Regulatory Submission Support - Phase 3

ACTEWAGL

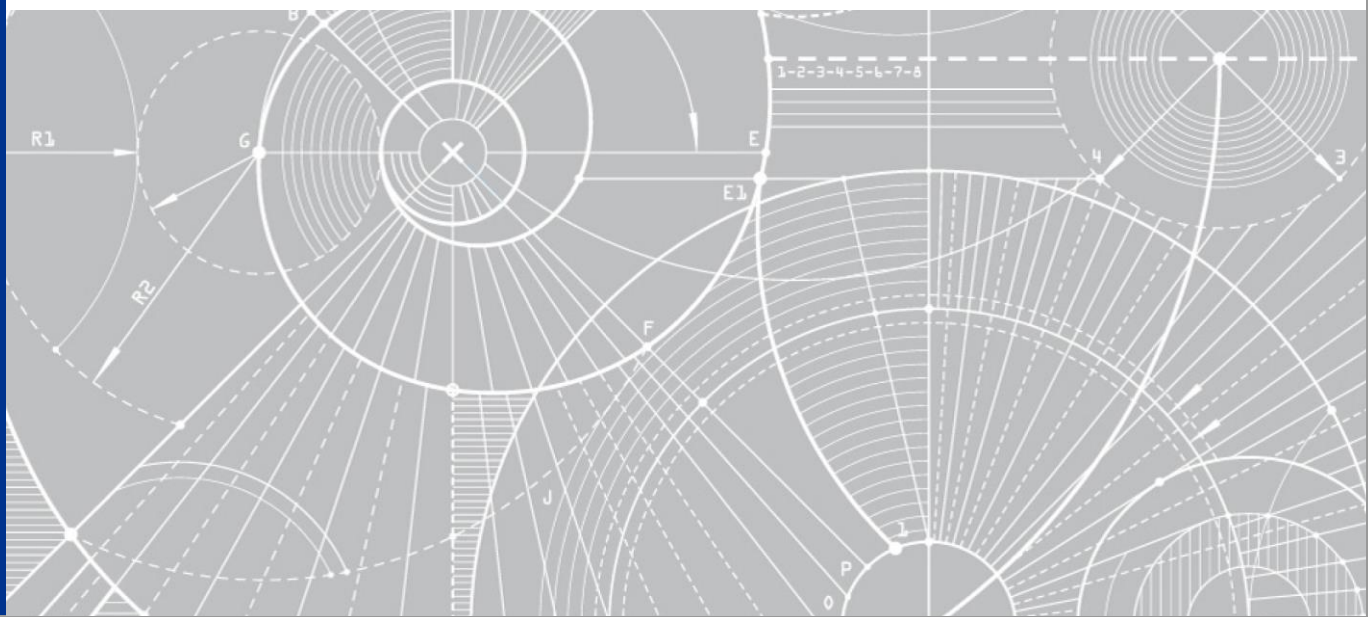
Customer Initiated Capital Works Plan

Network Augmentation Capital Works Plan

Asset Management Plan

QH10545RP0002 | G

30 May 2014



JACOBS SKM

Regulatory Submission Support - Phase 3

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Document history and status

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G	30.05.2014	Final v3 – Minor edits and forecast updates based on client feedback.	J Butler/M Farr/C Jones	C Jones	J Butler

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Important note about your report

The sole purpose of this report and the associated services performed by Jacobs SKM is to provide input into ActewAGL's 2014-19 Regulatory Proposal in accordance with the scope of services set out in the contract between Jacobs SKM and the Client. That scope of services, as described in this report, was developed with the Client.

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1. Customer initiated capital works plan

Customer initiated capital works is dominated by land releases for development by residential, commercial and industrial customers and special purpose developments. It also provides for large spot loads that are known and considered, definite, likely or potential loads depending on the timing of their development.

In essence, Customer Initiated capital works is non-discretionary. ActewAGL is obliged to ensure that adequate budget exists to meet all customer requests in a timely and cost effective manner.

1.1 General overview

In developing forecast customer initiated capital expenditure, ActewAGL Distribution takes account of:

- Direct customer or developer enquiries
- Major public and private development initiatives identified through public/media announcements
- Future development activity identified through the ACT Government planning, preliminary assessment and agency liaison/consultation processes
- Future development activity identified through discussions with the ACT Government on land release programs
- Investigation and reconciliation with ACT Government land release programs and BIS Shrapnel economic forecasting data
- Historic expenditure in the various customer initiated work categories, adjusted to reflect the anticipated broader short-term economic environment

Total customer initiated capital expenditure for the 2009-14 regulatory period was $137 million, or around 35 per cent of total capital expenditure for the period. This expenditure exceeded the AER's decision in the current determination by around $31 million, and was driven by stronger than anticipated growth in commercial and industrial development, as well as urban development associated with ACT Government land releases.

Customer initiated capital expenditure is expected to be lower in the coming regulatory period, but will remain relatively stable, averaging around $22.3 million per year, at 2013/14 real values.

1.2 Land releases

Land released for development within the ACT is controlled by the ACT Government, which prepares and releases a four (4) year indicative land release program. This program sets out the governments intended program for residential, commercial, industrial and community land releases. The programs are indicative and subject to change as market conditions change or as government priorities are adjusted.

The objective of the land release programs include:

- Promoting the economic and social development of the Territory, including contributing to the vision set out in the Canberra Plan of a city representing the best in Australian creativity, community living and sustainable development
- Meeting the on-going strong demand for residential land in the Territory, particularly generated by increased levels of migration into the ACT
- Establishing an appropriate inventory of serviced land
- Maintaining flexibility of land releases to ensure they reflect market conditions and do not contribute to rapid land price changes
- Providing a mix of land and housing options
- Facilitating the provision of affordable housing

- Addressing the locational objectives set out in key Government documents such as the Territory Plan and the Spatial Plan
- Achieving satisfactory returns to the Territory from the sale of unleased Territory land
- Assisting the operation of a competitive private sector land development market

1.3 Molonglo Valley development

The timing of the proposed Molonglo substation is highly dependent upon the rate of residential and commercial land development and building constructions in the Molonglo valley area and especially the suburbs of Wright and Coombs, as well as the suburbs presently supplied by the existing HV feeder system. To better understand the development occurring in these areas, ActewAGL personnel accompanied Jacobs SKM personnel to inspect these areas to sight the level of development and also inspected yet to be occupied stand-alone housing. Jacobs SKM and ActewAGL personnel also met with representatives from the Land Release Section, Economic Development from the ACT Government, who made a detailed presentation on projected land releases in the ACT.

Jacobs SKM understands that the forward projections of land releases from the Land Release Section, Economic Development from the ACT Government, that impact the timing of the Molonglo substation include:

- Wright: An additional 700 apartments, 283 detached and 20 terraces by 2019
- Coombs; Dwellings to commence with an initial 150 detached and 100 terraces by 2015 and increasing to 500 detached, 400 terraces and 400 apartments by 2019
- Denman Prospect: Dwellings to commence with an initial 50 detached by 2016 and to include 650 detached and 250 terraces by 2019
- Molonglo Town Centre: Terraces to commence in 2023
- Molonglo stage 3: Dwellings to commence in 2025

ActewAGL advise that given that the ACT government now mandates reticulated gas to each residence and a five star energy efficiency, the After Diversity Maximum Demand (ADMD) for a dwelling is 2.5 kVA and less for apartments and terraces. Many of the new dwellings also had PV cells installed, further reducing the likely ADMD.

At present there are about 385 single and multi-unit residential dwellings and associated retail outlets in the suburbs of Wright and Coombs. The existing electrical load in the area is estimated at 1-2 MVA. The ultimate development of the Molonglo area is estimated to have a population of 55,000 over the next 20 years, with electrical demand expected to reach 15 MVA by about 2020.

Jacobs SKM notes that media articles as late as 1 May 2014, discuss the potential to advance the timing of land releases in the suburb of Coombs, due to strong land sales in the area.

The timing of the proposed Molonglo zone substation is 2018 and is expected to have an initial loading of approximately 11 MVA. However, this is highly dependent upon the rate of residential and commercial development in the suburbs of Wright and Coombs, as well as the suburbs presently supplied by the existing HV feeder system.

Jacobs SKM understands that there are no significant individual spot loads forecast for the Molonglo area.

1.4 Known and probable customer initiated projects

ActewAGL maintains a current and up to date database of known and probable new customer initiated projects, with estimates of the electrical loading for each project. For the purposes of this report, the database version dated 06/05/2014 was used, and a copy is attached.

Generally speaking, ActewAGL only becomes aware of customer initiated projects of this sort within about an 18 – 24 month timeframe before supply is required (sometimes shorter). Consequently the forward five year forecast is a hybrid of "known and probable" projects combined with trend analysis.

1.5 Impact on the system

The estimated electrical loading of the known and probable customer initiated projects is analysed on a zone substation by zone substation basis, and where the spot loads are substantially above historical load growth, the zone substation forecasts are adjusted accordingly.

Analysis of the probability weighted maximum (customer estimated) and minimum (ActewAGL estimated) estimates of additional electrical loadings by zone substation are shown in the table below.

Table 1

Zone substation	Max. forecast increase (customer estimate)	Min. forecast increase (ActewAGL estimate)	% of total (min.) forecast increase
Belconnen	3,984.00	3,560.00	28%
Telopea Park	4,905.13	3,057.80	24%
Woden	3,487.56	2,256.00	18%
Gold Creek	3,056.00	1,972.30	15%
City East	1,867.20	1,299.50	10%
Latham	611.00	340.50	3%
Fyshwyck	274.50	236.70	2%
Civic	139.50	126.00	1%

This gives a general indication of the high growth areas, with Belconnen, Telopea Park, Woden and Gold Creek zones figuring prominently.

1.6 Overall customer initiated capex forecast

Table 2 below provides the forward forecast of overall customer initiated capital expenditure by category, and the sections following the table provide commentary on each category of expenditure.

Table 2: Customer initiated projects

Year ending 30 June ($2013/14)	*2014/15 $'m*	*2015/16 $'m*	*2016/17 $'m*	*2017/18 $'m*	*2018/19 $'m*	*Total $'m*
Commercial and Industrial Developments	4.6	6.0	5.2	6.2	8.7	30.8
Community and Associated Developments	0.6	0.6	0.6	0.6	0.6	2.9
New Urban Development	8.8	7.6	5.9	6.6	6.5	35.4
Relocations	2.8	2.8	2.8	2.2	2.9	13.5
Replacement	0.3	0.3	0.3	0.3	0.3	1.3
Rural Developments	0.6	0.6	0.6	0.7	0.7	3.2
Services	3.3	2.6	2.7	2.7	2.7	14.0
Special Customer Requests	0.6	0.6	0.6	0.7	0.7	3.2
Urban Infill	0.9	0.6	0.7	0.6	0.8	3.6
Total Customer Initiated	**22.4**	**21.7**	**19.4**	**20.6**	**23.8**	**107.9**

1.7 Commercial and industrial load trends

Commercial and industrial projects involve the network connection and directly associated network extension works required for new commercial or industrial development or redevelopments within established areas that have already been reticulated/services (ie, the HV and/or LV).

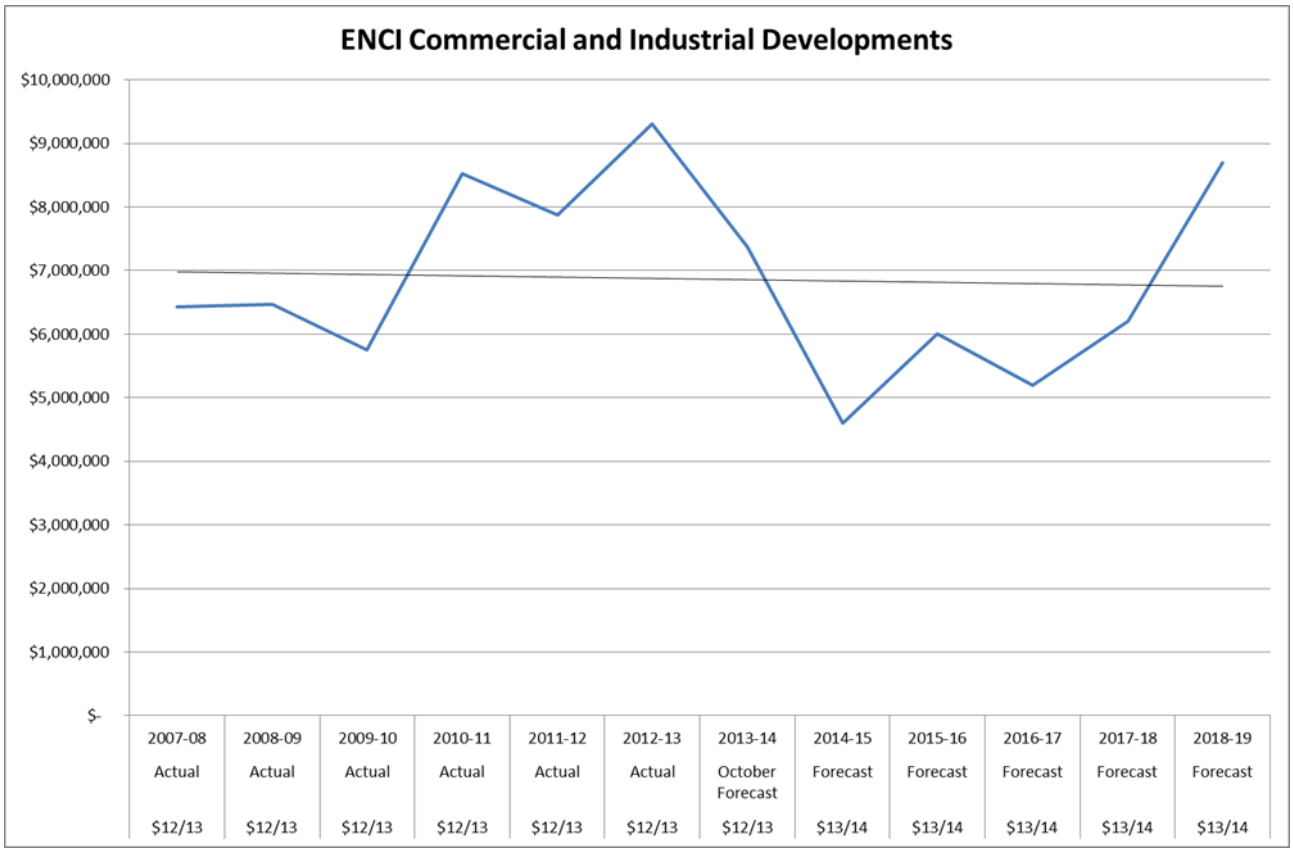
Commercial and Industrial activity levels largely correlate with the activity levels in the construction industry because newly constructed buildings will typically require some form of network augmentation to better cater to the new/increased electrical demand.

Actual expenditure on C&I developments has been trending downwards from $7 million in 2007-08 to a forecast $6.2 million in 2019-20. Isolated peaks occur in various years representing specific developments, with subsequent years having markedly reduced expenditures.

The forecast for commercial and industrial load trend has been derived based on BIS Shrapnel's Building and Construction Industry. It was found that historical expenditure correlates most closely with the "Social & Institutional Building Commenced" indicator.

Note: Forecast figures are in FY13/14 dollars. These figures will need to be adjusted for inflation to derive the nominal dollar figure for each year. The peak in the Social Institutional building sector in FY2015/16 is largely contributed by the $350 million University of Canberra Public Hospital project, which is the largest project expected to commence over the forecast horizon. After this peak in FY2015/16, expenditure is expected to return to the previous year's level before moving towards an average of $6 million to $7 million per year. This econometric forecast was then moderated to fit within budget constraints.

Figure 1: Commercial and industrial trend (FY12/13 $real) and forecast (FY13/14 $real)



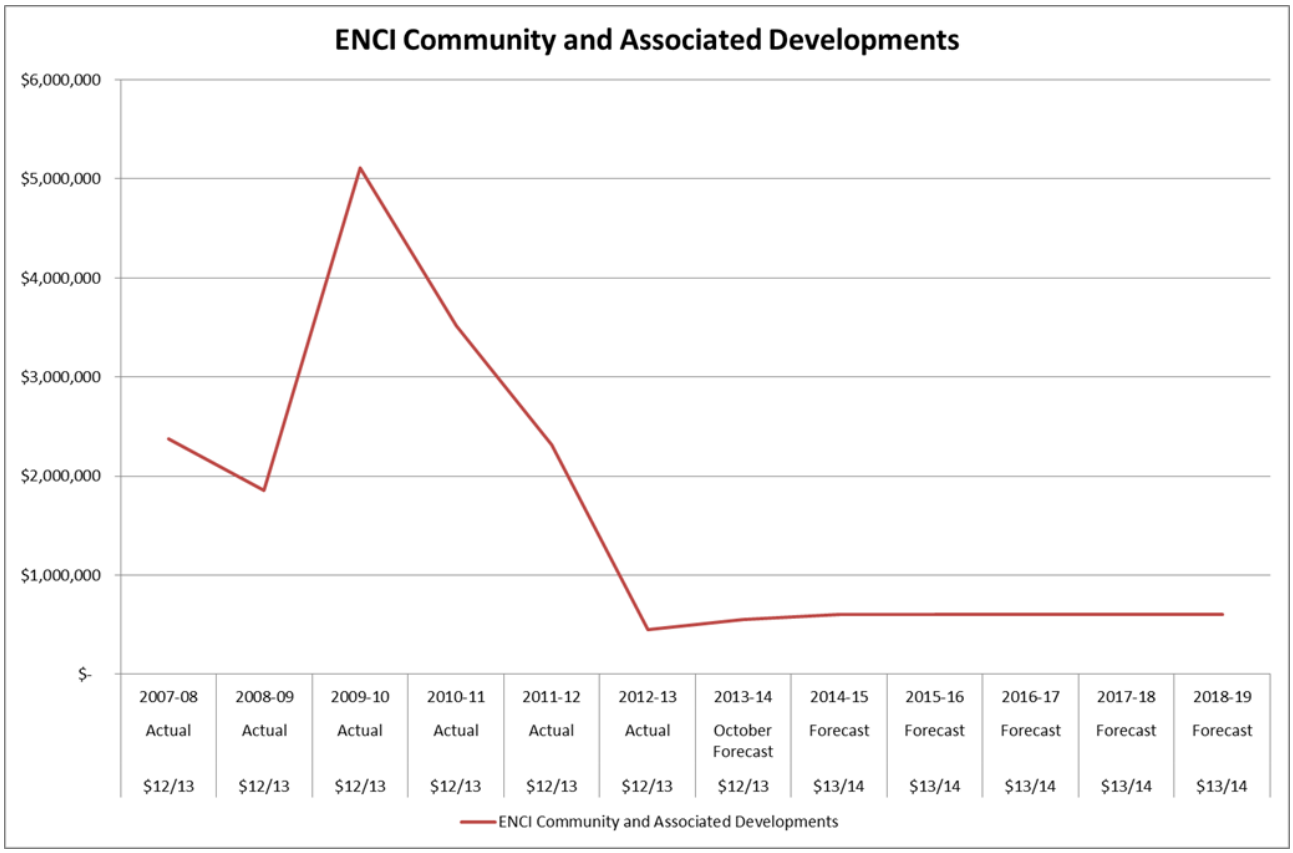
1.8 Community and associated development

Typical community based development projects involve electricity network infrastructure works associated with:

- Churches
- Schools and kindergartens
- Child care facilities
- Hospitals
- Public ovals, parks and sporting grounds and associated amenity buildings

There is no clear market indicator by which to forecast future community and associated development activity levels. Historically, expenditure has been decreasing from approximately $5 million in FY09/10 to approximately $450,000 in FY12/13. If there are no specific known projects, the trend seems likely to remain at around $600,000.

Figure 2: Community and associated development trend (FY12/13 $real) and forecast (FY13/14 $real)



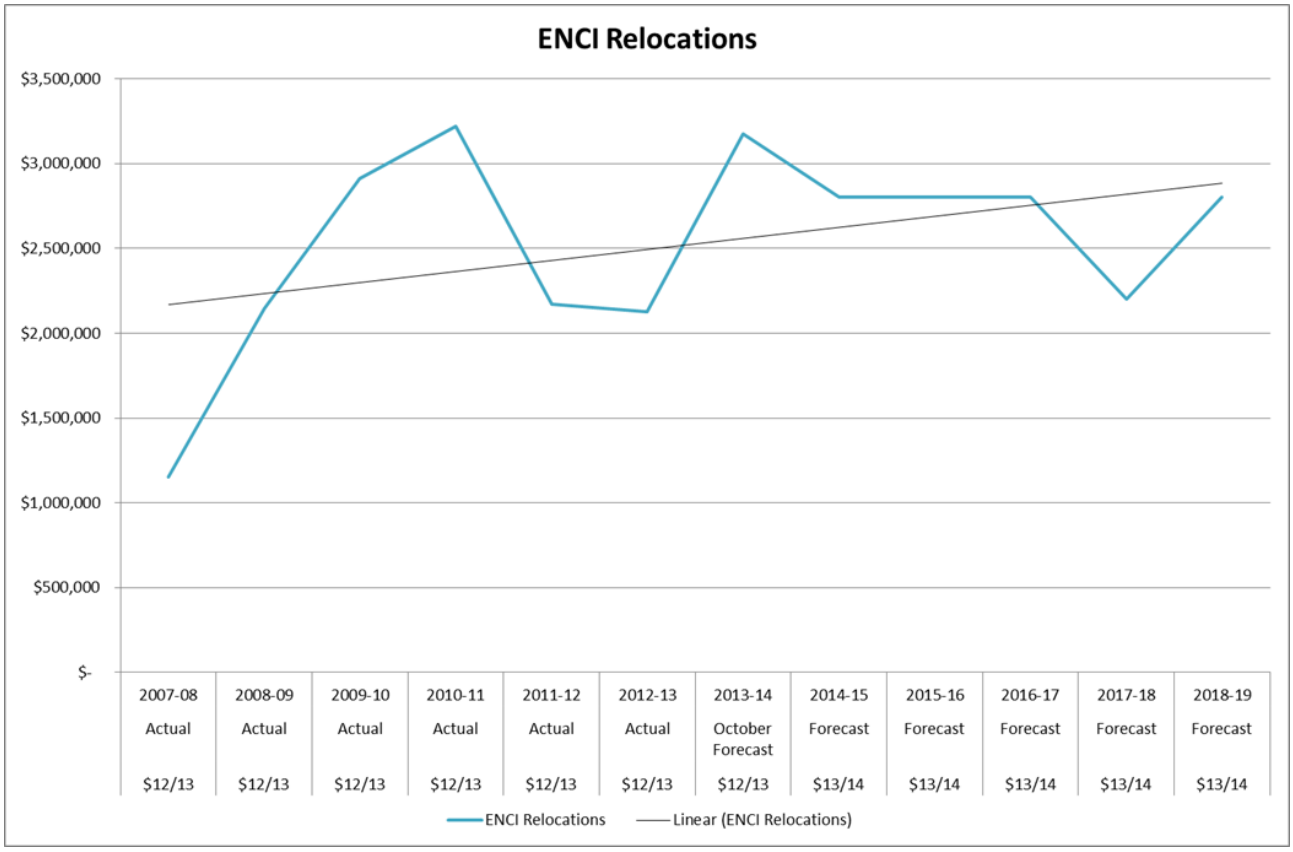
1.9 Relocations

This category of capex relates to projects where the customer requested the relocation of existing electricity network infrastructure where the “relocation” is achieved through removal of the existing infrastructure and installation of new replacement infrastructure to achieve a generally equivalent network arrangement.

Relocation of infrastructure through physical relocation/repositioning of the same infrastructure assets without provision of additional new assets is not usually classified as capital works and therefore cannot be classified as a customer initiated relocation project.

There is no clear market indicator by which to forecast future relocations activity levels. As such, expenditure forecast tends to be of provisional nature. The forecast level of $2.8 million is based on historical and increasing trends in expenditure.

Figure 3: Relocations trend (FY12/13 $real) and forecast (FY13/14 $real)

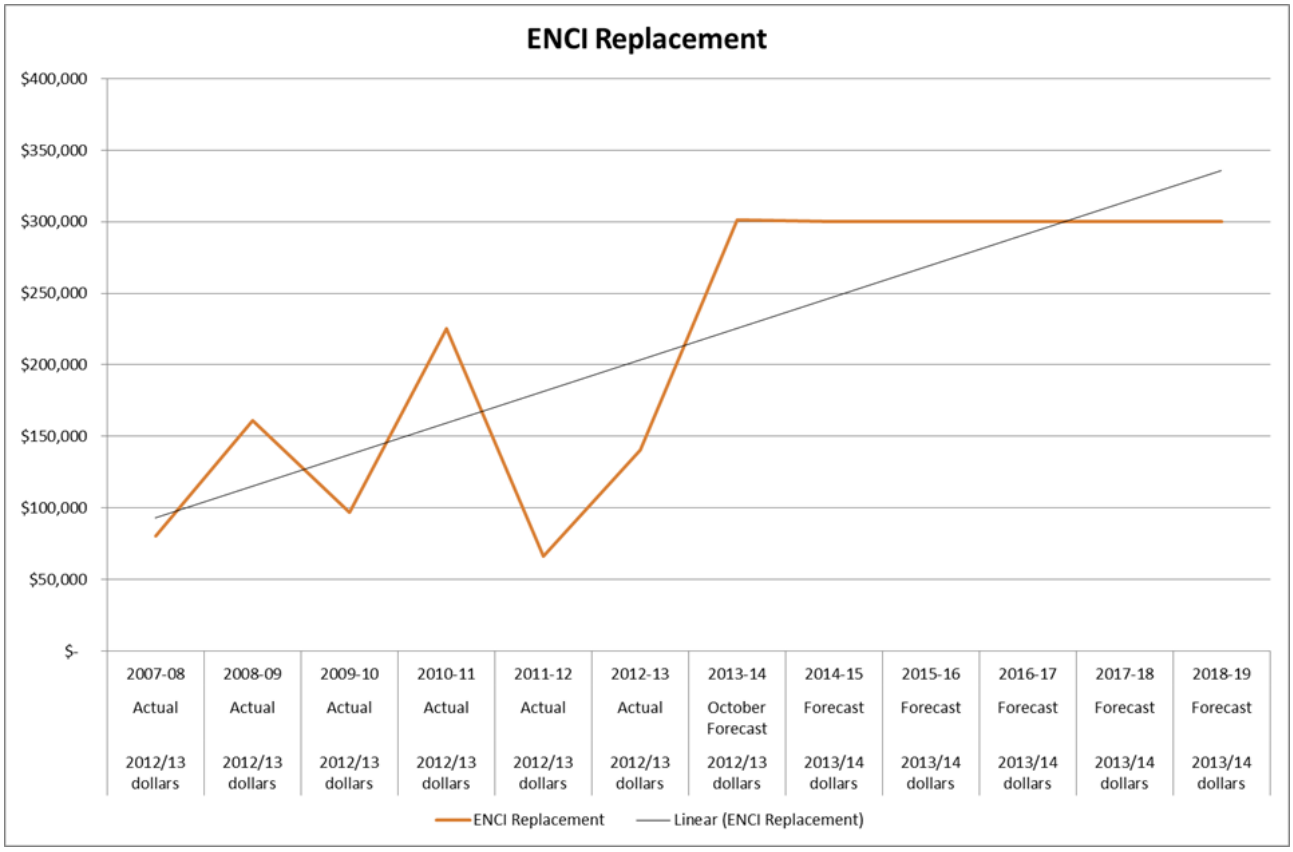


1.10 Customer initiated replacements

The customer initiated asset replacement classification was established to allow separation of asset replacement works initiated by a customer from asset replacement plans developed by ActewAGL.

There is no clear market indicator by which to forecast future Customer Initiated Replacement activity levels. As such, expenditure forecast tends to be of a provisional nature. Historically, since FY07/08, expenditure tends to fluctuate within the range of $100,000 to $300,000. If there are no specific known jobs, the trend seems likely to remain at around $300,000.

Figure 4: Customer initiated replacement trend (FY12/13 $real) and forecast (FY13/14 $real)



1.11 Urban development

New urban development projects involve establishment of the initial electricity network reticulation infrastructure for land within urban areas not previously reticulated/serviced and is applicable to both residential and commercial/industrial estates.

Considerable effort has been made to ensure that all major development initiatives currently being considered have at least been identified. However, uncertainty in land release plans makes it impossible to forecast with a great degree of confidence. Detailed customer initiated capital investment requirements beyond the first one or two years of the 2009–14 regulatory period are speculative only.

New urban developments are not expected to proceed at the levels seen on average over the last several years. Indeed the level of new urban developments has been continually trending down since 2008-09, with this trend expected to continue to 2023-24, with 2023-24 forecasts approximately 52% of the 2007-08 trended value.

The development of the new urban development forecast is constrained by the release of information on the latest land release program by the ACT Government Economic Development Directorate, which is not due for release until post 30 June 2014.

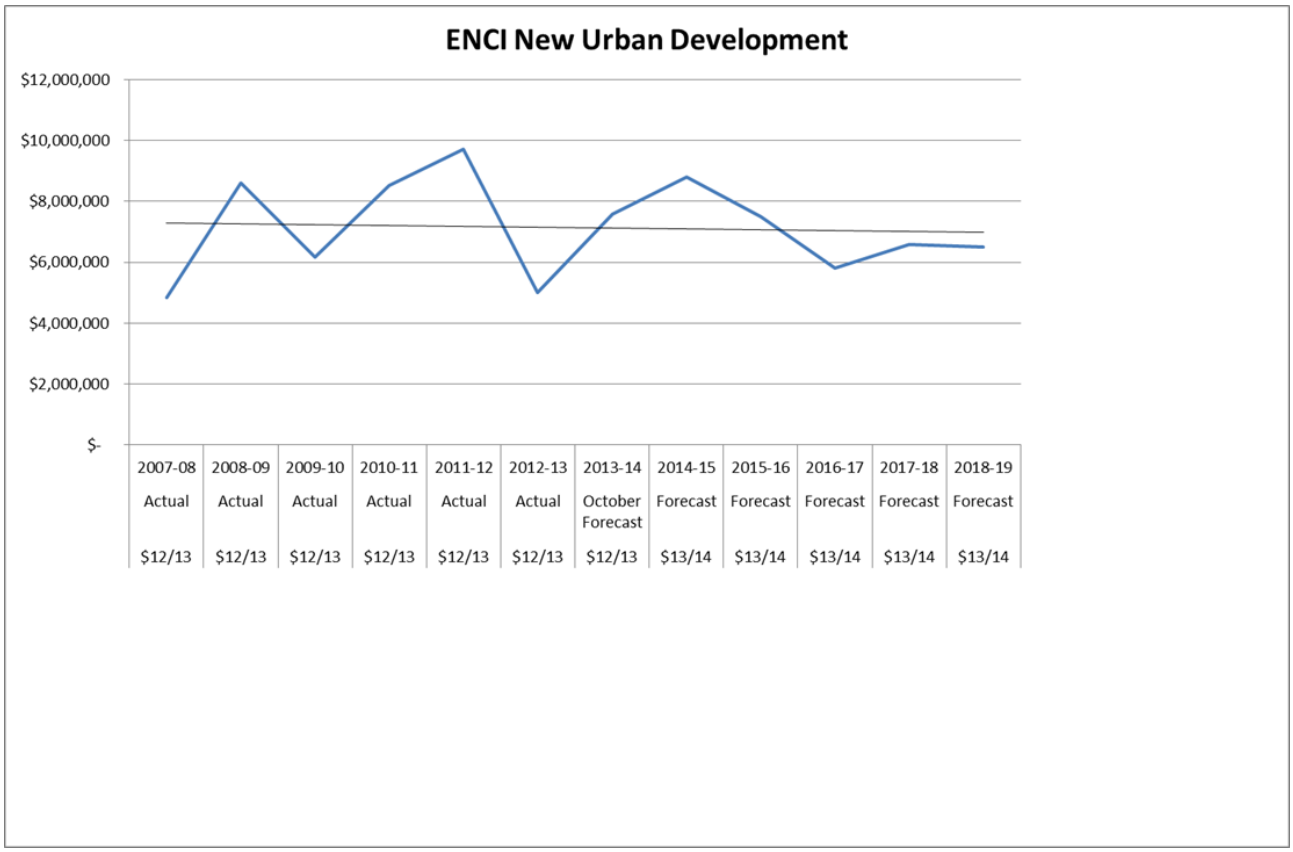
New urban development activity levels largely correlate with the activity levels in the construction industry because newly constructed buildings typically will require some form of network augmentation to better cater to the new load demand.

During the 2014–19 regulatory period, expenditure on new urban developments is expected to steadily trend down from $7.6 million in 2013/14 to $6.5 million in 2018-19 ($2013/14 values).

The forecast for new urban development trend have been derived based on BIS Shrapnel's Building and Construction Industry forecast. It was found that ActewAGL's historical expenditure correlates most closely with the "Medium Density Completed" and "Total Public Completed" indicators.

The expenditure profile for this category is predicted to trend slightly downwards following a similar trend in Medium Density and Public Housing constructions in the ACT. This is primarily due to public sector budget cuts resulting in weaker population growth and underlying demand for land in the ACT. A slight expenditure increase in FY2017/18 can be expected due to an increase in public housing construction activity.

Figure 5: New urban development trend (FY12/13 $real) and forecast (FY13/14 $real)



1.12 New meters and new PV meters

Major changes to the regulatory framework for metering services were recommended by the AEMC in the November 2012 Power of Choice review, and in October 2013 the Standing Council on Energy and Resources (SCER) submitted a set of rule change proposals to implement the recommendations. As such new meters, replacement meters and new PV meters have been combined under the heading "Alternative Control Metering Services".

ActewAGL Distribution's indicative forecast of meter installations and replacements is shown in **Error! Reference source not found.** below. The main driver of the indicative estimates of the number of new meter installations (not for PV) is the level of activity in the construction sector in the ACT.

The demand for meters for PV installations is driven by different factors, including government policies and incentives, the cost of PV installations and electricity prices. Demand has fallen significantly from the previous peak, when the ACT feed-in tariff scheme for small-scale (less than 30 kW) installations was still open to new applicants. Installation of new PV meters is expected to decline further in the next regulatory period but this does not necessarily reflect a decline in the uptake of PV installations. Rather, it is the case that following the introduction of net metering arrangements on 1 July 2013, PV readings can now be taken from the standard

meters that have recently been installed or will be installed in the future without needing additional meter registers.

In addition to the installation of customer-initiated new meters and new PV meters, ActewAGL Distribution plans to replace approximately 3,600 meters per year over the 2014-19 regulatory period. Overall the indicative estimates of new meter installations are subject to a high degree of uncertainty.

As this is the first time new and replacement meters and PV meters have been combined under the category Alternative Control Metering Services, there is no historical data to display

1.13 New services

This category of expenditure covers supply and installation of overhead or underground services for new domestic residential installations where the load is less than or equal to 100 Amps and the service can be connected of the existing LV mains reticulation without modification of the LV mains.

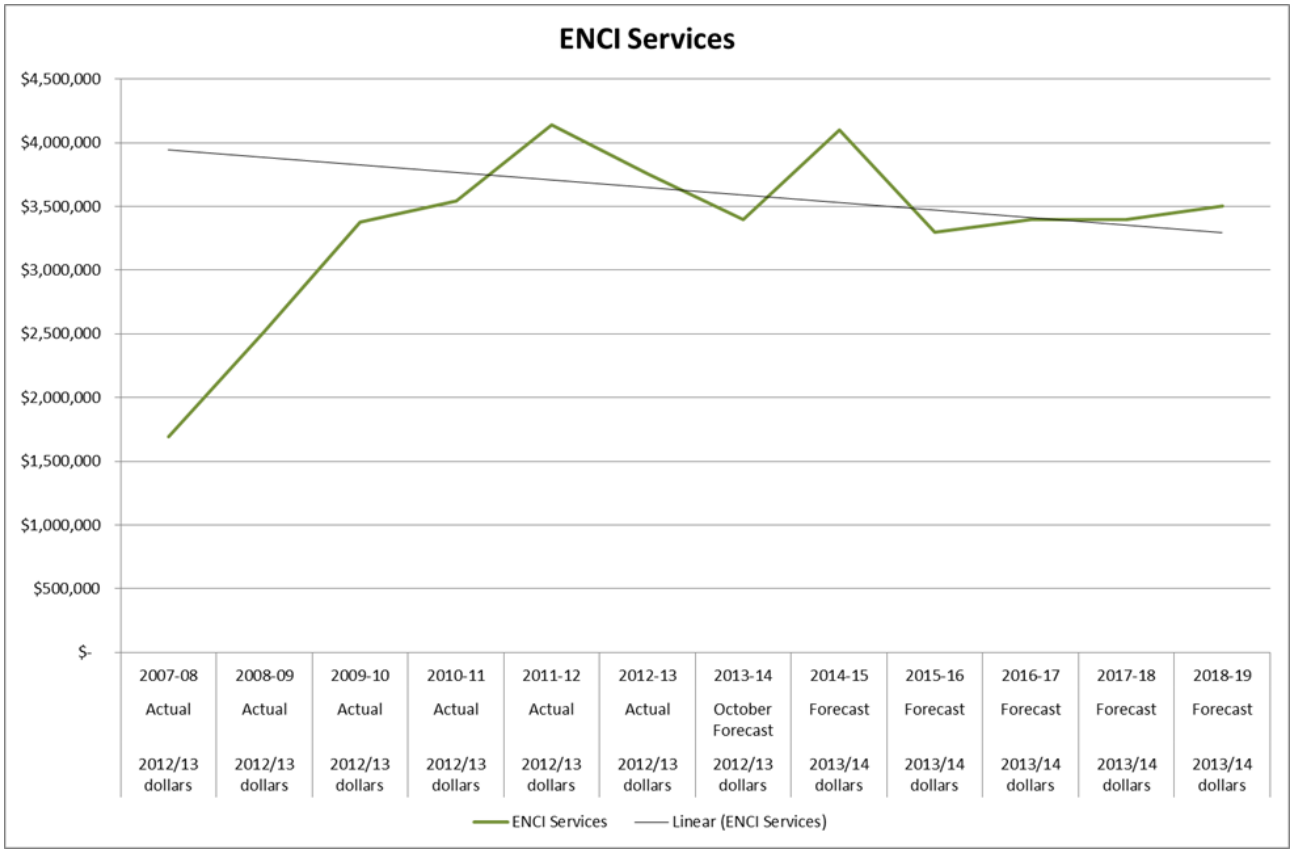
All new services in urban areas in the ActewAGL supply area are underground connection/services, whilst those in rural areas are overhead services.

As stated above in section 1-9 the level of new urban developments is expected to steadily decline to 37% of the 2014/15 level by 2018/19. Jacobs SKM would expect to see a similar decline in new services over the same period.

The forecast for new services trend derived forecast, was based on BIS Shrapnel's Building and Construction Industry forecast for "Medium Density Completed" and "Houses Completed" indicators. Note: Forecast figures are in FY13/14 dollars.

The expenditure profile for this category is predicted to trend downwards following similar trend in Houses and Medium Density constructions in the ACT. This is primarily due to public sector budget cuts resulting in weaker population growth and underlying demand for housing in the ACT.

Figure 6: New services historical (FY12/13 $real) and trend forecast (FY13/14 $real)



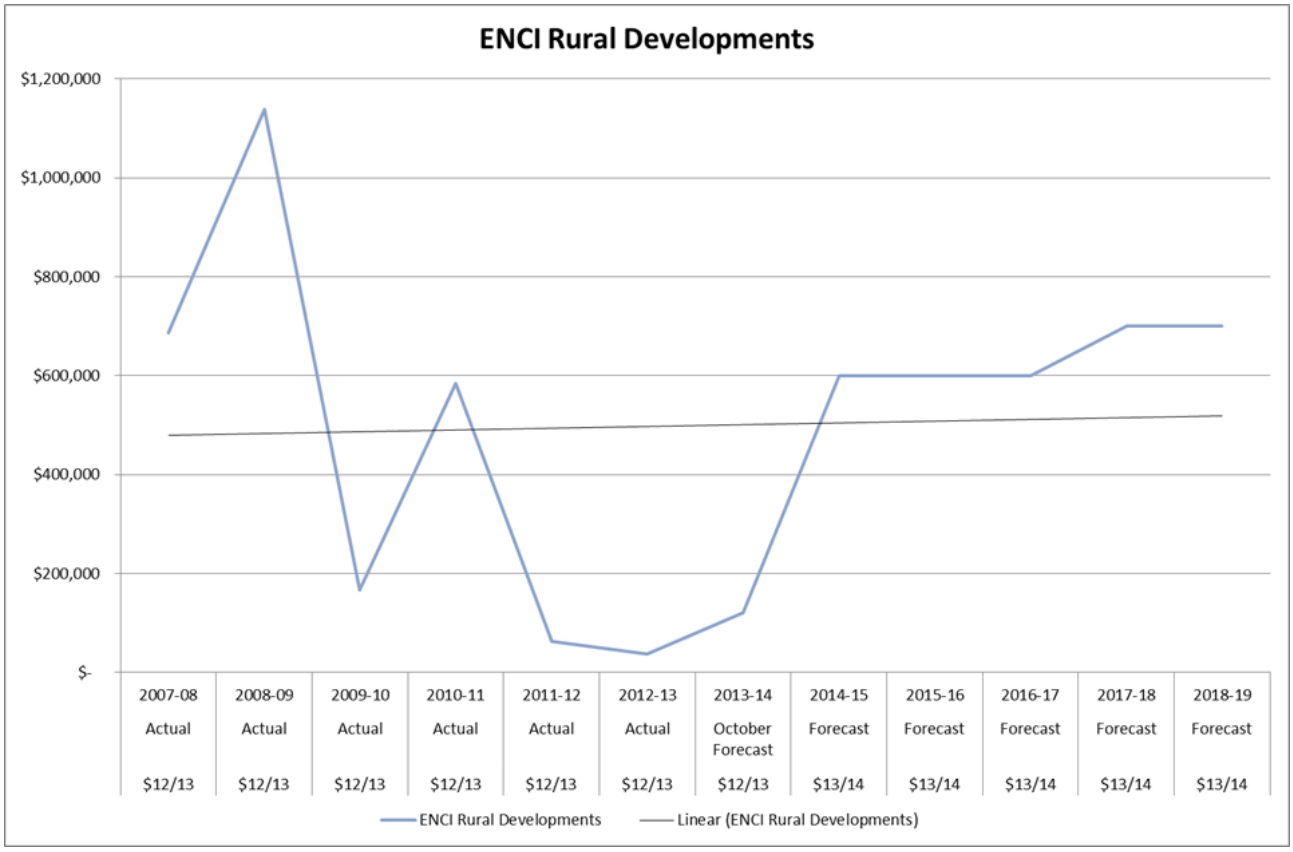
1.14 Rural development

Rural development projects involve establishment of the electricity network reticulation infrastructure for rural land not previously reticulated/serviced or individual rural customers/loads and is applicable to residential, agricultural and commercial/industrial customers.

There is no clear market indicator by which to forecast future Rural Development activity levels. As such, expenditure forecast tends to be of a provisional nature. The level of rural development peaked in 2008/09, and again in 2010/11 (though at a lower level). The overall trend has been gradually increasing since 2007/08.

The forecast level of $600,000 represents the average annual expenditure since FY07/08.

Figure 7: Rural development historical (FY12/13 $real) and trend forecast (FY13/14 $real)

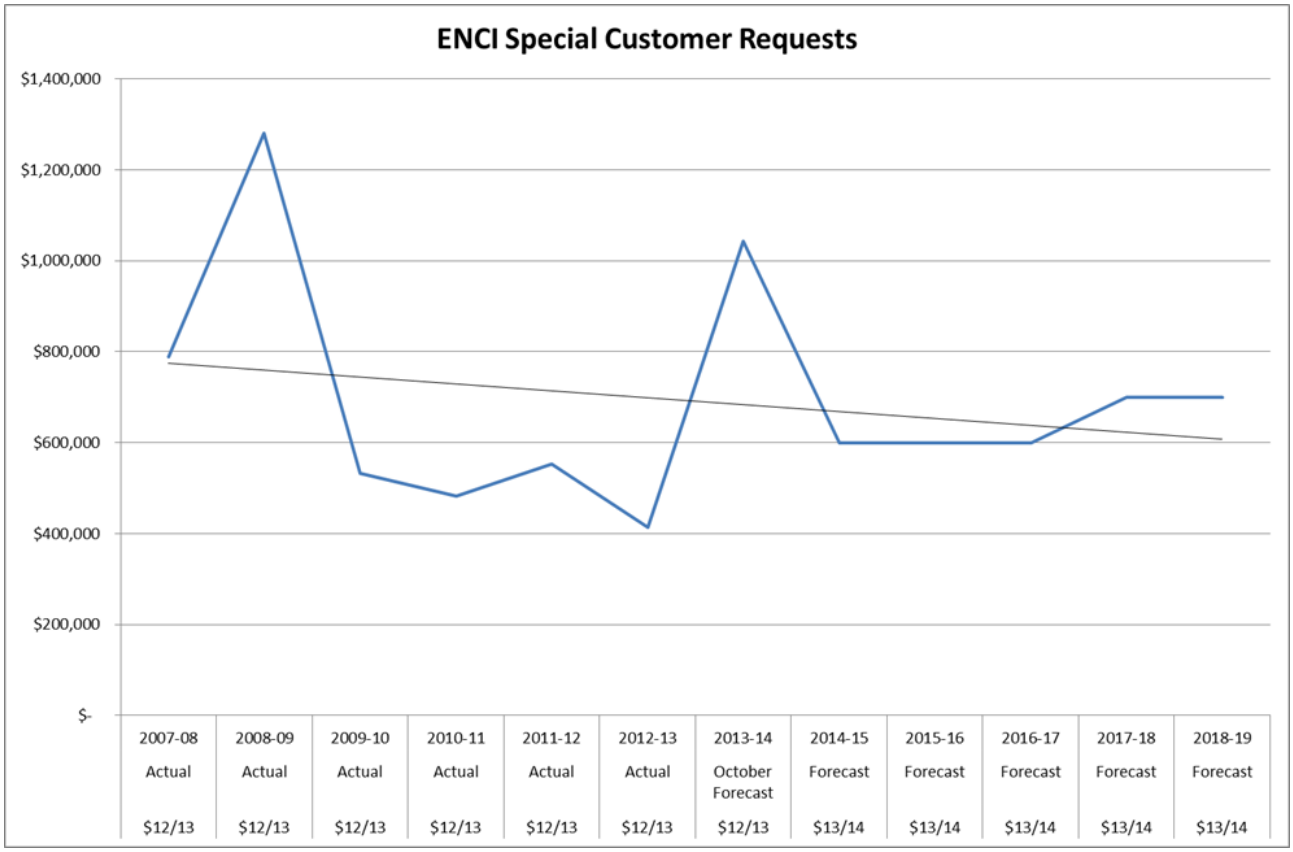


1.15 Special customer requests

Special customer request works undertaken by ActewAGL involve small to moderate expenditures and are typically identified through direct approaches from developers, government departments, telecommunication providers and members of the public.

There is no clear market indicator by which to forecast future Special Customer Requests activity levels. As such, expenditure forecast tends to be of a provisional nature. The level of special customer requests peaked in 2008/09, and again in 2013/14 (though at a lower level). The overall trend has been in decline since 2008/09. The forecast level of $600,000 represents the average annual expenditure over the period 2009/10 to 2012/13.

Figure 8: Special customer requests historical (FY12/13 $real) and trend forecast (FY13/14 $real)



1.16 Urban infill development

Urban infill has been defined as the use of land within a built-up area for further construction, especially as part of a community redevelopment or growth management program or as part of smart growth. It focuses on the reuse and repositioning of obsolete or underutilized buildings and sites. Redevelopment or land recycling is development that occurs on previously developed land. Infill buildings are constructed on vacant or underutilized property or between existing buildings.

Urban infill projects involve the network connection and directly associated network extension works required for new multi-unit residential developments or redevelopments within established areas that have already been reticulated/serviced (ie, the HV and/or LV).

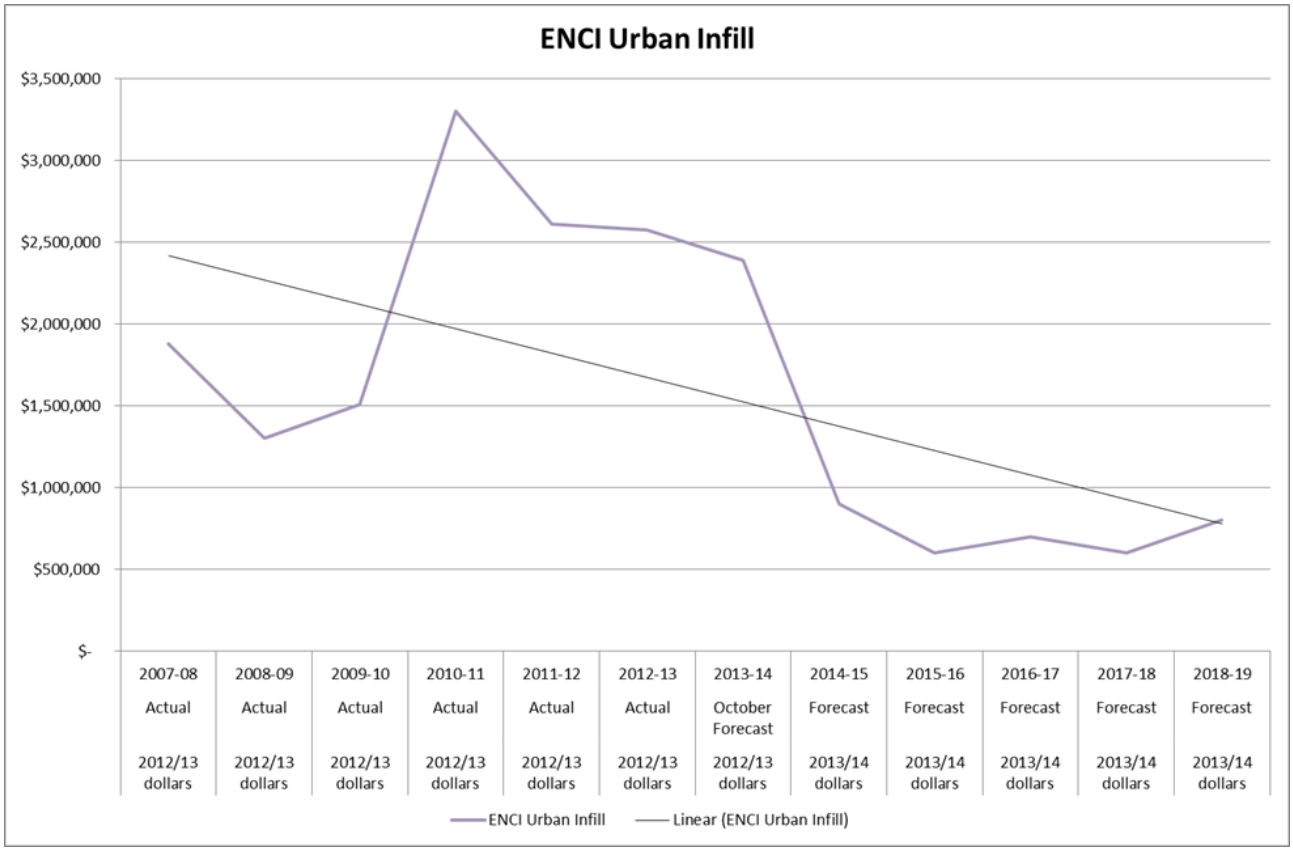
The expenditure for urban infill peaked in 2010/11 at $3.3 million and has been in consistent and rapid decline since then. The most significant annual reduction in expenditure is forecast to occur in 2013/14 to 2014/15. Over this period the expenditure is forecast to reduce from $2.4 million to $0.68 million.

Urban Infill activity levels largely correlate with the activity levels in the construction industry because newly constructed buildings will typically require some form of network augmentation to better cater to the new load demand.

The forecast for urban infill trend derived forecast was based on BIS Shrapnel's Building and Construction Industry for "Medium Density Approved" and "High Density Approved" indicators. Note: Forecast figures are in FY13/14 dollars.

The expenditure profile for this category is predicted to trend downwards following the general trend in the construction industry in the ACT. This is primarily due to public sector budget cuts resulting in weaker population growth and underlying demand for the ACT. A slight expenditure increase in FY 2018/2019 can be expected due to an expected increase in Medium Density Approval in FY2017/18.

Figure 9: Urban infill development historical (FY12/13 $real) and trend forecast (FY13/14 $real)



2. Network augmentation capital works plan

2.1 Overview of major augmentation projects 2014 – 2019

The following sections provide information and commentary about augmentation projects during the 2014 - 2019 period under the general network categories of:

- Transmission projects
- Zone substation projects
- Secondary systems projects, and
- Distribution projects

The projects listed are likely solutions to addressing anticipated network constraints and performance issues. ActewAGL will consult with non-network providers and customers, where appropriate, to take advantage of any emerging non-network options before committing to the final solutions to address these issues.

2.2 Transmission constraints and proposed developments

ActewAGL Distribution electricitynetwork is connected to the TransGrid transmission network at three connection points. These are:

1) Canberra 330 kV bulk supply substation
2) Williamsdale 330 kV bulk supply substation
3) Queanbeyan 132 kV bulk supply substation

The Canberra and Williamsdale 330 kV bulk supply substations are the main connection points. Queanbeyan 132 kV connection point supplies Fyshwick commercial and industrial areas via Fyshwick zone substation.

ActewAGL's 132 kV transmission network is an N-1 secure network, for all credible contingency events that may occur on the ActewAGL system.

ActewAGL's 66 kV transmission network is made up of two radial feeders (also N-1 secure) from Transgrid's Queanbeyan BSP to Fyshwick zone substation.

The peak demand on ActewAGL's transmission network over 2013 summer was 586 MVA on 18 January 2013. The forecast peak demand based on 10% PoE for the next ten years (2014 – 2023) is within the thermal rating of the transmission lines in response to a single contingency event on the network.

2.2.1 Reconfiguration of the ActewAGL transmission network

In 2013, ActewAGL commissioned the East Lake 132/11 kV zone substation, which is equipped with an 11 bay 132 kV GIS switchboard. This switchboard is designed to enable the reconfiguration of the 132 kV system in the area, and in particular to allow for the eventual decommissioning of the Causeway 132 kV switching station. This project is known as East Lake Zone Substation Stage 2, and is scheduled for 2017. The full scope of work associated with East Lake Stage 2 includes:

- Decommissioning and removal of the Causeway switching station by 2017
- Removal of the existing 132 kV overhead line section from East Lake zone substation to Causeway switching station
- Construction of a new underground cable section from East Lake zone substation for connection to the existing City East 132 kV line (to replace the overhead section removed above)

- Removal of a section of the existing 132 kV overhead line from Gilmore to Causeway switching station
- Construction of a new underground cable section from East Lake zone substation for connection to the existing Gilmore 132 kV line (to replace the overhead section removed above)
- Extension of the existing 132 kV UG cables between Telopea Park and Causeway to East Lake Zone substation

2.2.2 Transmission project capex forecast

The forecast capital expenditure on Transmission category projects over the period 2014/15 -2018/19 is shown in the Table 3.

Table 3: Transmission forecast capex

Project name	Project number	Project cost	14/15	15/16	16/17	17/18	18/19
Southern supply to the ACT 132 kV lines stg 2	7519208	$9,650			$6,350	$3,300	
OPGW on 132 kV network	7521157	$5,597	$1,142	$1,028	$2,057	$1,370	
TNSP Metering	7522902	$994	$497	$497			
		$16,241	**$1,639**	**$1,525**	**$8,407**	**$4,670**	**$0**

2.2.3 Southern supply to the ACT-132 kV line upgrade

ActewAGL has implemented a project to develop the southern portion of its transmission system to meet a directive issued in 2006 by the ACT Government to establish a southern supply to the ACT (the now existing Williamsdale substation). Therefore in the event of the total loss of Canberra 330/132 kV bulk supply substation, the ACT will be supplied from the Williamsdale 330/132 kV bulk supply substation.

A transmission line constraint has been identified on the transmission line section between Theodore and Gilmore zone substations should the ACT need to be supplied from Williamsdale 330 kV bulk supply substation.

This constraint is planned to be rectified by the upgrade to the feeder, scheduled for 2018, and is shown in the Table above.

2.2.4 OPGW on 132 kV network

The existing ActewAGL communications network which is a mix of digital radios, pilot wires and Telstra cables is extremely limited in capacity. The reliability of this network presents a severe bottleneck to realising the benefits of the current SCADA system and thus the effective and reliable performance of the electricity network. Furthermore, the performance of some aspects of ActewAGL's existing 132 kV network protection fault clearing times falls short of technical compliance with the current National Electricity Rules but is considered acceptable due to ‘grandfathering’ provisions in the Rules.

A need for upgrade will arise, for example, every time a large scale generator is connected to the 132 kV network or when 132 kV network upgrade, modification or new investment takes place. ActewAGL network may not comply with the new performance standards in these instances depending on the nature of the load and the application of the relevant Rules to the particular installation.

Several options have been investigated for economic prudency and technical feasibility to replace the existing communication networks with a single communication network that will provide the speed, security, reliability and functionality required for the power network.

The preferred option is to replace the existing overhead earthwires on 132 kV circuits with OPGW (overhead pilot ground wire). The 132 kV overhead lines between Belconnen and Bruce have already been upgraded with

OPGW conductor. OPGW is also currently being implemented within the second supply to the ACT project. Future upgrade of Woden to Wanniassa lines will present another opportunity for OPGW installation. Continued implementation of the OPGW solution will ensure uniformity throughout the network and simplify maintenance and procurement activities.

2.2.4.1 TNSP Metering Installation

Chapter 3 of the NER requires ActewAGL Distribution as a registered Transmission Network Service Provider (TNSP) to install NEM compliant metering at each point of connection between a transmission network and a distribution network.

ActewAGL Distribution plans to spend almost $1 million installing TNSP metering in the first two years of the 2014-19 regulatory period. This expenditure will be attributed to the completion of site works, the installation of energy meters and National Association of Testing Authorities (NATA) accredited meter testing.

2.3 Zone substation constraints and proposed developments

ActewAGL has twelve 132/11 kV zone substations (incl. East Lake, commissioned in December 2013), one mobile 132/22 kV zone substation, one 66/11 kV zone substation, and two 132 kV switching stations. Due to the dual function categorisation of assets all 132/11 kV zone substations are classified as transmission assets, except Fyshwick, Telopea Park and Angle Crossing which are classified as distribution assets.

Stage 1 of the East Lake zone substation project, completed in late 2013, relieved an existing overloading situation at Fyshwick zone substation and will provide additional supply capacity to meet increasing electrical demand in the South Canberra region.

The ten year zone substation 10%PoE load forecast, combined with analysis of system limitations on the 11 kV distribution system, indicates that some zone substation augmentation will be required within the 2014-2019 regulatory period.

After application of the 10% PoE maximum demand forecast, and considering the options available for either system reinforcement, or demand side initiatives, ActewAGL has developed the following schedule of major projects, which are the most probable “best economic solution” to overcoming projected system limitations and constraints.

Potential solutions have been identified to address the existing and emerging constraints at zone substations, and on the related distribution feeder systems. A combination of equipment upgrades, load transfers between zone substations, and potential demand management solutions are considered to be the most cost effective solution.

The scope, timing and estimated costs of these major projects are subject to final ActewAGL Board approval, and RIT-T or RIT-D consultation processes, where appropriate.

The forecast capital expenditure on zone substation category projects over the period 2014/15 – 2018/19 is shown below.

Table 4: Zone substation forecast capex

Project name	Project number	Project cost	14/15	15/16	16/17	17/18	18/19
Belconnen zone substation fence upgrade	7520944	$50	$50				
Belconnen zone substation security upgrade	7522789	$0					

Project name	Project number	Project cost	14/15	15/16	16/17	17/18	18/19
Civic zone substation 415 V augmentation (DRF supply)	7523132	$0					
Disaster recovery room Civic zone substation	7523231	$1,065	$1,065				
Earthing upgrade (zones)	7523383	$2,619	$342	$455	$797	$455	$569
East Lake zone substation stage 1		$0					
East Lake zone substation stage 2	7522033	$0	$0	$0	$0		
Fire protection zone substations		$0					
TNSP metering installation project		$995	$497	$497			
Under-frequency relay installation project	7519210	$1,040	$160	$160	$160	$160	$160
Gold Creek zone substation 11 kV switchboard extension	7520759	$770		$270	$500		
Mitchell zone substation	7522034	$44,895		$600			
Molonglo zone substation	7519206	$23,200		$4,640	$11,600	$6,960	
Provisional power transformer	7523384	$3,000		$3,000			
Belconnen zone substation augmentation	7522037	$12,717			$2,904	$3,664	$6,149
		$90,350	**$2,114**	**$9,623**	**$15,961**	**$11,239**	**$6,878**

2.3.1 Belconnen zone substation upgrade

Belconnen zone substation was built in 1976 and has been servicing the Belconnen District for 36 years. The substation was designed as a two 132 kV/11 kV power transformer substation with two 11 kV switchboards. The continuous firm rating of this substation is 55 MVA in both summer and winter.

The two hour emergency firm rating has recently been increased by upgrading 11kV transformer cables, to 74 MVA and 76 MVA in summer and winter respectively. The continual residential and commercial load growth over the past 36 years resulted in the demand on Belconnen zone substation exceeding the summer two hour emergency firm rating in both 2009 and 2011.

Although the latest demand forecast for Belconnen zone appears fairly flat, significant potential and sizeable block load increases in the next few years could result in capacity constraints recurring towards the end of the next regulatory period.

It is proposed to return Belconnen to N-I security by installing a third transformer, associated building works, 132 kV and 11 kV switchgear, and associated control and protection systems, for completion by 2018/19.

2.3.2 New Molonglo zone substation

The Molonglo Valley to the west of Canberra is being promoted by the ACT Planning and Land Authority (ACTPLA) as the centre of residential and retail development over the next 20 years. The main area of existing development includes the suburbs of Wright and Coombs.

At present there are about 385 single and multi-unit residential dwellings and associated retail outlets in the area. The existing electrical load in the area is estimated at 1-2 MVA. The ultimate development of the Molonglo area is estimated to have a population of 55,000 over the next 20 years, with electrical demand expected to reach 15 MVA by about 2020. ActewAGL currently have to hand applications for supply to between 0.9 and 1.6 MVA of load over the next 18 – 24 months.

The existing Molonglo area load is supplied by two HV feeders from Woden zone substation (the Hilder and Cotter feeders), both of which have a substantial amount of “front-end loading” from the suburbs they supply before they reach the developing suburbs of Wright and Coombs. These HV feeders are estimated to have approximately 3.0 to 3.5 MVA of spare capacity before they reach their thermal limits. This capacity would have to cater for load growth not only at Molonglo, but also at the other suburbs they currently supply.

Plans are in place to reinforce and extend supply from the Black Mountain HV feeder from Civic zone substation, which will deliver another 2.5 MVA of additional feeder capacity into the Molonglo area. Allowing for the normal ActewAGL HV feeder security criteria of two feeders being able to carry 75% of the full load, in the event of loss of the third feeder, the area will require further augmentation when the total load reaches about 4-5 MVA.

As will be seen from the zone substation load forecast, there is adequate capacity to supply additional Molonglo load from the adjacent zone substations at Woden (nearing capacity) and Civic. However the nature of the terrain, the existence of other developments and infrastructure, and other construction restrictions suggests that it will be extremely difficult to construct additional overhead or underground feeders into the Molonglo area from adjacent zone substations.

Molonglo zone substation is currently scheduled for commissioning in mid-2018.

2.3.3 Zone substation earthing upgrade

The earth grids at ActewAGL’s zone stations were installed when the stations were first developed and hence range in age up to 46 years.

As the earth grids are buried beneath the station surfaces, and most likely beneath at least some equipment foundations, their widespread exposure for physical inspection is not practical nor could it be easily achieved. As such the condition of the earth grids, particularly those of the greatest age, is largely unknown.

In light of their unknown condition and the increase in network fault levels over time, the effectiveness of the earth grids and hence the level of safety provided at each station is uncertain.

It is proposed to undertake a staged program of inspection, electrical testing and refurbishment/upgrading as necessary of the station earth grids. For each station the program would be comprised of two stages:

- Stage 1 - would incorporate the sample inspections, electrical testing and overall condition assessment of the earth grids.
- Stage 2 - would cover the refurbishment and upgrading as necessary of the earth grids as determined by the Stage 1 outputs.

The proposed program would be conducted over the period 2014 to 2018 with works being undertaken nominally at a rate of three stations per year.

2.3.4 Gold Creek 11 kV switchboard extension

The existing 11 kV switchboard at Gold Creek zone substation does not have any spare 11 kV circuit breakers to accommodate additional 11 kV feeders that may be required to supply new loads, or augment feeders reaching their thermal limits. The existing switchgear is GEC type SBV 3 which may require adaptations to be made to accommodate a different make and type of switchgear, as an extension to the existing switchboard.

Developers have previously advised of expected upgrades to the proposed Metronode and Australian Data Centres that would require additional 11 kV feeders, and associated zone substation circuit breakers. Both these data centres have been delayed by the customer, however it is considered prudent to proceed with the switchboard extension (which has a longer lead time than the associated feeder works).

At present it is planned to complete the Gold Creek switchboard extension over 2015/16 and 2016/17, with the feeder works to be undertaken in 2017/18 (Australian Data Centre) and 2018/19 (Metronode Data Centre).

2.3.5 Provisional transformer

ActewAGL has a fleet of twenty-five 132/11 kV zone substation power transformers of nominal ratings up to 57 MVA within the distribution network. The zone substation transformers are one of, if not the most critical asset class within the network, with their reliability directly related to that of customer supplies from the respective zone substations.

Unlike most other asset classes the lead time for procurement of transformers is long, typically of the order of 6 to nine months. In the absence of a suitable spare, the loss of a transformer can result in disruption to customer supplies for an extended period of time until a replacement can be sourced.

The transformers within the ActewAGL network range in age from five to 46 years. Condition assessment based on regular analysis of oil samples has shown that for other than the two most recently installed units, typical aging characteristics are evident across the balance of the population. Given that the loading regime for the transformers has mostly been within their nominal ratings the observed deterioration is generally in line with the age of the respective units.

ActewAGL has had an independent audit done of its fleet of zone transformers and identified four transformers with an estimated remaining life of less than five years.

The proposed project is to purchase a provisional transformer which will serve the dual purpose of providing an emergency back-up, in the event of an unexpected failure of one of the existing fleet, and to provide a temporary replacement while some of the existing fleet are refurbished /overhauled.

Several locations are being considered to determine the best and most effective location to install the provisional transformer initially.

2.3.6 Under-frequency relay installation project

Major power system disturbances on the national grid include the loss of generation and tripping of interconnector ties. Such disturbances cause an imbalance between generation and load consumption leading to a decline in the network frequency from its nominal value. To prevent system collapse during under-frequency events load must be rapidly shed to stabilise and recover the network frequency.

The National Electricity Rules (NER) administered by the Australia Energy Market Commission (AEMC) clause S5.1.10 outlines the obligations for Network Service Providers (NSPs) in relation to maintaining power system security and reliability standards. NSPs in consultation with NEMMCO under S5.1.10 must ensure that a sufficient amount of load (minimum 60% expected demand) is under the control of automatic under-frequency load shedding (UFLS) relays that in the event of multiple contingency events, the network system frequency does not move outside of the extreme tolerance limits.

NSPs must therefore provide, install, operate and maintain facilities for automatic load shedding, and conduct periodic testing of the facilities without requiring load to be disconnected.

In order for ActewAGL Distribution to comply with the NER in relation to power system security this project has been initiated to introduce automatic under-frequency protection into the ACT distribution network.

Options for implementing the proposed UFLS scheme have been investigated, and the preferred option is expected to cost $1.04 million spread over approximately 10 years.

2.4 Secondary systems

The list of secondary systems projects and their associated capex forecast is shown in the Table 5.

Table 5: Secondary systems forecast capex

Project name	Project number	Project cost	14/15	15/16	16/17	17/18	18/19
SCADA communications upgrade – fibre to distribution substations	7523386	$1,900	$300	$350	$400	$400	$450
SCADA communications upgrade – MPLS WAN backbone	7523385	$1,295	$275	$270	$260	$290	$200
SCADA communications upgrade – SCADA radio IP, bandwidth and security	7523387	$600	$120	$120	$120	$120	$120
TMR radio system augmentation		$270	$135	$135			
		$4,065	**$830**	**$875**	**$780**	**$810**	**$770**

2.4.1 ActewAGL networks telecommunications strategy

The existing ActewAGL SCADA telecommunications network is a mix of UHF digital radios (DDRN) and pilot wires, with some small scale use of optical fibre and microwave links. The network is extremely limited in capacity and does not provide adequate and timely real time SCADA information for effective control room operations, with some analogue and digital changes taking several minutes to be reported.

The following bearer types are currently in use in the ActewAGL network:

- Optical fibre
- Microwave radio
- UHF digital radio (in the DDRN outlined above)
- Metallic pilots (not to be considered for future requirements – replace with optical fibre)

The performance constraints of the network present a roadblock to realising the benefits of the SCADA system and this will only become more apparent with the implementation of the ADMS, where real time data is critical to correctly calculating the network state, load flows and correctly reporting network outages.

ActewAGL have prepared an overarching Networks Telecommunications Strategy that will enable the limitations of the existing system to be overcome, and which will provide for a multi service fibre optic and microwave MPLS network covering the main control centre at Fyshwick, the future DRF facility at Civic Zone substation and connecting to all zone substations.

The distribution network will be serviced by a mix of fibre optic and an upgraded DDRN. The communication network will also support requirements for advanced metering and future network automation requirements. The multi service network will provide individual virtual private networks for different services such as protection, SCADA, advanced metering and corporate services.

This strategy aligns with the ICT strategy by ensuring Operational Technology (OT) systems are independent of, and segmented from, corporate ICT services. The strategic vision for the ActewAGL communication network is to create a converged communication network to deliver multiple services required for the existing and future requirements of the electrical network.

The following projects are components of the overall network communications strategy.

2.4.2 SCADA communications upgrade-fibre to distribution substations

Optical fibre cabling is widely used in the power industry, with the capability of supporting high transmission bandwidth on individual fibre pairs (2 x fibres for transmit and receive).

The benefits of fibre cabling include:

- Large capacity medium compared to other bearer types such as radio, power line carrier and metallic pilot cables
- Reliable carriage that achieves zero transmission error and performance that is unaffected by changing environmental conditions
- Can be run with electrical transmission and distribution lines with a small incremental cost
- Low environmental impact

The implementation of fibre optic to individual distribution substations will be required in the following situations:

- Replacement of existing copper pilot cables with fibre due to failure of the metallic pilot (asset renewal of pilots with fibre)
- Additional business requirement such as chamber substation SCADA or advanced metering infrastructure (AMI)
- Additional network protection requirements such as protection inter-tripping
- Network automation requirements such as flop over schemes for critical customers such as hospitals
- HV customer and generator network connections (normally separately customer funded)

Estimated costs over the five year period for fibre optic provisioning to distribution substations/network are estimated at between $300,000 and $450,000 p.a. Projects for fibre optic communications will be specified in separate business cases covering one or more distribution substations.

2.4.3 SCADA communications upgrade-MPLS WAN backbone

To meet the business requirements needs outlined in ActewAGL's Network Communications Strategy, a multiservice communication network employing the MPLS technology is proposed.

MPLS is by far the most commonly selected WAN technology for smart grid implementations because of its:

- Maturity and proven capabilities across large-scale industrial and enterprise networks
- Ability to support both traditional applications and next-generation requirements
- Ability to virtualize the WAN into independent sub-networks
- Centralised management of physical infrastructure and virtualized sub-networks
- Ability to enhance and become an integral part of the security framework across the WAN
- Modularity for scalability and flexibility, as well as the ability to protect the overall system from domain failures

MPLS has recently been adopted by BSD to segment sensitive Payment Card Industry client traffic from the corporate network. Currently BSD have MPLS configured between the data centres in Fyshwick and Greenway, and ActewAGL House. It is proposed to implement an MPLS network to electrical network sites in four stages. The MPLS rollout will occur in conjunction with the proposed OPGW fibre rollout.

2.4.4 SCADA communications upgrade-SCADA Radio IP, bandwidth and security

Estimated costs over the five year period for the IP upgrade of the Digital Data Radio Network (DDRN) are approximately $120,000 per annum, and migration of DDRN remotes to the chosen IP (internet protocol) solution will only occur during the normal asset renewal cycle as assets fail or otherwise reach the end of their service life.

2.4.5 TMR Radio system augmentation

For mobile voice communications, ActewAGL currently employs a TMR radio system operating in the 400 MHz UHF band and a VHF radio network operating at 70 MHz. The VHF radio equipment has reached the end of its useful life and it is proposed to upgrade the remaining VHF base station at Mt Tennent to a TMR base. This will rationalise the deployment of bases and mobile radios to the TMR radio system.

The existing radio network design exposes radio repeaters and substation SCADA RTUs to cyber intrusion and denial of service attacks. The risks to ActewAGL are similar to those from the Maroochy Water Services SCADA Cyber Security attack in the year 2000, where a hacker operated radio controlled sewage equipment. Migrating the zone substations to MPLS and upgrading the DDRN will mitigate these risks.

2.5 HV distribution feeder augmentation and inter-zone tie capacity

In addition to the Molonglo and Belconnen zone substation projects there will be several larger HV feeder projects required over the period 2014-2019. Some of these projects will be required to cater for local area load growth and spot load increases, while others are designed to strengthen inter-zone ties and to re-balance and optimise zone substation loading into the future.

The list of HV feeder augmentations and their associated capex forecast is shown in Table 6.

Table 6: HV feeder forecast capex

Project name	Project number	Project cost	14/15	15/16	16/17	17/18	18/19
City West Edinburgh feeder	7519152	$0					
Australian data centre HV supply stage 2 Mitchell	751445	$3,190	$3,190				
East Lake zone substation feeder installations stage 1	7519222	$0					
Anticipated network augmentations stage 1	7519150	$4,000	$500	$500	$1,000	$1,000	$1,000
East Lake zone substation feeder installations stage 2	7522685	$2,000	$1,500	$500			
Hilder feeder extension	7522681	$600	$600				
ANU feeders 6 and 7	7520000	$640		$640			
Bushfire mitigation – remote area power supply	7523683	$273		$273			
East Lake zone substation feeder installations stage 3	7522686	$2,000		$1,000	$1,000		
Ijong feeder augmentation	7522683	$145		$145			
City East new feeder	7519151	$912			$912		
Cotter 22 kV upgrade at Woden ZS	7522684	$0					
Fyshwick CDC data centre HV supply stage 2	7523489	$1,000			$1,000		
Tuggeranong town centre development supply	7522690	$2,686			$1,000	$1,686	
Belconnen service trade area	7520614	$2,085				$1,000	$1,085
Black Mountain feeder upgrade	7523491	$1,500				$1,500	
Kenny development HV supply feeder	7522689	$1,530					$1,530

Project name	Project number	Project cost	14/15	15/16	16/17	17/18	18/19
Molonglo zone substation feeder installations	7519229	$4,970					$1,400

2.5.1 HV feeder augmentation

A number of known or highly likely projects are listed below:

- **Australian Data Centre HV supply, Mitchell:** initially, the Australian Data Centre and Metronode Data Centre indicated load requirements of between 3 MVA and 7 MVA each, and original timing was for 2013/14. The timing of both data centres has recently been deferred, and the developers are unable to advise new connection dates required. It is considered prudent however to make provision for at least one of the data centres to proceed, and a notional date of 2014/15 has been set.
- **East Lake substation feeders, Stage 2 & 3:** East Lake zone substation was commissioned in December 2013 with a single transformer, and a stage 1 feeder system which picked up approximately 15 MVA of load. The stage 2 &3 project feeder project is designed to enable a further 20 – 25 MVA of load to be transferred from Fyshwick and Telopea Park zones.
- **Hilder Feeder Extension:** The Hilder 11 kV feeder out of Woden zone substation supplies load to the north of Woden. It is proposed to extend this feeder into the Molonglo valley, thereby reinforcing the distribution system to Molonglo until the new zone substation is established.
- **ANU Feeders 6 & 7:** The ANU's Acton Campus has experienced rapid electricity load growth in recent years. In particular, summer demand has grown by approximately 4% per year since 2003/2004. The rapid load growth that has occurred during this period can be attributed to land development, major refurbishments, and retrofitting of air-conditioning systems across the campus.

  At the historical average annual load growth, the total ANU Acton Campus electricity demand (10%PoE forecast) will exceed the total firm capacity of the existing bulk supply point / external feeders by 2014. This is, dependent upon whether the previously proposed HV power factor correction (PFC) facility at SWS1254 proceeds, or not.

  Furthermore, potential catastrophic failure and/or complete loss of the current single bulk supply point constitutes a significant ongoing security of supply risk to the ANU Acton Campus, as the two existing back-up supply points can only supply approximately 50% of the ANU Acton Campus summer peak demand.

  The preferred augmentation option is to install two new underground feeders (each 1.1km) from Civic zone substation to the ANU.

- **Bushfire mitigation – remote area power supply:** Two remote sites at Gudgenby and Corin Dam are currently connected with ActewAGL's network via dedicated high voltage overhead distribution lines. The lengths of the lines are approximately 7 km and 9.5 km respectively. Both of the lines present high bushfire risk and are costly to maintain.

  Three options have been investigated and costed, including "do nothing", undergrounding of the problem feeders, and the installation of a RAPS system associated with customer energy efficiency measures.The preferred option is to install RAPS and to remove the existing overhead lines at Gudgenby Homestead and Corin Dam, by the end of June 2016. This option has a higher capital cost than the "do nothing" option, but has a lower ongoing O&M cost, and has the lowest capital cost for reducing the bushfire risk on the existing overhead lines supplying electricity to the two remote locations.
- **Ijong Feeder augmentation:** Some sections of underground cable in the Ijong distribution feeder, which supplies commercial buildings in the Bradden area, are over 50 years old and have suffered faults in recent years. There are numerous cable joints in the feeder, giving rise to concerns about its reliability. Some sections of the cable have multiple U-turns in it, with the result that these sections effectively run parallel

with each other, and end up where they started. It is planned to remove the redundant sections of the cable, thereby reducing system losses and improving reliability. The work is programmed for 2015/16

- **City East new feeder:** A new feeder installation was initiated in 2008 from the City East Zone Substation into the city area to provide supply to an upcoming large residential and commercial development. That particular development has been delayed due to the current economic environment, but may be reinitiated in the near future. There are also other customer developments which have recently been initiated in the same area, and augmentation of the distribution system is expected to be required. It is proposed to reinforce supply to the area by installing a new 3km underground distribution feeder from City East zone substation. Work is tentatively scheduled for 2016/17
- **Fyshwick CDC Data Centre:** The Fyshwick CDC Data Centre has started construction and is expected to require electricity supply by September 2014. The data centre is expected to require a maximum demand of 8.5MVA by 2021. Existing capacity on the network will be used until the data centre demand exceeds network capacity. The development of the data centre has been divided into separate stages. Stage 1 has commenced and is due to be completed in 2014. Stage 2 is forecast to be completed in 2016/2017 financial year. Stage 2 is expected to require the installation of either 1 or 2 distribution feeders

  Augmentation to Tuggeranong Town Centre: The ACT Government Environment and Sustainable Development Directorate (ESDD) has developed a new master plan for the Tuggeranong town centre, including a new residential development which is expected to add approximately 1.5 MVA of load when fully developed. The existing 11 kV feeder system is heavily loaded, and several options have been investigated to reinforce the supply from either Wanniassa or Theodore zone substations.
- **Belconnen Service Trade Area:** The Belconnen Service Trade area is a development proposed to take place to the west of the town centre. This development will have a mix of residential and commercial load over an area of approximately 37582m². It is planned for 799 residential developments and a commercial centre employing approximately 4000 people. The estimated ADMD for the proposed development is around 12MVA, comprised of 9MVA commercial/retail and 3 MVA residential loads. It is proposed to supply the new development from Latham zone substation by installing a new 4.9km underground cable.
- **Kenny Area Development:** A new residential suburb, Kenny, is planned for the near future and is located near Exhibition Park in Canberra and Watson. It is expected that Kenny will have a maximum demand of 6MVA once completed, however it is still in its very early stages of development and building work has yet to start. There are a minimal number of existing feeders in the proposed development area as most of the land is undeveloped. It is planned to supply the Kenny development from City East zone substation, and to rearrange existing feeder loads to enable an underground cable extension to the Kenny development. The work is presently programmed for 2018/19.
- **Extending and uprating the existing Black Mountain feeder:** as with the Hilder feeder from Woden zone substation, it is proposed to extend and uprate the Black Mountain feeder (out of Civic zone) to reinforce supply to the Molonglo valley, prior to the commissioning of the new zone substation.
- **Molonglo zone substation feeder installations:** a number of new 11 kV feeders will be required to connect Molonglo zone substation into the existing feeder system
- **Anticipated Network Augmentations, Stage 1:** In addition to the above, allowance has been made for small to medium unspecified HV feeder augmentations, which will arise during the course of the next regulatory period. Such HV feeder augmentations typically average about $500,000 - $1 million p.a.

3. Asset Management Plan

The Asset Management System is a collection of functionally related elements working together towards the purpose of effectively and efficiently managing ActewAGL Distribution core assets.

The overarching Asset Management Policy is informed by corporate level policy objectives, and states that ActewAGL is committed to the effective implementation of asset management with a disciplined approach to maximise value and deliver its strategic objectives through managing assets over their whole lifecycle. This approach conforms to the requirements of PAS 55-1:2008 Asset Management which supports effective asset management outcomes and ensures continuous improvement in asset management processes.

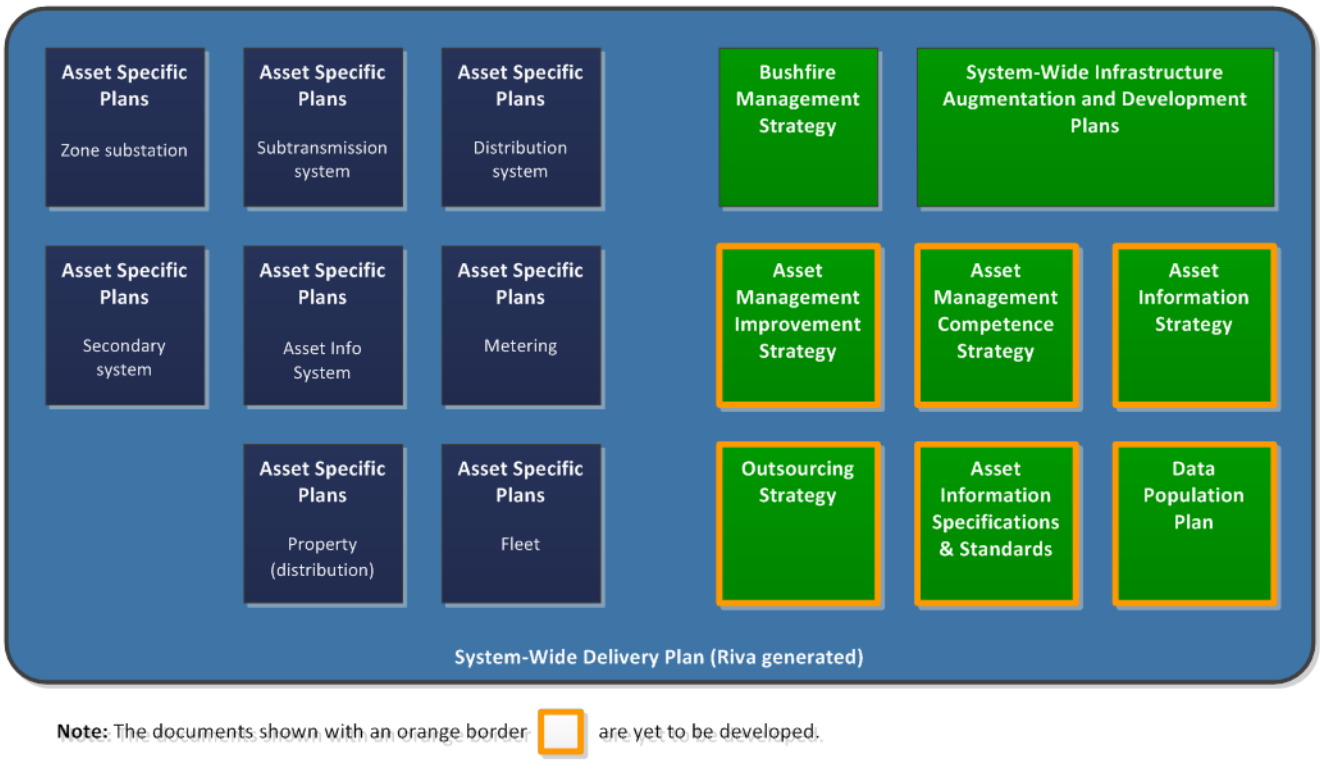
The Asset Management Strategy is the central document that defines the strategic objectives and approach to the management of physical assets which is optimised and sustainable in terms of whole-of-life/whole-of-system cost over the long-term. This document identifies activities to be performed, and is implemented by the asset management plan.

3.1 Asset Management Plan documents

With the introduction of the Riva decision system, the ActewAGL asset management system does not rely upon a conventional asset management plan, but on a collection of documents generated by Riva and supporting augmentation and development plans and management strategies.

The asset management plan consists of a compilation of documents, as shown in Figure 10.

Figure 10: ActewAGL Asset Management Plan



Note: The documents shown with an orange border are yet to be developed.

The Asset Specific Plans are plans for each particular network, non-infrastructure and non-network asset type, and are integrated over the life of the asset, and with other assets to produce the optimum whole-of-life/whole-of-system strategy for each asset. In compliance with the PAS 55 Asset Management standard, the suite of documents that are shown in **Error! Reference source not found.** deliver the asset management objectives across the following life cycle activities:

- Creation, acquisition or enhancement of assets
- Utilisation of assets
- Maintenance of assets
- Decommissioning and/or disposal of assets

The processes and procedures for the implementation of the asset management plan are consistent with the asset management policy, asset management strategy and asset management objectives, and ensure that costs, risks and asset system performance are controlled across the asset life cycle phases.

3.2 Network augmentations

Within the suite of documents that constitute the Asset Management Plan, the *Network Augmentation Program Summary report* is generated by Riva, and provides a list, schedule and budget estimate of all significant network augmentation projects planned by ActewAGL. The projects are planned up to 10 years into the future, with budgeted expenditure broken down into financial years. All projects have been developed through a thorough process of load and demand forecasting, gap analysis, assessing alternative solutions (both network and non-network), and finally selection by consideration of the whole-of-life/whole-of-system costs and benefits.

Table 7 shows the projected augmentation expenditure for the 2014-19 regulatory period. All expenditure values shown are in real values with a base of 2013/14.

Table 7: Estimate of network augmentation capital expenditure 2014/15 to 2018/19

Year ending 30 June $ million (2013/14)	2014/15	2015/16	2016/17	2017/18	2018/19	Total
Total augmentation	9.6	17.1	35.7	26.9	17.0	106.3

Key augmentation projects to be undertaken during the 2014-19 regulatory period are:

- Construction of a new zone substation to meet demand from the new urban developments in Molonglo and North Weston
- An upgrade to Belconnen Zone Substation to maintain ongoing reliability in the Belconnen region
- Stage 2 of the Southern Supply to ACT project initiated by an ACT Government regulation in 2006
- Optic fibre installation on the 132 kV overhead network to enhance SCADA and network protection functions and capability, and to improve network operational effectiveness and reliability

3.3 Customer initiated augmentations

The *Customer Initiated Augmentation* report generated by Riva provides a list, schedule and budget estimate of all significant customer initiated augmentation projects planned by ActewAGL. The projects are planned up to 10 years into the future, with forecast expenditure broken down into financial years.

Table 8 shows the projected customer initiated augmentation expenditure for the 2014-19 regulatory period. All expenditure values shown are in real values with a base of 2013/14.

Table 8: Estimate of customer initiated augmentation capital expenditure 2014/15 to 2018/19

Year ending 30 June $ million (2013/14)	2014/15	2015/16	2016/17	2017/18	2018/19	Total
Customer initiated augmentation	23.3	22.4	20.1	21.3	24.6	111.7

Customer initiated capital expenditure relates to new housing and similar developments, where the customer (being the developer) contributes to the cost of a network to service the area. This follows a zero-based approach, with forecast developments based on the following:

- Direct customer/developer enquiries
- Major public and private development initiatives identified through public/media announcements
- Future development activity identified through the ACT Government planning, preliminary assessment and agency liaison/consultation processes
- Future development activity identified through ACT Government land release programs
- Economic forecasting of underlying demand and of dwellings commenced identified by market analysts
- Historical expenditure in the various customer initiated work categories adjusted to reflect the anticipated short-term broader economic environment
- The Customer Initiated Augmentation report from Riva notes that the significant proportion of the capex forecasts are based on forecasts for building and construction activity produced by BI Shrapnel and a correlation against historical expenditure for similar activities.

3.4 Asset replacement/refurbishment

Asset replacement/refurbishment includes the following asset groups:

- Distribution including substations/switching stations and overhead
- Zone substations
- Transmission
- On-Ground and Underground
- Secondary systems
- Metering
- Property

Asset renewal, including pole replacement expenditure, is forecast using a zero-based approach utilising activity and event unit rate costs and asset activity algorithms in the asset management software Riva. Each asset is analysed and prioritised for replacement based on the input of a series of condition reports and risk ratings, generating a work schedule for the replacement of assets by financial year and the associated capital expenditure.

Table 9 shows the projected asset replacement/refurbishment augmentation expenditure for the 2014-19 regulatory period. All expenditure values shown are in real values with a base of 2013/14.

Table 9: Estimate of asset replacement/refurbishment expenditure for 2014/15 to 2018/19

Year ending 30 June $ million (2013/14)	2014/15	2015/16	2016/17	2017/18	2018/19	Total
Distribution	0.1	0.1	0.1	0.1	0.1	0.3
Distribution Substations	2.1	2.1	2.1	2.2	2.3	10.8
On-Ground & Underground	2.4	3.7	3.7	3.8	3.9	17.4
Overhead Distribution	16.6	17.4	16.3	16.2	15.9	82.3
Property	1.7	1.6	1.7	1.7	0.0	6.8
Secondary Systems	1.2	1.6	1.6	1.5	1.5	7.5
Transmission	0.6	0.6	0.6	0.6	0.6	2.9
Zone Substation	2.2	1.3	2.3	1.9	2.0	9.7

Year ending 30 June $ million (2013/14)	2014/15	2015/16	2016/17	2017/18	2018/19	Total
Total asset renewal	**26.8**	**28.5**	**28.3**	**27.9**	**26.2**	**137.7**

The significant programs are:

- Ongoing pole replacement program, replacing wood poles with concrete poles in public areas and fibreglass poles in back-of-block overhead reticulation
- Cross-arm replacement program for pole-top upgrade
- Planned replacement of underground cables that have exceeded their average service life and are failing at an increasing rate

3.5 Metering

The AER has classified off-peak metering (type 5 and type 6), new type 5-7 meter installation, and customer requested meter upgrades as alternative control services for the 2014-19 regulatory period.

The metering replacement program is based on the Meter Asset Management Plan v 2.5 (MAMP) which documents the current state of the meters, and their replacement, maintenance and testing schedules; and build date, date installed and other details relating to each meter in the ACT held in Riva. Information contained in the MAMP is then included in Riva to arrive at a replacement and new meter installation schedule, along with associated costs

There are two types of metering capital expenditure: replacement and new meter installations. Both types follow a zero-based method.

3.5.1 Meter replacements

The metering replacement schedule is identified in the MAMP and Riva, which contains the build date, date installed and other details relating to each meter in the ACT. Using this information, a forecast is developed for the number of replacements expected during the regulatory period in conjunction with an estimate of labour rates and parts.

3.5.2 New meters

For customer initiated metering installs, estimates are also zero-based. These are based on broader projections for other customer initiated capex incorporating BIS Shrapnel projections on employment, home borrowing and other land release data.

Table 10: Estimate of metering alternative control service expenditure for 2014/15 to 2018/19

Year ending 30 June $ million (2013/14)	2014/15	2015/16	2016/17	2017/18	2018/19	Total
New meter installations	3.2	3.3	3.3	3.3	3.4	16.5
Meter replacement	1.7	1.7	1.7	1.7	1.7	8.5
Total	**4.9**	**4.9**	**4.9**	**5.1**	**5.2**	**25.0**

3.6 Asset maintenance

Network maintenance is forecast using Riva and the result of the inputs and parameters of each asset combined with algorithms that prioritise the maintenance schedule. Being fully zero-based, maintenance costs can be difficult to predict. In such cases, additional system algorithms help smooth and remove any volatility by bringing forward and delaying maintenance needs as appropriate, with the objective being to minimise the cost over time.

Each asset's maintenance forecast is based on the following key activities:

- Planned maintenance
- Unplanned maintenance
- Condition monitoring

Network maintenance includes maintenance carried out on zone substations, secondary systems, distribution and transmission assets and property. It includes planned and unplanned maintenance together with condition monitoring costs, maintenance strategy and planning and vegetation management.

Table 11: Estimate of network maintenance expenditure 2014/15 to 2018/19

Year ending 30 June $ million (2013/14)	2014/15	2015/16	2016/17	2017/18	2018/19	Total
Network maintenance	22.4	22.4	22.1	22.6	22.8	112.3

The major maintenance programs are:

- Pole inspection program and auditing of inspectors and lineworker quality of work
- Pole reinforcement and priority repair work for poles that represent an unacceptable hazard
- Power transformer maintenance and condition monitoring
- Distribution substation transformer, switchgear, low voltage switchboard and enclosure maintenance
- Vegetation management - vegetation costs are forecast using a base-year approach, being largely recurrent in nature and adjusted for changes in contractual arrangements. ActewAGL Distribution is responsible for managing vegetation surrounding rural lines. The forecast expenditure relates to normal tree cutting, undergrowth control and waste disposal associated with line clearing, including co-ordination and supervision of vegetation control work. Emergency work is excluded from this forecast.

3.7 Key outcomes from the Asset Management Plan

Pole replacement and renewal are anticipated to continue to dominate the forecast expenditure program during the 2014-19 regulatory period. ActewAGL Distribution is implementing a range of strategies to address its aged wood pole population. This includes the selection of the optimal pole type through consideration of replacement capital cost, ongoing maintenance requirements, ease of construction and safety.

ActewAGL also has an aged underground distribution network that has 15% of the population over the average service life, and another 11% that will exceed the average service life over the next 10 years. These aged cables are experiencing failures at an increasing rate. During the 2014-19 regulatory period, ActewAGL Distribution will initiating a condition monitoring program of critical underground feeders, and anticipates that there will be in excess of five kilometres of cable to be replaced during the next regulatory period.

Other significant planned projects and programs are:

- Establishment of Molonglo Zone Substation
- Augmentation of Belconnen Zone Substation
- Renewal of revenue metering (type 5-7) that has reached the end of its service life