel (Stage 3A) and 33MVA for the Rozelle Interchange (Stage 3B) of the proposed WestConnex motorway. WestConnex Stages 3A and 3B are both currently under construction. Westconnex Stage 3A is to be supplied from Alexandria 132/33kV STS.

Two network options were considered to supply Westconnex Stage 3B:

Option 1 – Upgrade Rozelle STS

This option includes the installation of a 33kV busbar and upgrade of one Rozelle transformer from 30MVA to 60MVA. This approach provides a diversity of supply to the Westconnex Stage 3 tunnel and will facilitate other future connections at Rozelle anticipated due to development in the Rozelle and White Bay areas. This option provides network assets close to the required connection point.

The Net Present Cost of this option is \$25.7 million.

Option 2 – Expand Alexandria STS

Alexandria STS has been recently completed, and would require expansion to facilitate the additional connections. This approach would have all Westconnex Stage 3 tunnel supplies from a common source, does not address other anticipated connection requirements at Rozelle 132/33kV STS. The length of new 33kV cables would be greater with this option.

Option 2 was ultimately disregarded because the connection of additional 33kV cables may require complex civil works (i.e. underbore) due to cable access/egress issues in the underground routes at Alexandria STS. In addition, this option will not avoid the need to augment the network to accommodate future load requirements in the Rozelle area.

Ausgrid has also considered the ability of non-network solutions to assist in meeting the identified need. A demand management assessment has determined that non-network options cannot cost-effectively address the need to connect the customer loads.

The project was approved by Ausgrid Board on 15/03/2019, at a total cost of \$24.2 million (\$22.7 million excluding contingency).

1.1.11 Replace 33kV feeders – Homebush to Lidcombe ZS and Auburn ZS

Key project milestones:

- Project initiated in August 2014
- Project expenditure authorised by Ausgrid Board at a meeting in February 2018
- Project completion is expected by July 2023

Options Analysis

Auburn and Lidcombe ZS's are 33/11kV zone substations located in the Inner West area of Ausgrid's network. These substations are supplied by three 33kV underground feeders respectively, all of which originate at Homebush STS. The oldest sections supplying Auburn ZS date back to 1942, while most feeder sections on the other feeders were commissioned in the 1940s and 1950s. These underground subtransmission feeders are a combination of paper insulated and gas pressure cable technologies, and have reached the end of their service lives. They have a combined length of approximately 37km, from which 22km are paper insulated and the remaining 15km are gas pressure cables.

In particular, the gas pressure cables are prone to gas leakages that results in high levels of unavailability due the long time required to locate and repair leaks. While paper insulated cables do not have the same requirements of pressured gas (nitrogen) to maintain insulation integrity and therefore do not present same risks as gas pressure cables, the paper insulated cable sections have experienced a number of outages in recent years. If these issues are left unaddressed, the risk of failure and poor availability of these assets will expose customers in the Inner West network area to a network risk that exceeds allowable levels under the applicable reliability standards.

Refer to section 7.3.1.11 for details of the options considered to address identified issues.

Ausgrid, working with Endeavour Energy, identified a preferred solution that makes use of spare capacity on the Endeavour network following closure of a Shell Australia oil refinery at Clyde in Western Sydney. Ausgrid considers that these joint planning efforts identified the most efficient solution across the respective networks as a whole. In particular, this solution was found to come at a significantly lower cost than rebuilding the existing feeders on a 'like-for-like' basis. In fact, the proposed solution defers upstream investments that would otherwise be required if supply of Auburn and Lidcombe ZS's were to continue to come from Homebush STS.

The proposed route from Camellia STS to Auburn ZS is mainly through industrial areas, crossing Duck Creek and the existing M4 Western Motorway by following the Duck River Cycleway. Ausgrid plans to use underground cables in certain areas in response to community feedback and to minimise risks along the M4 motorway. The overhead route between Auburn ZS and Lidcombe ZS will pass primarily through industrial areas and cross under the main western rail line at Percy Street. Ausgrid plans to locate the cables on the western side of Percy Street, on existing low voltage powerline structures to minimise construction impacts.

The project was approved by Ausgrid Board on 03/02/2018, at a total cost of \$37.2 million (\$31.3 million excluding contingency).

1.1.12 Willoughby to Mosman 132kV Feeders Replacement

Key project milestones:

- Project initiated in July 2017.
- Project expenditure authorised by Ausgrid Board in October 2018.
- Project completion is expected by February 2021.

Options Analysis

The 132kV self-contained fluid filled underground feeders supplying Mosman zone substation 9Y7/2, 9Y9/2 from Castle Cove zone substation to Mosman zone substation and 9P7 from Willoughby subtransmission substation to Mosman zone substation are an obsolete technology. These feeders require specialist skills to repair and maintain, outage times can be lengthy, and spares are not readily available. Two options have been considered to address issues with 132kV feeders 9Y7/2, 9Y9/2 and 9P7:

Option 1 – Replacement of feeders 9Y7/2 and 9Y9/2 from Willoughby subtransmission substation to Mosman zone substation via future Cremorne Junction zone substation and decommissioning of feeder 9P7

This option involves the installation of two new 132kV feeders from Willoughby subtransmission substation to Mosman zone substation via Ausgrid's proposed future Cremorne Junction zone substation site.

The Net Present Cost of this option is \$29.0 million.

Option 2 – Replacement of feeders 9Y7/2 and 9Y9/2 from Castle Cove zone substation to Mosman zone substation (like-for-like) and decommissioning of feeder 9P7

This option involves the like-for-like replacement of 132kV feeders 9Y7/2 and 9Y9/2 by installing two new 132kV feeders from Castle Cove zone substation to Mosman zone substation. Feeder 9P7 is to be decommissioned. This option consists of a longer feeder route than Option 1, as well as require new 132kV feeder to connect the proposed Cremorne Junction zone substation. In addition, this option does not provide any reliability improvements, as a loss of Willoughby to Castle Cove feeders 9Y7/1 and 9Y9/1 would result in an outage of both Castle Cove and Mosman zone substations.

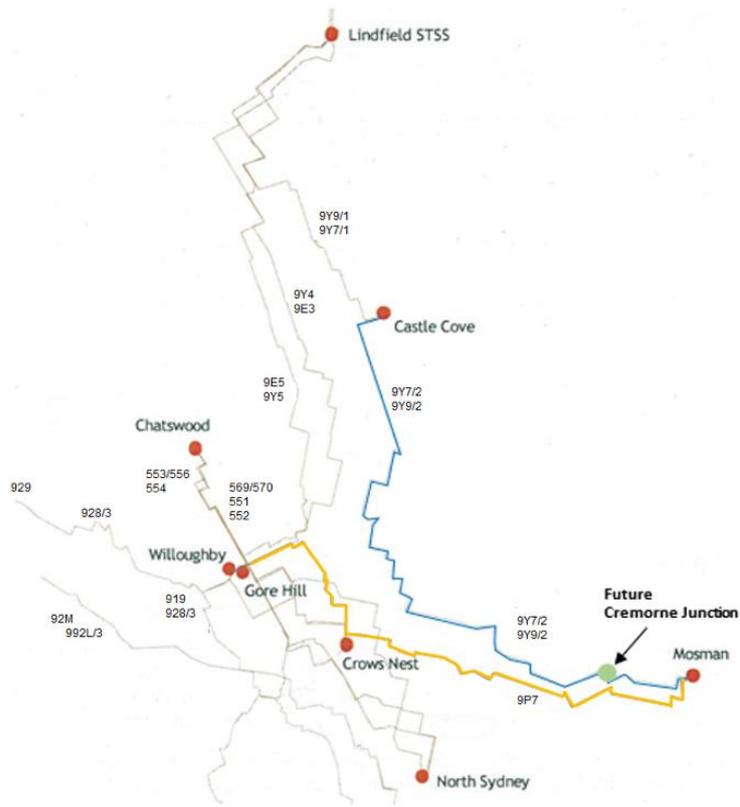
The Net Present Cost of this option is \$37.6 million.

The preferred option is Option 1 as it is the highest net market benefit. In addition, this option allows for future expansion through Cremorne Junction zone substation, while requiring a shorter route in comparison to Option 2. A RIT-D was completed for this project in 2018.

The project was approved by Ausgrid Board on 29/10/2018, at a total cost of \$37.7 million (\$35.4 million excluding contingency).

The figure below provides a geographical view of the Lower North Shore area and highlights the connections between Castle Cove and Mosman and the connection between Willoughby STS and Mosman ZS.

Lower North Shore network area



1.1.13 Waratah 132/33kV STS refurbishment

Key project milestones:

- Project initiated in April 2010.
- Project expenditure authorised by Ausgrid Board in March 2016.
- Project completion is expected by June 2022.

Options Analysis

The 33kV industrial busbar at Waratah STS is significantly aged and needs to be retired from service. The 33kV domestic busbar was refurbished in the 1980s but the oil circuit breakers now require replacement. Four out of seven of the 132/33kV transformers are at the end of their service lives.

Two options have been considered to address issues with Waratah STS:

Option 1 – Waratah STS supply rearrangement and refurbishment

This option involves removing all loads, except major customers, from the Waratah domestic busbar. All unused equipment at Waratah STS is to be decommissioned, including four transformers and three sections of 33kV busbars.

In addition, neighbouring zone substations Mayfield, Shortland and Wallsend and Kooragang West switching station are to be decommissioned with all loads to be transferred to new substations recently commissioned or about to be commissioned.

The estimated cost for this option is \$19.8 million.

Option 2 – Waratah STS replacement

This option proposes constructing a new 132/33kV substation on a nearby site and decommissioning the existing Waratah subtransmission substation.

In addition, neighbouring zone substations Mayfield, Shortland and Wallsend and Kooragang West switching station are to be decommissioned with all load is to be transferred to new substations recently commissioned or about to be commissioned.

The estimated cost for this option is \$44.3 million.

Given the low deferral value available for reducing demand and the scale of load reduction required it was determined that non-network options could not form part of a credible option for this replacement investment.

The preferred option is Option 1 as it is the least cost option.

The project was approved by Ausgrid Board on 30/03/2016, at a total cost of \$18.1 million (\$ 17.0 million excluding contingency).

1.1.14 Peakhurst STS 33kV switchgear replacement

Key project milestones:

- Project initiated in November 2016
- Project expenditure authorised by Ausgrid Board at a meeting in December 2018
- Project completion is expected by June 2022

Options Analysis

Two network options were considered to address the asset condition issues with the 33kV switchgear and switch building at Peakhurst STS:

Swap options as per DPAR RIT-D paper

Option 1 – Replacement of 33kV switchgear in new building

This option involves construction and equipping of a new 33kV switch building within the existing STS site.

The Net Present Cost of this option is \$26.5 million (with 10% risk).

Option 2 – Replacement of 33kV switchgear in existing building

This option involves a staged replacement of the 33kV switchgear in the existing switch building, in conjunction with the refurbishment of the building which has structural and roofing problems.

The Net Present Cost of this option is \$26.6 million (with 40% risk).

Option 1 is the preferred option. The estimated costs of each option are similar, however, the cost estimate for Option 2 has much more uncertainty due to the risks and unknowns associated with working in a “brownfield” situation, working around existing live equipment. Option 2 also has increased complexity in staging and longer outage requirements with increase risk of interruptions to customers.

A demand management assessment into reducing the risk of unserved energy from the 33kV feeders showed that non-network alternatives cannot cost-effectively address the risk, compared to the two network options outlined above.

The project was approved by Ausgrid Board on 17/12/2018, at a total cost of \$26.8 million (\$25.0 million excluding contingency).

1.1.15 11kV Load Transfers from Dalley St ZS to City North ZS

Key project milestones:

- Project initiated in January 2016.
- Project expenditure authorised by Ausgrid Chief Executive Officer in April 2017 (Stage 1) and January 2018 (Stage 2).
- Project completion is expected by June 2021.

Options Analysis

Ausgrid's strategic decisions for ensuring reliable supply in the Sydney CBD area arise from the need to address ageing infrastructure at City East and Dalley St ZS's. Three strategies were considered, which will address the identified risks to an appropriate degree:

Strategy 1 – New 132/11kV zone substation and decommission Dalley St and City East substations

This strategy involves establishing a new 132/11kV substation on the northern section of Sydney CBD, transferring all load at Dalley St and City East to the new zone substation and after that decommission both Dalley St and City East ZS's. The net present cost of this strategy is \$165 million.

Strategy 2 – Decommission Dalley St and City East by transferring load to City North and Belmore Park substations

This strategy involves transferring approximately two thirds of the existing Dalley St ZS load to City North ZS, and all load at City East as well as the remaining load at Dalley St to Belmore Park ZS. Once completed, both Dalley St and City East substations will be decommissioned. The net present cost of this strategy is \$58 million.

Strategy 3 – Refurbish existing City East ZS and decommission Dalley St ZS

This strategy involves transferring City East load to Belmore Park ZS, refurbish City East ZS at 33kV, transferring Dalley St load to the newly refurbished City East and decommission Dalley St ZS. The net present cost of this strategy is \$115 million.

Strategy 2 has the lowest net present cost and is the preferred option. To capture any differences in the value of the assets remaining at the end of the planning period residual benefits were calculated for each strategy. The present value of residual benefits for Strategies 1 and 3 were \$20 million compared to \$10 million for Strategy 2. This difference is not material compared to the cost difference of the strategies.

As the risk of equipment failure is significant at Dalley St ZS and could result in a prolonged outage, the partial offloading of Dalley St to City North zone substation should be completed as soon as practical. Up to 65% of the load at Dalley St ZS can be transferred to City North ZS, which will substantially reduce network risks at Dalley St and enable relatively low cost recovery actions in the event of a switchgear failure.

Non-network options were considered based upon a one-year deferral value of \$25/KVA and a total reduction of 50MVA required to be removed from Dalley St zone substation (65% of the load). Given the low deferral value available for reducing demand and the scale of load reduction required it was determined that non-network options could not form part of a credible option for this replacement investment.

The 11kV load transfers from Dalley St to City North ZS were initiated as a single project in January 2016. In order to reduce the impacts derived from the construction of the CBD & South East Light Rail Project, the 11kV load transfers were segmented in two stages. The two stages were presented as one project to Ausgrid Board for preliminary project approval (Gate 2 approval) because both are required to address the identified network need. The Board provided Gate 2 approval for the project in April 2016.

Stage 1 was authorised by the Chief Executive Officer on 07/04/2017 at a cost of \$9.9 million (\$9.0 million excluding contingency). The latest schedule review has adjusted the completion date of the project to March 2019.

Stage 2 was authorised by the Chief Executive Officer on 03/01/2018, at a total cost of \$12 million (\$9.9 million excluding contingency). Stage 2 was originally scheduled for completion in September 2018. This second set of load transfers have significant dependencies on the completion of the Light Rail Project, which is experiencing construction delays.

1.1.16 Ensuring reliable supply for the Sydney Airport network area

Key project milestones:

- Project initiated in June 2019.
- Project expenditure authorised by Ausgrid Chief Executive Officer in September 2020.
- Project completion is expected by January 2024.

Options Analysis

The 33kV switchgear at Sydney Airport is compound insulated with oil-filled circuit breakers, which could lead to failures ranging from single equipment failures to multiple equipment failures impacting the operation of an entire substation. Furthermore, the 33kV oil circuit breakers at Sydney Airport ZS were originally commissioned in 1955 and are now an orphan technology with very limited spare parts availability.

Replacement of the 33kV switchgear in a new switchroom has been identified as the only option available to address reliability risks based on the outcome of a RIT-D. Condition issues identified in the switchroom buildings have led to the decision to construct a new 33kV switchroom building at the customer's cost to house the new equipment.

The refurbishment of the 33kV switchgear with new equipment in situ (i.e. 'brownfield replacement') was also considered under a staged approach. However, brownfield replacement imposes materially greater safety and schedule risk, arising from work being carried out next to energised equipment.

Ausgrid also considered other options such as the retirement of the 33kV switchgear or the construction of a new 132/11kV zone substation, but these options were not progressed since they were found technically or commercially not credible. In the case of simple retirement, the reliability of supply would be significantly reduced and future developments in Sydney Airport would be limited. In the case of the new substation, the cost would be materially higher than replacing the switchgear, without providing a commensurate increase in benefits.

The scope of this project includes the construction of a new building, installation of new equipment and retirement of the existing 33kV switchgear at Sydney Airport ZS. Demolition of the existing building and site remediation will also occur as a result of the project. The new switchroom design will also support improved fire segregation, contributing to improved safety and reliability.

The project was approved by the Ausgrid Chief Executive Officer on 30/09/2020, at a total cost of \$9.6 million (\$8.6 million excluding contingency).

1.1.17 Stockton ZS 11kV switchgear replacement

Key project milestones:

- Project initiated in November 2018.
- Project expenditure authorised by Ausgrid Chief Executive Officer at a meeting dated March 2020.
- Project completion is expected by July 2021.

Options Analysis

The 11kV switchgear at Stockton ZS is compound insulated switchgear and is considered to be beyond its design life. These assets are likely to become less reliable, which could expose customers in the Stockton peninsula to a supply risk that exceeds allowable levels under the applicable reliability standards.

One credible network option has been identified to address asset condition issues. It involves the replacement of the 11kV switchgear at Stockton ZS, by constructing and equipping a new switchroom on adjacent land to the existing substation.

Other options were considered in the assessment but not progressed. The replacement of the 11kV switchgear in situ involved increased construction risks and longer delivery timeframes relative to the new switchroom. The retirement of Stockton ZS via 11kV load transfers is considered not feasible as the only adjacent substation is Williamstown ZS which is over 10km away. Retiring the substation would therefore require extensive 11kV augmentation and the resulting cost will be significantly higher than the replacement of the 11kV switchgear in situ. Another option considered was the construction of a new 33/11kV Zone Substation on a greenfield site to replace the existing Stockton 33/11kV ZS, but it was disregarded because it cost almost three times more than the replacement of the 11kV switchgear in situ and would not provide any additional benefits.

Ausgrid has considered the ability of any non-network options to assist in addressing the risks. A demand management assessment examined the possibility of deferring the proposed network investment at Stockton ZS by either 1, 2 or 3 years. The results indicate that costs for non-network alternatives would be considerably higher than the costs of network options.

The replacement of the 11kV switchgear with a new switchroom is therefore the preferred option. It involves the installation of a new Mobile Equipment Room to accommodate the new 11kV switchboard comprising two sections of single bus switchgear and 11kV circuit breakers.

The project was approved by the Ausgrid Chief Executive Officer on 11/06/2020, at a total cost of \$5.7 million (\$5.5 million excluding contingency).

1.1.18 Muswellbrook ZS Refurbishment

Key project milestones:

- Project initiated in July 2016.
- Project expenditure authorised by Ausgrid Chief Operating Officer at a meeting dated January 2020.
- Project completion is expected by December 2021.

Options Analysis

Condition issues have been identified in the 33kV outdoor switchgear at Muswellbrook ZS. In particular, the 33kV Essantee isolators have additional safety risks to personnel involved in switching operations. Furthermore, the 33kV oil filled circuit breakers of this age and type have a history of failures derived from degraded insulation quality. There are extensive condition issues with the existing control and protection, earthing and oil containment systems. There is also an opportunity to retire/reconfigure parts of the 33kV network after recent projects in the area have resulted in disused 33kV feeders and equipment.

One credible network option has been identified to address asset condition issues at Muswellbrook ZS. It involves refurbishing Muswellbrook ZS, to retire the 33kV switchgear that is redundant to the network and replace the minimum equipment to maintain 33kV supply in the area, and rearrangement of the Muswellbrook STS 33kV network.

Other options were considered but not progressed because they were not feasible. These included the retirement of Muswellbrook STS and reconfiguration of the 33kV network in the area; the retirement of both Muswellbrook STS and Muswellbrook ZS and transferral of 11kV load to Mitchell Line ZS and Aberdeen ZS, including rearrangement of the 33kV network to provide supply to mine operations and maintain back up supply to Moonan ZS and Rouchel ZS; and the establishment of a new Muswellbrook 132/33kV STS. These options were disregarded because the costs were considerably higher, noting that if both Muswellbrook STS and Muswellbrook ZS are retired, the supply capacity will be considerably reduced in the area. The connection of possible future renewable generation will pose increased technical and economic issues without Muswellbrook STS. Furthermore, the reconfiguration of the 132kV network post retirement of Muswellbrook STS will require extensive protection upgrades to achieve compliance with the National Electricity Rules.

Ausgrid has considered the ability of any non-network options to assist in addressing the risks. A demand management assessment examined the possibility of deferring the proposed network investment at Stockton ZS by either 1, 2 or 3 years. The results indicate that costs for non-network alternatives would be considerably higher than the costs of network options.

Refurbishment of Muswellbrook ZS and rearrangement of the Muswellbrook STS 33kV network is the preferred option. The works will involve the replacement of existing 33kV switchgear and decommissioning existing 33kV switchgear and all redundant 33kV equipment at Muswellbrook ZS, as well as replacement of 33kV feeder and busbar protection.

The project was approved by the Ausgrid Chief Operating Officer on 9/01/2020, at a total cost of \$3.6 million (\$3.3 million excluding contingency).

1.1.19 Muswellbrook STS Refurbishment

Key project milestones:

- Project initiated in July 2016.
- Project expenditure authorised by Ausgrid Chief Executive Officer at a meeting dated January 2020.
- Project completion is expected by December 2021.

Options Analysis

Condition issues have been identified in the 33kV outdoor switchgear and secondary systems at Muswellbrook STS. In particular, the 33kV Essantee isolators have additional safety risks to personnel involved in switching operations. Furthermore, the 33kV oil filled circuit breakers of this age and type have a history of failures derived from degraded insulation quality. There are extensive condition issues with the existing control and protection, earthing and oil containment systems. There is also an opportunity to retire/reconfigure parts of the 33kV network after recent projects in the area have resulted in disused 33kV feeders and equipment.

One credible network option has been identified to address asset condition issues at Muswellbrook STS. It involves refurbishing Muswellbrook STS, to retire the 33kV switchgear that is redundant to the network and replace the minimum equipment to maintain 33kV supply in the area, and rearrangement of the Muswellbrook STS 33kV network.

Other options were considered but not progressed because they were not feasible. These included the retirement of Muswellbrook STS and reconfiguration of the 33kV network in the area; the retirement of both Muswellbrook STS and Muswellbrook ZS and transferral of 11kV load to Mitchell Line ZS and Aberdeen ZS, including rearrangement of the 33kV network to provide supply to mine operations and maintain back up supply to Moonan ZS and Rouchel ZS; and the establishment of a new Muswellbrook 132/33kV STS. These options were disregarded because the costs were considerably higher, noting that if both Muswellbrook STS and Muswellbrook ZS are retired, the supply capacity will be considerably reduced in the area. The connection of possible future renewable generation will pose increased technical and economic issues without Muswellbrook STS. Furthermore, the reconfiguration of the 132kV network post retirement of Muswellbrook STS will require extensive protection upgrades to achieve compliance with the National Electricity Rules.

Ausgrid has considered the ability of any non-network options to assist in addressing the risks. A demand management assessment examined the possibility of deferring the proposed network investment at Stockton ZS by either 1, 2 or 3 years. The results indicate that costs for non-network alternatives would be considerably higher than the costs of network options.

Refurbishment of Muswellbrook STS and rearrangement of the Muswellbrook STS 33kV network is the preferred option. The works will involve the retirement of a transformer and decommissioning existing 33kV switchgear and all redundant 33kV equipment at Muswellbrook STS, as well as the rearrangement of the 33kV network by dismantling redundant connections and installing new links required.

The project was approved by the Ausgrid Chief Executive Officer on 9/01/2020, at a cost of \$5.6 million excluding contingency.

1.2. Refurbishment, replacement or augmentations – Dual function

Region	Committed Projects – Dual Function	Expected Project Completion	Estimated Cost (\$m)
Carlingford	New Macquarie 132/33kV STS	Jan-22	34.3

1.2.1. New Macquarie 132/33kV STS

Key project milestones:

- Project initiated in May 2018
- Project expenditure authorised by Ausgrid Board at a meeting in July 2019
- Project completion is expected by January 2022

Options Analysis

Three options, including some further variations, have been considered to make provision for the connection of a number of large customers in the Macquarie Park area.

Option 1A – New 132/33kV STS on the existing Macquarie Park ZS site, with expansion capability

This option was investigated and found not to be viable due to space constraints on the Macquarie ZS site.

Option 1B – New 132/33kV STS on a new site, with expansion capability

This option was investigated and found not to be viable within the required timeframe (completion 2021). Ausgrid does not own a suitable site and additional land would have to be acquired.

Option 1C – New 132/33kV STS on the existing Macquarie Park ZS site, without expansion capability

This option was investigated. A number of risks were identified, but it is considered to be viable. This approach is expected to meet the required timeframe of 2021 completion and allows for utilisation of land that is already owned by Ausgrid.

The Net Present Cost of this option is \$33.7 million.

Option 2 – New 132/33kV STS and 132/11kV ZS at Macquarie University, without expansion capability

This option was investigated but ultimately not progressed because it is subject to the provision of a suitable site by Macquarie University, and is considered unlikely to meet the required project timeframe. This option was also found to be higher in costs than Option 1C, and involve the construction of new assets remote from the load centre.

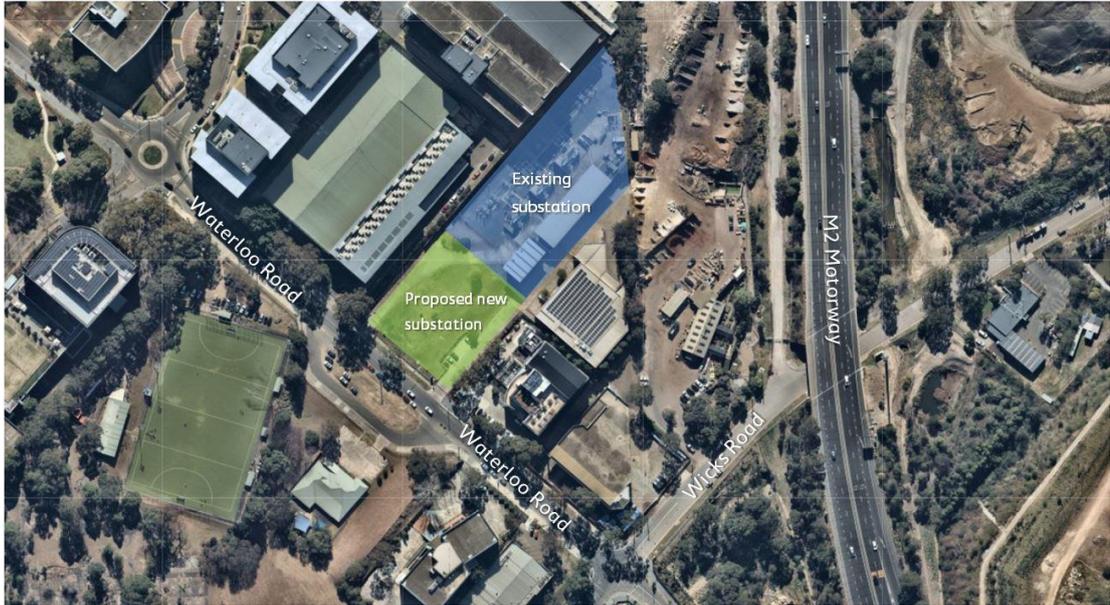
Option 3 – Third Transformer at Top Ryde ZS, deferring the need for new STS by two years

This option would assist in enabling Ausgrid to meet the required customer connection timing, however, it is not efficient as the new 11kV capacity would not be utilized in the longer term. Following a two-year deferral, it is anticipated that one of the other options would still be required. Therefore, this option was disregarded. This would act as an interim measure only and would require a further major network augmentation within a short period of time.

The preferred option is Option 1C as it is the only credible option capable to meet the required customer connection timing.

The project was approved by Ausgrid Board on 01/07/2019, at a total cost of \$40.1 million (\$34.3 million excluding contingency).

Location of proposed new Macquarie STS on existing Macquarie Park ZS site



2. Completed or cancelled investments

For the purposes of this document, a project is considered to be complete when it is commissioned and in service (practically complete).

2.1. Refurbishment, replacement or augmentations – Distribution

The following distribution refurbishment or replacement projects described in DTAPR 2019 have either been completed or cancelled during the preceding year.

Load Area	Completed or Cancelled Refurbishment or Replacement Investment - Distribution	Reason / comments
Canterbury – Bankstown	Bankstown STS 33kV switchgear replacement	Completed
Canterbury – Bankstown	Sydney South to Revesby 132kV feeders replacement	Completed
Eastern Suburbs	New 132kV Feeder Kingsford to Clovelly and decommissioning of Zetland-Clovelly 132kV feeders	Completed
Inner West	Leichhardt ZS 132kV conversion	Completed
Upper North Shore	Kuringai STS 33kV switchgear replacement	Completed

2.2. Refurbishment, replacement or augmentations – Dual Function

The following dual function refurbishment or replacement projects described in DTAPR 2019 have either been completed or cancelled during the preceding year.

Load Area	Completed or Cancelled Refurbishment or Replacement Investment - Distribution	Reason / comments
Canterbury – Bankstown	Canterbury STS 132/33kV Refurbishment	Completed
Muswellbrook	Singleton ZS 11kV switchgear replacement	Completed