2019-24 Capital Expenditure Proposal (SAMP)

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1.0 INTRODUCTION

Endeavour Energy's purpose is:

To be of service to our communities by efficiently distributing electricity to our customers in a way that is safe, reliable and sustainable.

This purpose states that Endeavour Energy strives to manage its electrical network assets in a sustainable way for the long-term benefit of the stakeholders. In order to do so, the company has identified network needs which are required to be addressed to ensure that the company can fulfil its purpose. This Strategic Asset Management Plan (SAMP) document these network needs. The primary stakeholders of the company include residential, commercial and industrial customers connected to Endeavour Energy's network, other members of the community in Endeavour Energy's franchise area, energy retailers, an Australian-led consortium of long-term investors, the NSW government, the Treasury and regulatory authorities.

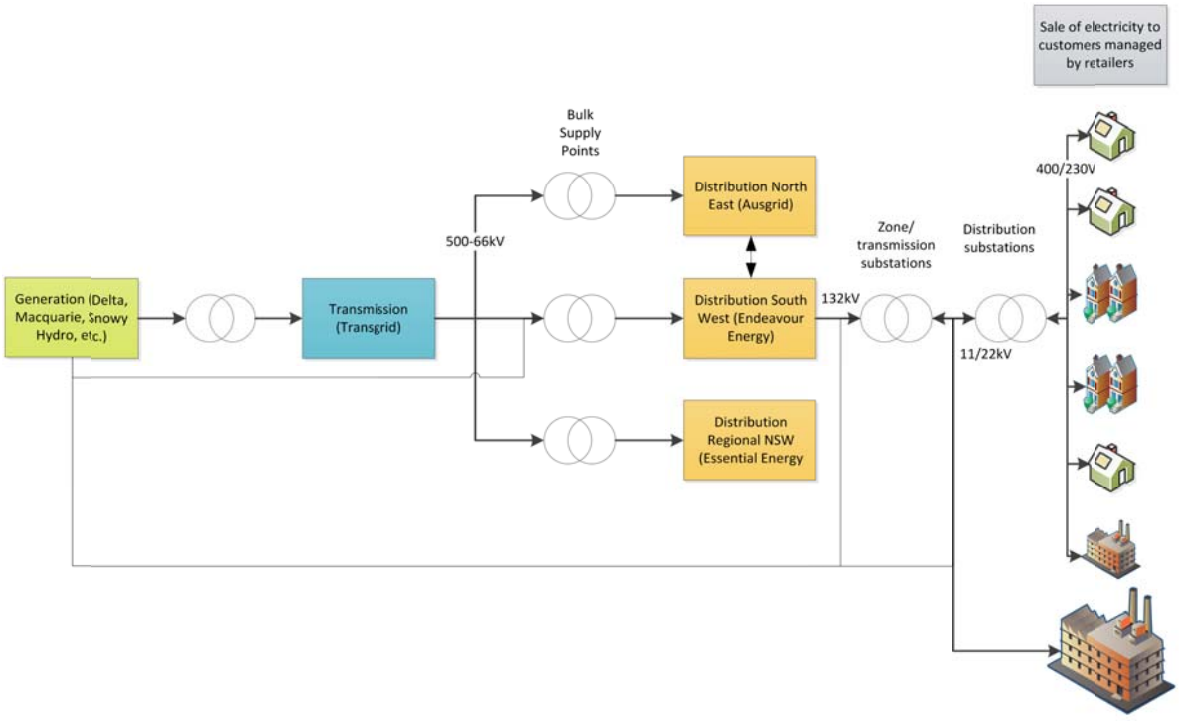
A key function of the SAMP is to prioritise the asset management activities in particular projects and programs and associated expenditure. In addition it discusses and documents the trade-offs that are made in developing the year ahead and ten-year network expenditure forecasts. In combination with the Workforce Plan, the SAMP helps to ensure the efficient and timely delivery of projects and programs.

Effective achievement of the strategic network objectives requires an assessment of the impact on network outcomes that each proposed project or work program will have. Individual plans are developed in the key expenditure areas based on asset need. The SAMP uses a risk-based project prioritisation framework to integrate and prioritise these plans into an overall capital and operating expenditure program with appropriate input from relevant stakeholders.

1.1 DESCRIPTION OF THE NETWORK

Within NSW there are four network businesses involved in the physical distribution of power from the generators to the customers by private retailers. TransGrid operates the transmission network between the generators, distributors and interconnectors to the wider National Electricity Market (NEM). Endeavour Energy, Ausgrid and Essential Energy are the other network businesses who connect the transmission network to the customers based on set geographical areas. Figure 1 below shows a simplified summary of the interaction between these stakeholders in NSW.

FIGURE 1 – SIMPLIFIED INTERACTION OF ELECTRICITY NETWORK BUSINESSES IN NSW

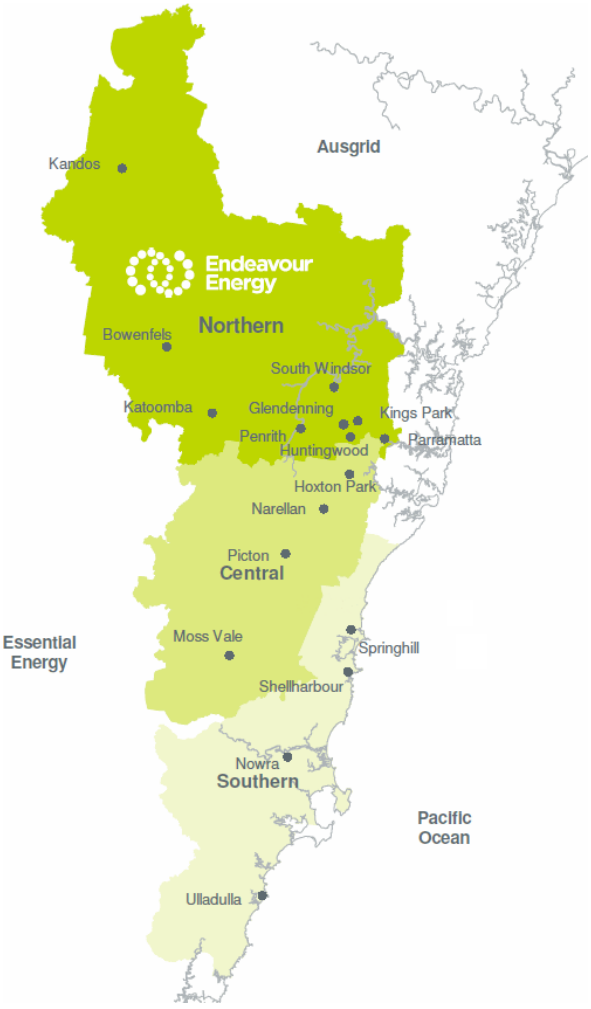


Endeavour Energy is a 'poles and wires' business with a total replacement cost of $17 billion (based on the recent ODRC valuation), and a network supply area that spans 24,980 square kilometres. We are responsible for the safe, reliable and efficient supply of electricity to almost one million customers or 2.4 million people in households and businesses across Sydney's Greater West, the Blue Mountains, Southern Highlands, Illawarra and the South Coast.

The following local government areas are currently in Endeavour's franchise area:

- Northern region:
  - Lithgow City Council;
  - Mid-Western Regional Council;
  - Hawkesbury City Council;
  - Blue Mountains City Council;
  - Penrith City Council;
  - The Hills Shire Council;
  - Blacktown City Council; and
  - City of Parramatta Council.
- Central region:
  - Fairfield City Council;
  - Cumberland Council;
  - Liverpool City Council;
  - Camden Council;
  - Campbelltown City Council;
  - Wollondilly Shire Council; and
  - Wingecarribee Shire Council.
- Southern region:
  - Kiama Municipal Council;
  - Shellharbour City Council;
  - Shoalhaven City Council; and
  - Wollongong City Council.

FIGURE 2 – ENDEAVOUR ENERGY FRANCHISE AREA



The assets covered by this plan consist of all network equipment involved in the distribution of electricity to end users, including 24 transmission substations; 164 zone substations; 13 major switching stations; 31,900 distribution substations; 433,100 poles (including private poles) and 205,500 streetlights bound together by almost 59,300km of overhead and underground cables; along with all associated control, protection, communications and ancillary equipment[1].

[1] Asset Databook 30 June 2017

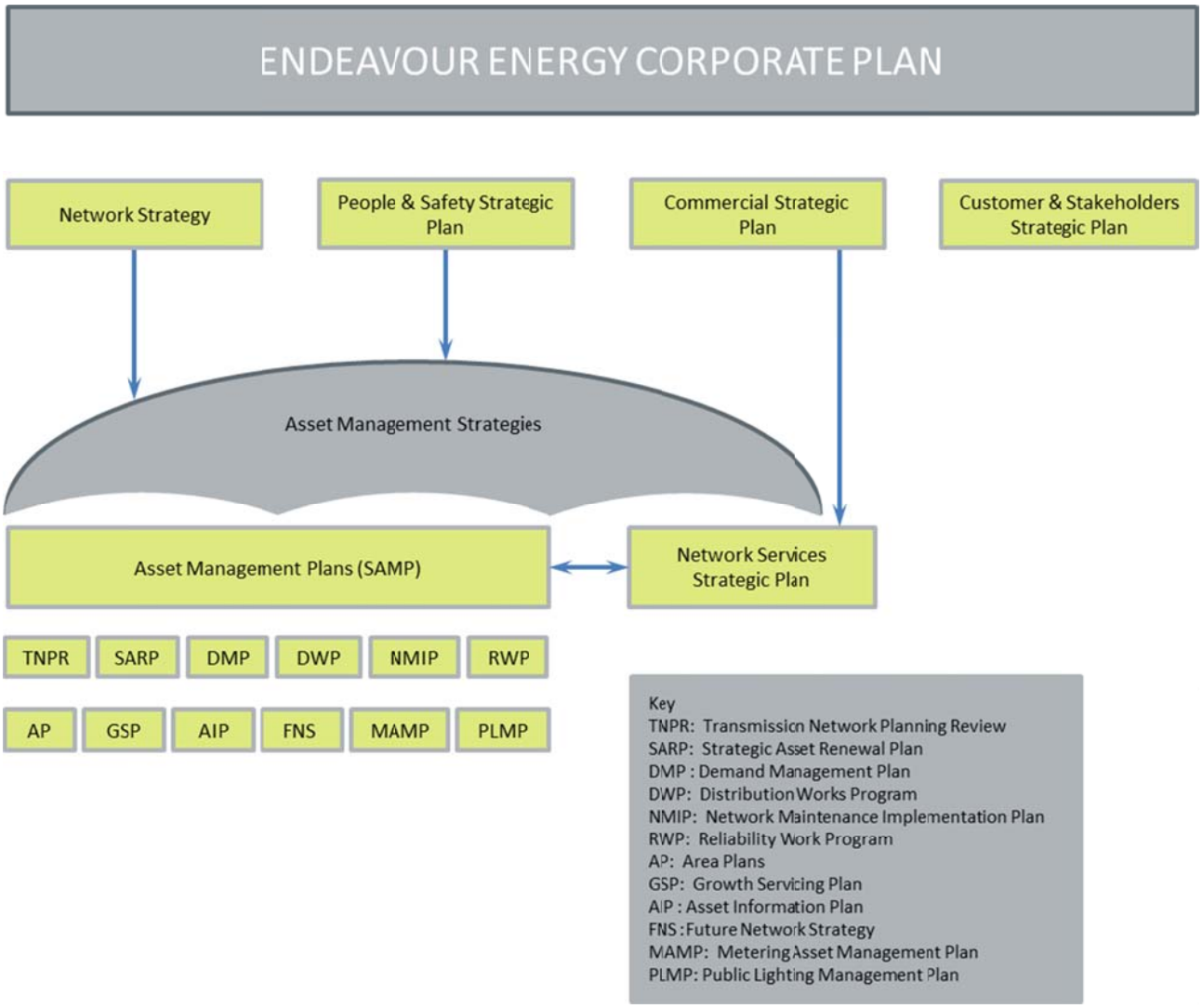
2.0 INVESTMENT OVERVIEW

2.1 ASSET MANAGEMENT AND INVESTMENT PLANNING

Endeavour Energy has developed an Asset Management System (AMS) to deliver the long-term safety, reliability and sustainability of the network. It provides a framework for effectively managing the network and its assets through the complete asset life cycle of planning, acquisition, utilisation, maintenance and disposal. The framework has been developed over many years based on practical asset management experience and is not aligned or based on any particular external standard.

Figure 3 below shows the relationship between our network strategy, asset management strategy, and the various plans and reports that combine to form a significant component of the Company's Asset Management System. Further, this system has been developed to provide continual feedback and forms the basis of the annual investment planning cycle.

FIGURE 3 - ASSET MANAGEMENT PLAN STRUCTURE



The intent of Endeavour Energy's investment planning process is to develop commercially optimal solutions (i.e. those that maximise the net benefits over the planning horizon) to meet the needs of our customers for a safe, reliable and sustainable electricity supply. Planning is conducted using a risk assessment framework for all segments of the investment program, with the level of detail commensurate with the complexity and value of different segments.

Plans to develop the network take into account the following factors:

- Statutory and regulatory requirements relating to the safe operation of the network and environmental performance;
- The need to address capacity constraints to achieve a level of supply security commensurate with reasonable customer expectations, accepted industry standards;
- The reliability performance required by our Licence Conditions;
- The condition and long-term sustainable performance of the network assets;
- Customer's connection requirements; and
- Joint planning requirements with TransGrid and Ausgrid.

These network investment planning processes result in a suite of investment plans that are reviewed annually and form an essential element of Endeavour Energy's Network Investment Governance Framework.

Investment decisions are informed by a full understanding of the costs, benefits and regulatory requirements and are authorised in accordance with Endeavour Energy's Investment Governance Framework Policy 2.6.

All major network projects and capital programs are required to comply with the procedures set out in the investment governance framework. These procedures, which are designed to give assurance that the network plan translates into an efficient capital program, incorporates the following key elements:

- Robust governance processes including oversight by internal governance committees for investments greater than $2 million and the Board for investments greater than $10 million. The internal committees test the need for the investment and prudency of the proposed options, as well as delivery risks and viability of the capital structure under a number of scenarios;
- An integrated, whole-of-business whole-of-life-cycle approach to development and delivery of capital programs and investment that considers impacts of a capital constrained environment;
- Accountability of all investment development and delivery stakeholders to the Chief Executive Officer in respect of the development, determination and authorisation of network investments;
- A formal post-project implementation review process which evaluates the benefits delivered against those planned and approved;
- Transparent risk-based prioritisation of investments, including non-network options, to enable informed investment decisions based on risk outcomes;
- Consistent documentation, options evaluation and project scoping to enhance the transparency of decision-making; and
- Multi-staged approval gates to ensure effective review, scrutiny, and decision-making with the number of gates being a function of the size of the investment.

The key stages of Endeavour Energy's investment governance process are outlined in

Figure 4.

FIGURE 4 - KEY STAGES OF ENDEAVOUR ENERGY'S NETWORK INVESTMENT GOVERNANCE PROCESS

2.2 INVESTMENT DRIVERS

2.2.1 SERVICING GROWTH IN DEMAND

2.2.1.1 OVERVIEW

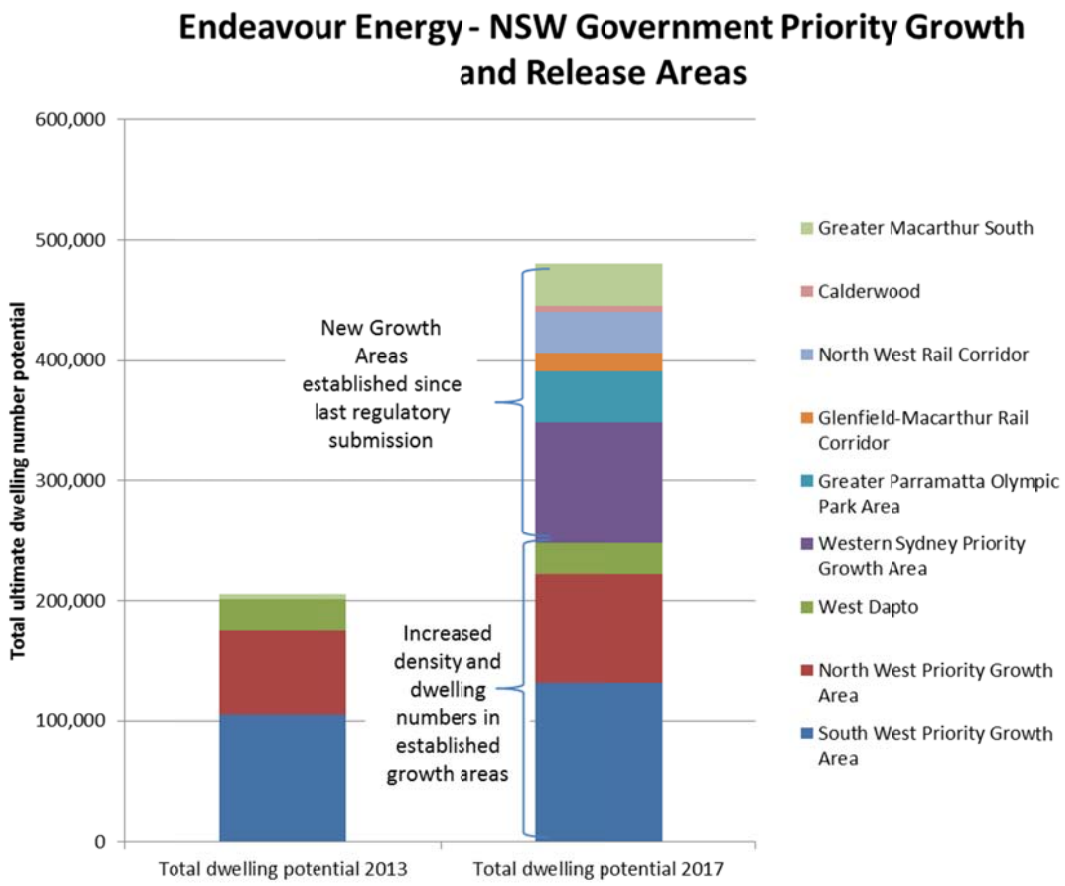
Electricity peak demand is a key driver of capacity-related network investment. In recent years it has been observed that peak demand growth from existing connections no longer presents a significant a driver of network augmentation capital expenditure. The energy demand in established areas has declined due to the effect of energy efficiency measures, the uptake of roof-mounted photovoltaic systems, and reductions in the demand from large industrial customers.

Notwithstanding this, Endeavour Energy continues to experience relatively high-levels of customer number growth in developing new areas, with the commensurate demand growth in many parts of its supply area where there is little or sufficient infrastructure to meet this growth. The demand growth in greenfield areas and redevelopment areas is forecast to remain strong for the foreseeable future.

We are currently connecting 23,000 new customers per annum, compared with only 11,000 customers in FY15. Our current 10 year forecasts are showing growth in demand in greenfield development areas to be on average 9% per annum, whilst older established areas are still experiencing growth rates of 1.5% per annum, fuelled by in-fill and redevelopment. Across the network our overall average growth in demand is forecast to be 2.3% per year over the 10 year forecast period.

Our network's greenfield development areas includes the North West and South West priority growth areas in Greater Western Sydney which are projected to accommodate 500,000 new residents, the equivalent to two cities the size of Canberra and Wollongong, over the next 30 years. These priority growth areas are the result of the biggest coordinated greenfield land release in the state's history, highlighted in the data shown in Figure 5 below.

FIGURE 5 - DWELLING GROWTH IN THE SUPPLY AREA



The establishment of the Western Sydney Airport at Badgery's Creek will drive further demand growth in the area. This development and associated development of the large surrounding residential, commercial and industrial areas are planned to support the Greater Sydney Commission's vision of a 'third city' for Sydney, with a potential 100,000 additional dwellings and 100,000 jobs. Commencement of construction of the airport is expected to act as a catalyst for the region with significant growth in demand, particularly in the Broader Western Sydney Employment Area in the longer term. Endeavour Energy's airport supply proposal has been developed to integrate with existing plans for supply to the South West sector and the Broader Western Sydney Employment Area.

Strong economic growth is also expected in the Parramatta and Liverpool CBD areas in addition to the North West and South West growth centres over the forecast period, with a series of major transport, health and education projects planned for the regions. The North West Rail Link, currently under construction, is expected to stimulate further high-density residential and commercial development in the North West Growth Sector. Examples of other significant brownfield development areas are the Glenfield to Macarthur Urban Renewal Corridor and the Greater Parramatta to Olympic Peninsula Priority Urban Area. There is also growth occurring as part of the Greater Macarthur and West Lake Illawarra Priority Growth Areas.

2.2.1.2 GROWTH FEATURES

There are three main drivers of growth-related (Augex) capital investment, these being:

- Brownfield augex – organic growth in established areas;
- Greenfield augex – new head-works infrastructure in developing areas (primarily subtransmission assets and zone substations and associated works); and
- Customer connections – shared asset funding for network connections in new and existing areas (primarily, but not necessarily, distribution assets and associated works).

The identified growth has the following features:

- Demand growth in existing established areas is being driven by general economic activity and changes in customer end-use patterns and appliance uptake. This is termed 'organic growth';
- Growth in connections in older areas is due to redevelopment, increased housing density and land re-use due to re-zoning (urbanisation of older industrial and commercial lands);
- There is substantial growth in new connections as new residential precincts are developed. This includes the development of new commercial centres, development of "employment lands" and the provision of supporting social infrastructure all of which adds to growth impacts and demand on network infrastructure; and
- Uptake of new technologies, increased appliance and end-use efficiency and 'demand shapers' such as rooftop solar PV installations and batteries is evident in lower per-unit demand for new connections, both in established areas as well as new greenfield areas, but this is not necessarily offset by the growth in the number of connections.

The above features are factored into the assessments of the impact that this growth is expected to have on the network.

Overall, current forecasts of expected summer maximum demands for the forthcoming ten-year period have identified that approximately one third of Endeavour Energy's zone substations are expected to experience growth rates of greater than 1.5% per annum, one third are expected to experience growth rates of between 0% and 1.5%, per annum, and the remaining third expected to experience a marginal decline in demand from present levels[2].

Given this, we have identified a number of network substation assets that will approach their firm capacity within the next ten years. This includes 10% of our zone substations that are all in greenfield development areas, all of which have high forecast growth rates noted above. Further, some of our major transmission substations and sub-transmission lines that form the backbone of the network are also forecast to reach rating limitations within the 10 year planning horizon, as identified in our annual planning reviews and detailed planning studies.

2.2.2 SUSTAINABILITY AND ASSET END-OF-LIFE IMPACTS

2.2.2.1 OVERVIEW

In the early 2000's Endeavour Energy recognised that the preceding low levels of investment in the replacement of network assets (particularly during the 1990's) was not sustainable and was leading to a decline in the condition and performance of the asset base.

In order to arrest this trend and to create a sustainable network asset base into the future, significant re-investment was required in a framework of strategic asset renewal planning.

Since that time, annual 10 year renewal plans have been developed that provide a long-term view of investment requirements and annual investment programs are prepared aimed at ensuring the sustainability of the network asset base consistent with the long-term plans.

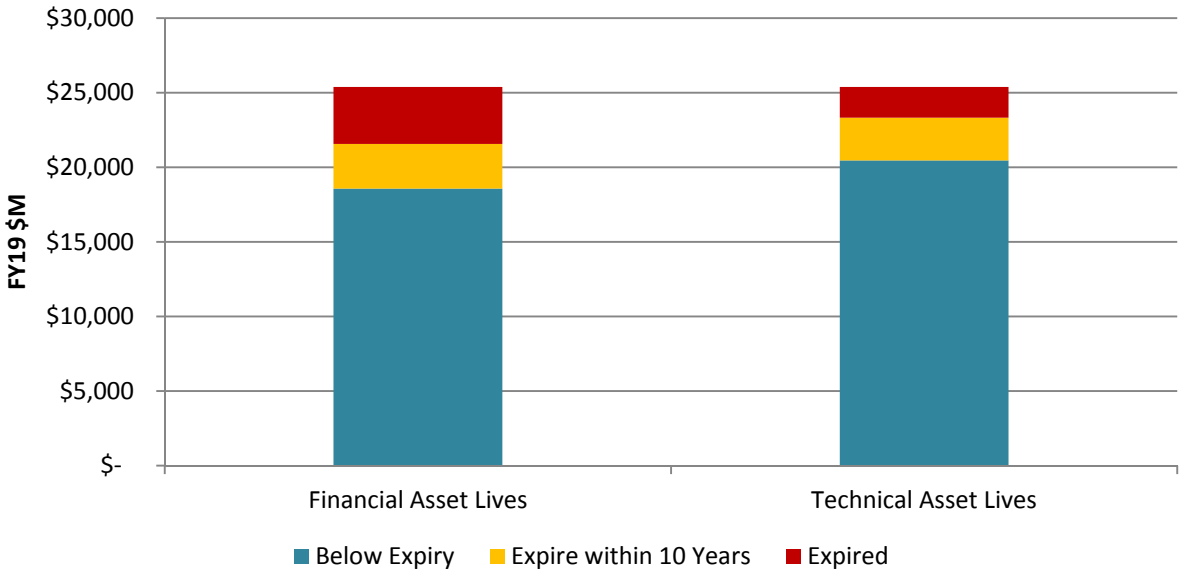
Notwithstanding this long-term renewal planning, there still remains a backlog of assets that have reached or exceeded their nominal lives that require renewal within forthcoming regulatory control periods. This is shown in Figure 6 below, and is based on Endeavour Energy's estimates of brownfield replacement costs and asset quantities as retained in our replacement models. As shown in the graph the asset expiry age has been assessed in two different ways:

1. Using standard financial lives, which underpin our depreciation allowances and asset register values; and

[2] The forecast decline however is as a result of Endeavour Energy's forecasting methodology that incorporates post model adjustments (PMA), catering for the potential impact of rooftop photovoltaic (PV) and other energy efficiency and demand-reducing measures. In fact, analysis of this declining group reveals that the majority have shown positive growth in recorded demand in the previous five years, and any actual measured decline has occurred through load transfers or due to a downturn in industrial load.

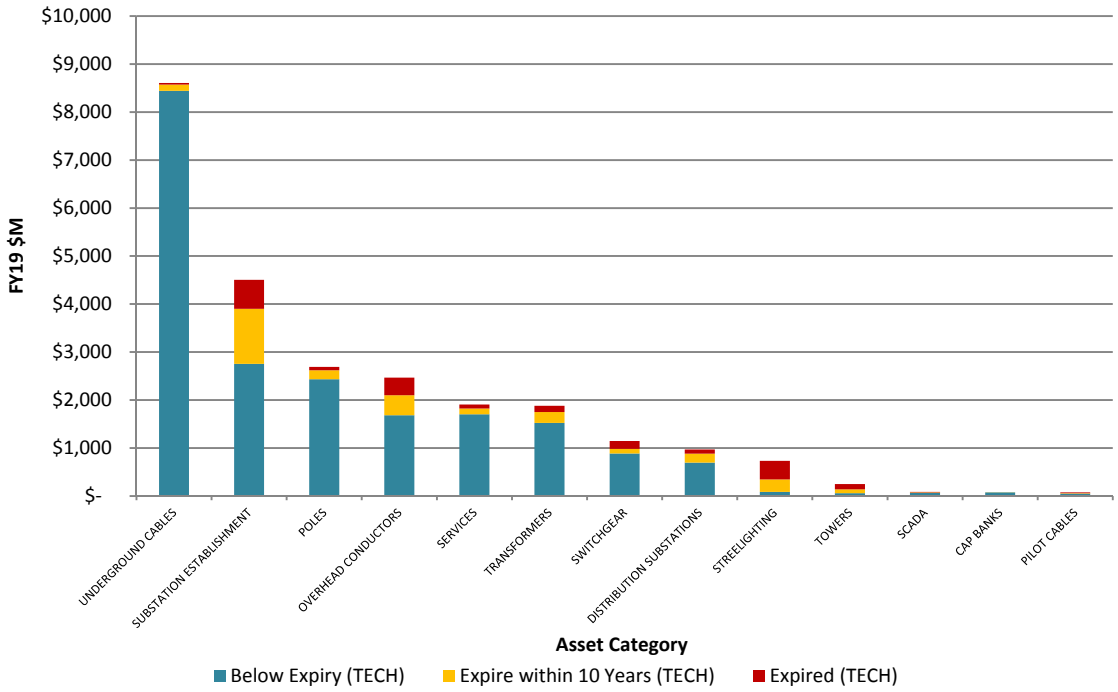
2. Using technical asset lives, which form the basis of our modelling assessments of future renewal needs.

FIGURE 6 - TOTAL ASSET BASE - EXPIRED ASSET VALUE



The technical asset age profile showing the value of near-expired and expired assets is given in Figure 7 below.

FIGURE 7 - ASSET CATEGORY EXPIRED ASSET VALUES



A summary of Endeavour Energy's asset base age is presented in Table 1. The average replacement age (or standard life) has been developed from the individual standard lives used in the 2010 Optimised Depreciated Replacement Cost (ODRC) assessment for each asset sub-category. Adjustments have been made to specific asset categories since 2010 (most notably power transformers) based on Endeavour Energy's experience and the results of a recent benchmarking exercise undertaken by Networks NSW.

TABLE 1 - ENDEAVOUR ENERGY ASSET BASE AGE SUMMARY

Asset category	Endeavour Energy Standard life (years)	Assets with age Greater than Technical Asset Life (%)	Weighted Average Remaining Life (WARL, %)
Sub-transmission overhead	56	11.7%	39.7%
Sub-transmission underground	45	6.6%	59.5%
Power transformers	50	10.8%	51.1%
Zone substation equipment	49	14.5%	47.1%
Distribution mains underground	60	0.0%	66.1%
Distribution mains overhead	50	10.7%	47.4%
Distribution substations and transformers	45	6.8%	50.9%

2.2.2.2 ASSET RENEWAL FEATURES

In order to ensure the outcomes from the asset renewal planning process are optimal, Endeavour Energy uses "top-down" expenditure projection modelling techniques to frame and challenge the "bottom-up" expenditure projections for actual planned investment programs.

To assist in this, our expenditure projection modelling tool, the Value Development Algorithm (VDA)[3], provides an indication of the appropriateness of investment levels and risk-treatment parameters used in the model through the tracking of Weighted Average Remaining Life (WARL) of the asset base. The WARL of the asset base measures the remaining life of the network assets as they exist at a point in time, taking into account both asset age profile and condition factors, assuming that variations in individual asset condition within a class of assets balance out over time. It has the advantage of weighting an asset's contribution to the overall asset portfolio health profile on the basis of replacement value rather than quantity (in order to avoid undue bias from low-value ubiquitous distribution assets) and reflects the fact that the total range of assets that make up the network have many and varied life expectancies.

In developing modelled expenditure projections, monitoring the trend of WARL enables us to set investment parameters that, over the long-term, do not overly improve WARL (thereby implying over-investment) nor allow it unduly erode over time (implying under-investment and unsustainable consumption of the asset base). In effect, this approach calibrates our model projections to our long-term approach of strategically investing to maintain the asset condition and risk profile of the network at sustainable levels. Maintaining WARL at a flat trend going forward calibrates future expenditure levels to the historical levels that have delivered the current levels of asset risk and network performance. Further discussion of the VDA and the development of the WARL are given in Section 2.4.2.

2.2.2.3 FUTURE ASSET RENEWAL

As directed by Company Policy 9.2.6 Network Asset Renewal, the identification of asset replacement needs are based on a range of considerations associated with the identification of the assets end-of-life, or its ongoing fit-for-purpose status. These are summarised as follows:

- End of life: where it is assessed that an asset should be removed from service due to deteriorating condition, deteriorating performance, inability to be effectively maintained or when it becomes more cost-effective for it to be replaced rather than to continue to maintain or refurbish the asset; and

[3] The VDA is a similar model to the AER's current REPEX model but has the additional functionality of being able to model the impact of expenditure constraints with the impact of retaining un-replaced assets reflected in the WARL indicator

- Fit-for-Purpose: where environmental risk, safety risk, network operability or supply security risk presented by the asset render it no longer suitable due to its failure to meet regulatory, safety or performance standards. Endeavour Energy utilises a risk-based assessment processes to determine the appropriateness of retaining and continuing an asset or asset type that is displaying these risk features, and targets replacement once risk levels become unacceptable.

Endeavour Energy has a range of renewal strategies, from like-for-like modern equivalent replacement of individual components within a parent asset (such as components of a sub-transmission substation or subtransmission overhead lines) through to wholesale renewal where the overall condition or fit-for-purpose nature of the entire asset warrants this. This approach serves to optimise the investment portfolio to ensure the most economically efficient asset renewal investment is achieved commensurate with network needs.

Whilst our overall investment in asset renewal continues to be a significant proportion of our total network capital investment going forward, renewal unit cost rates have been reduced in recent years through improved efficiencies in project delivery, by optimising construction standards and by the more rigorous and consistent application of the criteria for assessing end-of-life and replacement requirements.

2.2.3 RELIABILITY NEEDS

Network reliability performance is currently being maintained through our general approach to operational asset management. In general, our approach is to achieve STIPS-neutral performance outcomes, thereby attracting minimal specific reliability-based investment unless there exists a clear business case to do so in accordance with current regulatory mechanisms.

Endeavour Energy does however continuously assess individual feeder reliability performance against current licence condition requirements. Feeders that are identified as having poor performance in accordance with these requirements attract targeted investment specifically to treat the non-conformance.

As such, our Reliability Improvement program targets distribution feeders that are non-compliant or at risk of non-compliance assessed against Licence Conditions for individual feeder standards. Over the past five years, we have identified on average 22 feeders (or 1.5% of our feeder population) per quarter that are either non-compliant or are heading towards non-compliant performance. Consequently, capital investment to address feeder reliability is relatively modest at approximately $4 million per year.

Where justifiable on a business-case basis, capital investment programs typically implemented to address poor reliability performance include, but may not be limited to:

- Installation of auto-reclosers and/or remote-controlled load break switches;
- Establishment of distribution feeder automation schemes;
- Mains augmentation, utilising a range of technologies including:
  - Covered conductors;
  - Establishing new cross feeder / cross zone ties; or
  - Using larger conductors for enhanced backup capability;
- Installing improved fusing arrangements; or
- Installing Line Fault Indicators.

2.2.4 UPTAKE OF NEW TECHNOLOGY

In addition to the uptake of non-network solutions to growth driven investment needs, and in some case in support of these initiatives, Endeavour Energy is adopting new technology on a business-case basis to improve performance and extract more value from our existing assets. Examples of technology currently in use in the network to enhance network capability and performance include:

- The establishment of a wide area telecommunication network leveraging off our optical fibre network protection systems to provide high speed communications to over 25% of our zone and sub-transmission substations and the majority of field service centres;
- Implementing Distribution Feeder Automation (DFA) schemes that have demonstrated reliability improvements at a low cost;
- Deploying electronic monitors on distribution substations with high maximum demand indicator readings allowing their uprating to be deferred with a subsequent significant reduction in distribution transformer augmentation costs; and
- Deployment of smart meters with neutral integrity monitoring capability to continuously monitor the neutral integrity of CONSAC in order to better time and target their renewal, as noted above.

The Future Network Strategy (Future Grid) contains additional information on how Endeavour Energy uses technology to optimise management of the network.

2.3 CAPITAL EXPENDITURE PROJECTION DEVELOPMENT

Network capital expenditure forecasts take into consideration two principal drivers of:

1. Growth in the maximum demand; and
2. The asset end-of-life risks for the existing asset base.

Investment in response to these drivers ultimately affects the overall reliability performance of the network, although reliability performance is a lagging indicator of these requirements. For this reason, specific reliability focussed investment plans are targeted to isolated poor reliability feeders (or areas if necessary) as opposed to the network as a whole, and are not a principal investment driver, per se.

2.3.1 GROWTH INVESTMENT PLANNING

2.3.1.1 BACKGROUND

In the two regulatory periods to 2014 network capacity related investment was driven by supply security standards and the need to service greenfield residential developments in the north-west and south-west growth sectors of Sydney. There was a need to ensure compliance with the NSW Design, Planning and Reliability standards pertaining to network capacity and supply security.

In the early stages of this period, there were also shifts in customer behaviour, especially involving the rapid uptake of domestic air conditioning. This combined with initiation of the large scale residential developments led to increases in demand and the need for a large capital investment program in network capacity infrastructure.

In the latter part of this period, changes in building standards, the uptake of more energy efficient end use appliances, and the emergence of distributed energy resources at the domestic level has led to a per-capita reduction in demand. Whilst softening the impact of the growth in customer connections, accelerated expansion of new greenfield residential areas continues to drive the need for network supply and connection infrastructure investment.

The key driver of growth investment in the next period is the need to provide new customer connection and upstream network supply infrastructure in areas that had historically been rural or semi-rural in their nature, with insufficient supply infrastructure to accommodate the emerging residential and associated social infrastructure development.

Recent years have seen an accelerated growth in new connections and deliberate government policy actions to deliver housing supply at higher than historical levels. This has included an increase in the number of development frontiers, higher densities and record investment in road and transport infrastructure. The outcome has been diminished capacity headroom on the fringes of our network and therefore in an increased level of growth driven investment.

2.3.1.2 GENERAL APPROACH

As outlined in our Growth Strategy, in order to determine the long term supply infrastructure needs or a broad-acre greenfield development precincts, area plans are developed. These plans provide a road-map that outlines the long term network requirements to service the ultimate projected load of these areas, and ensure that infrastructure development occurs in an efficiently coordinated and staged manner. They also served to identify potential opportunities for optimising investment requirements through the identification of confluent needs in adjacent areas.

Once an area plan is developed the timing of specific network-capacity augmentation projects outlined in the plan is determined through application of the most recent forecast to models of the network. This is undertaken to determine the emergence of network constraints or capacity limitations in accordance with current standards at the relevant locations. Specifically:

- The Transmission Network Planning Review, undertaken on an annual basis, documents the results of load flows using the demand forecast to determine if there are constraints on the network under system normal and under single contingency scenarios. It includes a list of possible solutions, some of which may be operational in nature, and potential development of the network in response to the constraints identified.

  In greenfield areas, the process of identifying constraints or capacity limitations is often not as simple as referring to the capacity of the nearest zone substation. The existing distribution network capacity is often the limiting factor, especially where there are significant costs in establishing additional feeders from zone substations which are several kilometres away.

- The most likely supply-side solution for each constraint is determined by evaluating a range of options including distribution feeder augmentation, mobile or temporary infrastructure solutions, the use of Distributed Energy Resources, and possibly the staged or full establishment of a new zone substation. The ability to stage a solution for a particular location depends on the forecast rate of growth and the type of development. For example, it is easier to stage investment in a greenfield location which is predominately low density residential development, whereas it is more difficult to stage investment if a large town centre is proposed with high-rise residential towers in a greenfield location.

Endeavour Energy has a probabilistic planning policy in place. This requires that the timing of any proposed investment is determined by the economics of balancing the load at risk, operational constraint factors and the size of the preferred investment in order to determine an economically efficient investment point. This however predominantly applies to areas with established supply infrastructure experiencing incremental load growth on a substantial base, and with opportunities for risk mitigation through the implementation of operating arrangements.

In greenfield areas, the application of probabilistic analysis in business cases for network connection infrastructure would result in connection capacity being exceeded under system normal conditions with little opportunity to mitigate the resultant risk. In these cases, the probabilistic planning analysis does not determine timing, but moreover determines the value of the expected unserved energy, which is considered a market benefit for the purposes of evaluating network investment.

It should be noted that for any investment, non-network (opex) options are duly considered on a case-by-case basis in accordance with the National Electricity Rules, as noted in Section 2.3.5.1 and outlined in our Growth and Demand Management Strategies. Proposals for investment that factored into current capex plans that are within their lead-time for delivery have been timed to reflect both the economically efficient investment point and the impact of operational and non-network investment deferral options.

2.3.1.3 GROWTH EXPENDITURE PROJECTION DEVELOPMENT

A forward 10 year program is developed for growth-driven capital investments based on the cost of preferred solutions and the timing of required investments identified in the Area Plan studies, and through other annual planning reviews of network capacity in accordance with planning policy.

Historical unit rates are used for determining likely project costs for projects at various approval gates as required by investment governance process noted in Section 2.1.

Parallel with this, high-level growth-related expenditure projections are developed through application of the VDA modelling in order to frame the likely expenditure requirements for the forthcoming ten-year period. The top-down challenge provided by these modelling assessments ensures that the identified requirements of the overarching needs-based program are in-line with anticipated future need, calibrated to historical trends. The program thus developed for any one year reflects actual investment need. This however is constrained by the over-arching growth-related capex requirements in accordance with regulatory expenditure allowances that may be applicable following the most recent regulatory determination. Where these allowances cease to remain current (towards the end of a regulatory control period), the longer-term capex requires that frame any one year's expenditure plan is determined through the modelling outcomes noted above.

Testing and screening for non-network solutions for individual investment proposals occurs during the Network Investment Option phase of the project. A demand management plan is developed from the forward network investment program assessed on these assessments, and the likelihood of successful DM and non-network options being identified for the range of investment proposals.

2.3.2 RENEWAL INVESTMENT PLANNING

2.3.2.1 BACKGROUND

A principal objective of Endeavour Energy's asset management strategy is to achieve an appropriate balance between condition-related equipment failures and sustainable capital and maintenance expenditure levels. To avoid unmanageable levels of failure and emergency investment, the asset renewal strategy adopted includes a long-term posture to plan the renewal of the electrical network in a timely way, cognisant of the need to not create shocks in expenditure levels and resource requirements and to balance this against the need to manage network risk. Further, the changing role of the network to becoming a one that is more and more required to facilitate energy transfers between Distributed Energy Resources (DER's), as noted in the Company's Network Strategy, means that asset renewal will become a vehicle by which network redesign will occur in-line with future requirements.

Whilst acknowledging this to be an appropriate and sustainable long-term asset management approach, the Company undertook a number of calculated decisions during the early parts of the current regulatory period that temporarily compromised this strategy in order to meet the funding challenge, as noted previously. The temporarily reduced capital program was optimised to minimise the impact on asset without creating a long-term deterioration in risk that could not be easily recovered from. With a recovery to a more sustainable funding situation, the organisation is now in a position to return to the balanced strategic renewal approach whilst at the same time constraining expenditure consistent with overall the corporate objectives of containing costs and network usage charges.

2.3.2.2 GENERAL APPROACH

Each year's expenditure program for asset renewal is based on specific condition and risk driven requirements but sits within the context of a long-term strategic expenditure plan for asset reinvestment. The long-term expenditure settings are developed and framed using modelling approaches, historically using the VDA and in more recent times cross-referencing and challenging these against the AER's REPEX model.

The key elements of the process that develops the Company's asset renewal expenditure projections are:

- Determining future expenditure scenarios that are consistent with historical expenditure patterns, aimed to achieve desired network outcomes and that constrain expenditure to achieve corporate investment efficiency objectives;
- Formulating long-term renewal plans and associated expenditure projections based on prioritisation methodologies for major assets and asset classes;

- Deriving needs-based short-term expenditure projections for various asset classes based on asset condition, performance, or regulatory requirements;
- Framing and challenging needs-based plans against the high-level expenditure projections to assess the outcomes of the proposed expenditure levels and the ability to achieve the desired network strategic objectives in an economically efficient way;
- Collating and integrating renewal needs in the annual Strategic Asset Renewal Plan in order to identify and remove overlaps; and
- Coordinating with other investment activities through the annual Strategic Asset Management Plan (SAMP) development process.

The intent of this approach is to ensure that Endeavour Energy's proposed investment in asset renewal is targeted and appropriate for the range of asset end-of-life and performance issues being addressed. The combination of approaches ensures that any proposed investment is appropriately targeted to actual need. Revising the detailed renewal plan on an annual basis for all asset classes ensures that the most recent asset condition data is available to confirm that replacement works are required at the time of committing to the expenditure (i.e. within project lead-time) and provides the opportunity to adjust priorities should higher-priority investment requirements emerge.

2.3.2.3 RENEWAL EXPENDITURE PROJECTION DEVELOPMENT

As noted above, multiple approaches are utilised in developing the short-term and the longer term renewal program expenditure estimates. Modelled long-term expenditure projections frame and challenge needs-based forecasts to resolve and optimise the asset renewal expenditure required for each asset class or asset replacement program. Asset-specific condition assessments are used to establish the scope of assets that will be potential candidates for renewal. The modelling establishes efficient investment levels and informs the size of programs, thereby enabling a long view about the appropriateness of the proposed expenditure program.

Detailed condition-based assessments are used for key individual assets which have high replacement values and/or perform a critical role in the network (such as sub-transmission power transformers). The replacement plans for these assets are developed using replacement criteria specified by the Company's asset maintenance and performance standards and through individual asset condition and performance assessment regimes.

As noted in Section 2.3.5, candidates for renewal are those identified that have exhausted opex-based management programs and are no longer suitable or fit-for-purpose for their role in the network.

The forecast of replacement costs for these assets is developed using actual data based on historical unit rates and current equipment costs and labour rates. Model based assessments (from REPEX/VDA) are used to ensure the proposed expenditure levels are appropriate and consistent with long-term needs.

The challenging of needs-based investment programs with modelling projections ensures that the proposed expenditure programs are consistent with the risk-profile required to achieve Endeavour Energy's strategic network outcomes. Model calibration takes into account the correlation of inter-related asset replacement programs and the potential impact of other network investment drivers such as growth-related investments as reflected in historical expenditure patterns (for the REPEX model) and/or through the setting of model parameters (in the case of the VDA).

In addition, to address the potential issue of asset class derived plans potentially being included in multiple programs (risking inflation to expenditure forecasts through not accounting for the effects of aggregation) Endeavour Energy considers assets and asset classes in a hierarchical way. That is, when renewal plans are developed, the opportunity is taken to review the condition of assets at the parent (e.g. substation) level for any opportunities to aggregate / optimise the investment opportunity. Further, asset renewal requirements that are likely to be addressed though growth programs are identified in advance and removed for renewal expenditure projection requirements.

Replacement programs for low-value, high-volume assets (typically distribution network equipment such distribution poles and associated hardware), are projected using a “top-down” or model-based approach. These projections are then optimised by actual asset need (determined through condition assessment programs, as in the case of rural network steel conductor assets), the size of the asset base and any extraneous drivers such as changes in regulatory requirements (such as that required for bushfire prevention management). The expenditure projections are based on actual average replacement costs, with asset category totals discounted for network/asset growth based replacements as appropriate.

Within the asset class expenditure programs, the specific candidates for replacement are identified prior to the implementation of a program and are controlled through Endeavour Energy’s investment governance and portfolio management processes. The identification of an asset requiring replacement occurs through the implementation of asset inspection and maintenance regimes.

2.3.3 EXPENDITURE PROGRAM OPTIMISATION

Network investment is driven by the need to address capacity versus demand imbalance and the risks of asset failure impacting network safety and performance. These risk drivers collectively introduce network risk that is mitigated through application of Endeavour Energy’s asset management processes. Capital investment in the network is one of the asset management tools used to treat or mitigate unacceptable network risk.

As noted above, integrated renewal and growth-driven investment solutions are often used to mitigate confluent risks. Endeavour Energy’s investment planning processes identify these potentially confluent needs at the planning stage, resulting in major capital works investment programs that are integrated and optimised at the earliest possible stage. This approach generates an efficient, optimised capital investment program.

Further, much of the Company’s investment portfolio is made up from a range of smaller investment programs that treat a range of asset need and network capability related risks across the distributed network asset base. These programs, many of which are initiated by very different risk drivers, are nevertheless required to be optimised against each other. The Company’s investment portfolio planning processes requires that the entire network capital investment portfolio be optimised, integrated, and prioritised on the basis of the treatment of network risk in a manner that is agnostic towards the risk driver itself.

To facilitate this process, Endeavour Energy employs a long-running and well-established methodology to prioritise the competing demands for network investment expenditure on the basis of risk. This prioritisation process is employed as part of the annual investment planning cycle and is supported by the Company’s Capital Allocation Selection Hierarchy (CASH) decision support tool. CASH assists in the assessment of the comparative risk that the suite of competing projects and programs are targeting to enable the development of a prioritised and holistic investment program. Combined with the top-down challenge of the VDA and REPEX model derived projected funding requirements, a risk-optimised program of actual investment needs is developed for implementation through our asset management delivery processes.

Assessing the various projects and programs on the basis of treating risk and business outcomes enables the development of a consistent and informed view of the relative priority of the competitors for expenditure on the basis of their contribution to mitigating risk and achieving the desired business outcomes.

2.3.4 DEMAND MANAGEMENT AND NON-NETWORK SOLUTIONS

Endeavour Energy is committed to identifying and implementing Demand Management (DM) programs for all projects subject to Regulatory Investment Test – Distribution (RIT-D) as required under the National Electricity Rules. Historically, this has covered a range of initiatives from pay-to-curtail Demand Response agreements with major customers in constrained areas, through to broader based end-use load management trial programs. The latter have ranged from incentive payment and tariff structure mechanisms to encourage alternate customers’ behaviours, through to

technology-oriented programs such as utilising Demand Response Enabled Devices (DRED) such as air conditioning systems.

The changes in customer end-use patterns observed in recent times due to the uptake of solar PV installations and increasingly the emergence of local energy storage facilities are now limiting the range of options available for wide-spread broad based DM programs sponsored by the company.

Endeavour Energy has responded to this shift by continuing to work with customers to trial more effective broad-based Demand Response programs, and to call for market-based solutions to identifying non-network options for identified RIT-D projects. The Company has trialled and/or successfully implemented four different types of demand management programs in order to test the appetite of consumers to embrace demand response initiatives and to defer targeted network infrastructure investment. These are:

- Demand Response;
- Pricing Trials;
- Pay to curtail (major customers only); and
- Assist with major customer infrastructure upgrades to reduce demand.

Demand response trials have involved the early development and trial of Demand Response Enabling Devices (DRED - typically domestic air conditioning, but in some case pool pumps). Endeavour also trialled a Dynamic Peak Pricing product as part of the Blacktown Solar Cities (BSC) program. This initiative sent a high price signal to customers during peak times to encourage energy reduction. Similarly, the *Peak*Saver program rewarded customers for reducing electricity consumption during peak times rather than penalising them with high prices.

The most successful demand management programs have involved direct engagement with industrial and large-scale commercial customers to implement pay-to-curtail arrangements, triggered by expected peak demands impacting constrained parts of the network.

The DM payments for these initiatives were originally funded from the regulatory D-Factor cost recovery mechanisms. Going forward, Opex payments for these programs are to be funded from a mixture of savings in deferred capital expenditure as well as regulatory DM incentives.

In addition to the above, the Company has implemented two remote area generation schemes at Colo Heights, north-west of Sydney, and at Bawley Point, south of Ulladulla. These schemes have been successful in effectively reducing the demand on the local network in order to defer the need for augmentation until it is more economically efficient to invest in the local distribution network, and to improve supply reliability for the local areas. Whilst both of these programs are approaching the economic cross-over point, they have been effective in trading off the need for capex at the expense of opex.

Current DM investment plans are focussed on identifying innovations in this field and establishing proof-of-concept of technological innovations prior to the initiatives forming part of our business-as-usual response to managing the impacts of demand growth. Central to this is the recognition that the customers themselves have been empowered to manage their own demand through energy efficiency initiatives and the increasing penetration of distributed energy resources (DERs) such as rooftop solar PV generation and battery energy storage.

In this context, the future opportunities for market based, broad-based non-network solutions are reducing. The role of the network in providing the aggregating capability necessary to fully leverage the capacity of DERs in a coordinated manner will become central to the success of future DM programs, and Endeavour Energy is committed to pursuing these opportunities.

2.3.5 OPEX - CAPEX TRADE-OFFS

Endeavour Energy factors in Opex – Capex trade-offs at the decision making stage for any specific asset investment. Asset end-of-life decisions are triggered by an assessment on the ongoing fit-for-purpose requirements of the asset, including expected future maintenance costs.

Operating cost escalation, either through increasing preventative maintenance requirements to maintain serviceability or fault & emergency responses to emerging asset class failures, will invariably trigger the identification of an asset renewal need. The economics of whether it is better to service and maintain an asset (such as a mid-life refurbishment of a major primary asset), or to replace it with a more suitable modern equivalent forms the primary decision gate that may trigger and asset renewal (or otherwise as the case may be).

Similarly, growth-related investments in the network invariably follow on from the exhaustion of operating arrangements to maximise the utilisation of the existing asset base, prior to options being considered for capital investment. In this respect, operational plans are developed and implemented in areas with emerging capacity constraints. This is done to pre-condition the network through strategic reconfiguration to mitigate potential supply risks in forthcoming peak demand periods, typically in preparation for summer periods. Capex investment to mitigate supply capacity risks are timed to be implemented when these operational risk-management opportunities are exhausted, thus deferring the capex for as long as is practicable.

Further, once a capital investment is being considered (either drive by renewal or growth requirements), operating expenditure –based Demand Management options are consider as legitimate alternatives in order to defer the capital investment for a period of time, or obviate it altogether.

2.3.5.1 PORTFOLIO-LEVEL TRADE-OFFS

As noted above, consideration of the merits of Opex – Capex trade-offs are made on a case-by-case basis at the investment decision stage. As a consequence, candidates for asset renewal have the opex-capex assessment at the point where it has been determined the asset requires renewal, given that ongoing operating costs are one of the key factors leading to the decision to make an asset renewal capital investment. Similarly, investment proposals to enhance the capability of the network flow-on from the realisation that capex investment is required beyond the opex required to manage the risk of the emerging constraint.

These trade-offs invariably occur through business as usual operational planning processes and in some cases form part of the economic justification for key capital investment decisions. Nevertheless, Endeavour Energy has modelled these impacts and has observed that there is a negatively-correlated relationship between capital investment in asset renewal and operating costs.

At the investment portfolio level, this relationship is in the order of -6%. In other words, for every $1 million investment in capex (irrespective of the driver of need for this investment), opex costs will reduce by an amount in the order of $60,000. Recent broader industry research and analysis by Network NSW found similar relationships.

Portfolio level opex-capex relationships for growth-related investments are not as strong, due to the various factors at play. For example, adding new network to supply new developments brings with it additional operating costs, whereas enhancing the network in an existing constrained area may reduce operating costs if there have been operating arrangements established to manage the associated risk.

An obvious exception to this is the establishment of a Demand Management facility, funded through opex, in order to defer a capital investment. In this respect, portfolio-level opex-capex trade-offs can be observed for those investments where DM may have an impact, but this is unable to be extrapolated (and therefore modelled) as being representative of the whole growth capex portfolio where the majority of augmentation related expenditure is driven by new customer connections, as is the case for Endeavour Energy.

2.3.5.2 ASSET MAINTENANCE IMPACT

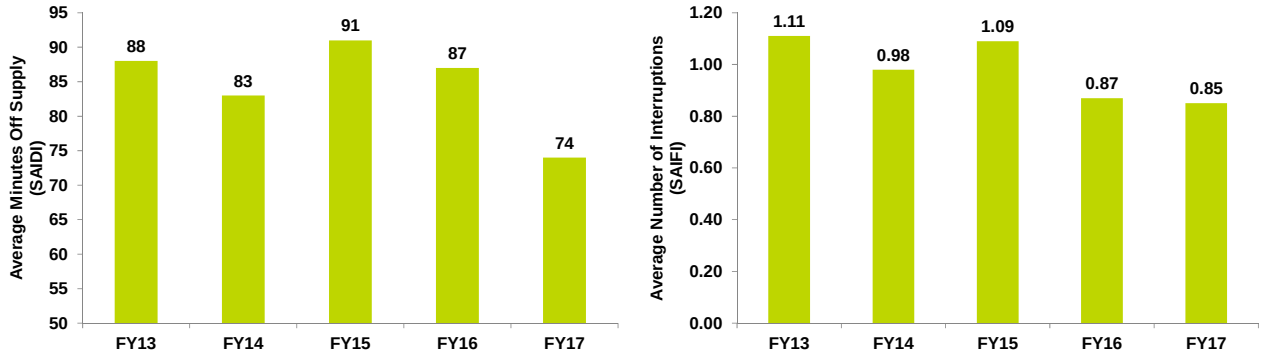
Maintenance is carried out to ensure that the physical assets continue to fulfil their intended function. Maintenance on Endeavour Energy's electrical network is classified into the categories of:

1. Inspection/investigation;
2. Preventative maintenance;
3. Condition based maintenance; and

4. Fault and emergency maintenance.

The outcomes of the current maintenance and asset re-investment strategy is successfully maintaining a stable reliability performance and managing impacts on the community such as safety and bushfire ignition to levels that are as low as reasonable practicable. This performance is shown in the performance indicators shown in Figure 8 below. The most recent year's performance result is largely due to relatively benign weather conditions that prevailed during the year rather than being representative of a significant underlying improvement trend.

FIGURE 8 - RELIABILITY PERFORMANCE



Endeavour Energy's strategy going forward is to focus on inspection, monitoring and condition based maintenance with reduced volumes of routine time-based maintenance reserved only for assets for which that type of maintenance is most appropriate.

The condition based maintenance and reinvestment strategy will control fault and emergency expenditure principally to responses to natural weather events and third party impact incidents.

The Reliability Centred Maintenance (RCM) methodology of Failure Modes, Effects and Criticality Analysis (FMECA) is applied to high volume and critical asset categories to determine the efficient and effective maintenance regime for individual assets, classes of assets and groups of assets. Further, an asset health index process (independent of the RCM methodology) has recently been developed and is being applied to significant assets to assess the condition of the asset and determine any specific individual maintenance requirements including trigger points for refurbishment and/or replacement.

As noted above, the end result of the maintenance process is the need to replace an asset that is no longer able to be economically maintained, or is no longer fit for its modern-day purpose. This is the point at which the opex-capex trade-off decision is made.

Some examples where this approach has been applied in recent times are given below. These include cases where opex investment is employed to defer capex, and capex investment is used in lieu of opex to generate a more efficient asset management outcome. The examples include, but are not limited to, the following:

- CONSAC cable replacement strategy, where replacement is based on electrical integrity measurements through continuous monitoring via smart meters;
- Air Break Switch replacement strategy, in which it there are identified circumstances where it is more economically efficient to renew the asset rather than maintain it (as outlined in our asset management procedure SMI101);
- Holec MD4 switchgear management process and replacement strategy in order to manage the type-failure risk of these assets, again as required in our asset management procedure SMI101. This standards includes various operational management strategies required to be implemented prior to renewal, such as routine 3-yearly inspection and testing of Holec MD4 HV switchgear to detect signs of degradation that may lead to catastrophic failure; and
- Pole nailing as a means to extend the life of the pole prior to its replacement is as per Mains Instruction MMI0001.

2.4 HIGH LEVEL CAPITAL EXPENDITURE PROJECTIONS

As described previously, Endeavour Energy uses a range of approaches to determine its future capital expenditure requirements. Historically, expenditure models have been used to establish long-term projections and needs-based investment plans to determine future renewal and augmentation capital investment requirements. The Company has a long history of developing model-based renewal expenditure projections in order to frame and establish a "top-down" challenge for its needs-based renewal investment plans in order to achieve desired network outcomes. This has underpinned every regulatory proposal since 2004.

In more recent times, we have enhanced this modelling approach to include modelling projections for augmentation related expenditure derived from our integrated Value Development Algorithm (VDA) model. This tool natively integrates renewal and growth related investment modelling to develop an optimised view of future investment needs, calibrated to maintaining existing network risk and performance outcomes.

The AER's REPEX model is now also used to frame and challenge our detailed investment plans. These models are similar to our VDA model, although less sophisticated and non-integrated. Calibration of these projections is based on historical expenditure levels. VDA modelling allows us to test the proposed CAPEX investment levels in order to assess the long-term impacts of the proposed investment levels on network outcomes. In doing this we are able to determine whether the proposed investment levels lead to sustainable future CAPEX, OPEX and reliability outcomes.

Our expected future requirements for capital expenditure for the forthcoming regulatory period are expected to be approximately $1,988 million.

It is noted that short-term reductions in the expenditure in this regulatory period would not be sustainable into the longer term. Renewal expenditure in particular was reduced to meet financing constraints as opposed to being driven by asset management and risk-management requirements. This has led to an increase in future renewal requirements that will require redressing in future years to ensure network outcomes are sustained into the long-term.

2.4.1 MODELLING OVERVIEW – REPEX AND VDA

As noted above investment modelling has been used since 2002 to facilitate understanding of the levels of network investment required to achieve and maintain strategic business objectives and network performance outcomes. This modelling is undertaken on a business-as-usual basis as part of the investment planning cycle.

It supports the identification of the required investment levels at a high-level, which is then used to inform the overall investment planning outcomes approved each year through the investment governance process. A cornerstone of this modelling approach is the application of the VDA discussed earlier in this report.

The VDA is a sophisticated model, integrating a range of CAPEX drivers and linking investment levels to outcomes including reliability performance, OPEX, WARL and future CAPEX. Whilst in the past this was primarily used to determine renewal investment requirements, in more recent times the fully integrated capability of the VDA has been used in order to determine projected growth expenditure requirements and network outcomes.to map proposed overall investment levels for asset renewal, demand/capacity balance to the achievement of network objectives.

The modelling is undertaken on an annual basis as the first step in determining projected capital expenditure requirements, particularly for asset renewal needs. This informs the assessment of overall investment needs prior to the development of actual needs-based investment programs.

The modelling capability of the VDA enables Endeavour Energy to assess consider various investment scenarios, and understand at a high-level the implications of these scenarios on network outcomes. Once calibrated, the VDA is able to provide high-level impacts of the network outcomes of the projected capital expenditure levels.

The AER's REPEX model is used to inform Endeavour Energy's views on future investment requirements. These are calibrated using historical expenditure levels (in other words historical *inputs*), whereas the VDA utilises a range of outputs for calibration of the appropriate expenditure

level. By combining the two approaches we are able to assess the expected impacts on network outcomes for the proposed investment levels that are developed in part using the AER's models.

The combined use of the different modelling approaches draws on the following features of the two models:

- The VDA uses WARL as a means to assess the impacts of future renewal expenditure projections. As WARL is linked to actual asset parameters it is able to capture and reflect historic under or over investment in forward projections. The VDA also accommodates the growth in the asset base through up-stream capacity driven investment and the gifting of connection-driven assets. This is reflected in the WARL through the models' integration, which further enhances the ability to assess the impacts of proposed expenditure projections;
- The REPEX model uses historical expenditure levels to calibrate future projections, which require judgement as to whether historical expenditure levels may or may not have been efficient or sufficient to effectively address asset and network risk. In this way, whilst the fundamentals of the models are similar to the VDA, the calibration approach is less sophisticated, being inputs oriented as opposed to outcomes-oriented. The calibration mechanism forces modelling outcomes that reflect historical (potentially) sub-optimal investment approaches, as opposed to correcting for them. As a consequence, we use the VDA to assess the potential impacts of the projections developed through application of the AER's models and other investment determination methodologies.

VDA modelling includes the direct costs for network CAPEX and OPEX and excludes corporate overheads. The modelling also takes into account augmentation driven by customer funded network connections in addition to Endeavour Energy funded network augmentation and asset renewal expenditure. The model predicts outcomes over a forward-looking 20 year period.

The following capital expenditure categories are not captured in the VDA model:

- Reliability program;
- Efficiency programs;
- Power quality programs;
- Metering programs; and
- Network switching and capitalised overheads.

For scenario comparison purposes (to assess the impact of differing strategic approaches to investment), this limitation is not critical. Given this, comparison of high-level expenditure projections do not include these categories unless stated otherwise.

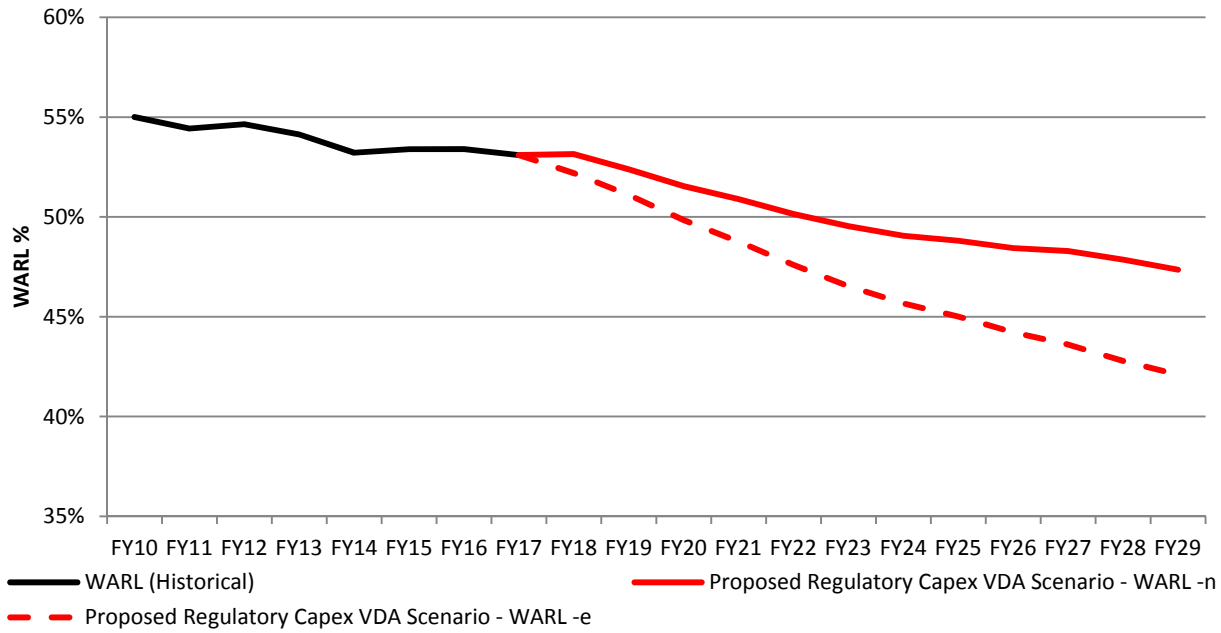
2.4.2 INVESTMENT PROJECTIONS AND NETWORK OUTCOMES

As noted above Endeavour Energy utilises its investment modelling capability to test the impacts of proposed investment levels on network outcomes, and conversely to assess the impact on investment requirements if greater network asset risk is accepted. In particular, historically the Company has used WARL trends to assess future renewal expenditure requirements. This approach has underpinned the determination of Endeavour Energy's approved asset renewal investment levels through successive regulatory revenue resets.

The overall projected WARL trend is however influenced by the conflating of three modelling features: the decline due to assets being retained beyond their standard lives, the improvement from replacing assets in accordance with modelling parameter settings, and the improvement from the addition of new assets due to growth.

The determination of the remaining life of the existing asset base, excluding the impact of the effects of new network investment in assets to supply demand growth, is referred to as $WARL_e$. The weighted average remaining life of the asset base including the impact of new connection assets (both funded and gifted) is referred to as $WARL_n$. The difference between the two WARL indicators is shown in Figure 9 below.

FIGURE 9 - WEIGHTED AVERAGE REMAING LIFE PROJECTIONS – $WARL_e$ & $WARL_n$



$WARL_e$ accounts for changes in replacement capital due to its emphasis on the existing asset base, however $WARL_n$ provides a long-term holistic view of total asset portfolio WARL and is thus a more balanced indicator of future risk. This distinction is important as it reflects the somewhat bi-polar nature of asset condition and remaining life profiles. In recent times there has been a great deal of old assets renewed and new assets created. This can skew the overall view of WARL, and disguise the fact that there are still assets at the end of their useful lives that require renewal in order to appropriately manage the associated network risk that their deterioration introduces.

Current levels of network risk and network performance reflect the outcomes of historical investment profiles. Macro-level correlation of $WARL_n$ to current network asset performance levels, combined with the integrated growth and reliability investment modelling capability of the VDA, facilitates the Company's understanding of the impacts of investment levels on future network risk and performance outcomes. When Endeavour Energy commenced using the VDA model in 2004, a trajectory for $WARL_e$ was targeted to be in the vicinity of 50%. This was done as a means of calibrating the model outcomes to network outcomes given the significant decline in remaining life of the existing asset base that the model was predicting.

However, the inclusion of growth-driven new assets into the model renders this historical approach no longer suitable due to the skewing phenomenon noted above. Accordingly this approach is no longer used as a model calibration mechanism.

Setting model parameters in the VDA to maintain a flat forward trend in $WARL_n$ effectively calibrates the expenditure levels to reflect current approaches to managing asset and network risk. This assists in determining the potential impacts of current investment projections that have been framed by other Company imperatives such as investment constraints aimed at containing network service costs, as shown in the graph above and potentially foreshadows the need for a shift in future approaches to managing asset and network risk.

2.4.3 MODELLING APPROACH

2.4.3.1 CALIBRATION

The same age profile and various modelling parameters have been used for both the VDA and the REPEX model. Key differences in the models derive primarily from the calibration mechanisms adopted.

Calibration of the VDA model is undertaken at an investment driver level. For augmentation projections, growth parameters are normalised to actual historical growth expenditures and capacity increases. Renewal projections are calibrated by adjusting asset condition profile spreads

(asset lives) and backlog redemption profiles to achieve WARL-neutral movement of the asset base in conjunction with the WARL uplift provided by the addition of new assets. Opex and Reliability outcomes from the VDA are correspondingly calibrated against historical actual outcomes from a base reference year.

Calibration of the REPEX models is undertaken on a more simplistic basis in accordance with previous approaches signalled by the AER. This requires adjusting input parameters to achieve expenditure profiles on trend with recent historical spend patterns. Endeavour Energy observes that this approach assumes that the historical spend-pattern achieves the appropriate range of network outcomes, which may or may not be the case.

In this respect the REPEX calibration approach is predicated on the assumption that the past is a sound predictor of the future. Evidence suggests however, that there are significant shifts in demand trends and asset renewal requirements over time. It is noted that during the FY15 to FY18 period, asset renewal investment levels were unsustainably low due to financing constraints rather than asset management drivers, as noted elsewhere.

This temporary finance-driven reduction in renewal investment means that the overall total asset renewal investment in the current regulatory period appears off-trend to previously identified long-term renewal needs. Notwithstanding this, calibration of the investment model to this period appears to yield results that reflect the investment recovery required to sustain the asset base into the long-term. This represents a maturing of the expenditure profile in-line with having largely addressed the pent-up demand for un-replaced asset renewal investments in the past, but noting that additional renewal needs will continue to emerge as the asset base ages. This will create a further build up in overdue asset replacement volumes over time. In recognition of this our current renewal driven asset investment plans for FY19 onwards returns renewal investment to more sustainable volumes.

2.4.3.2 INPUTS

Replacement costs and network expansion costs for both models are derived from historical project expenditure and replacement quantities. The most recent asset valuation data is used as a guide to populate the models.

2.4.3.3 VDA MODEL REFLECTS BAU APPROACH TO ASSET RENEWAL.

The VDA has the ability to adjust various asset profile parameters to reflect condition variations (by adjusting age profile spreads as a surrogate). This provides the capability to adjust investment profiles to address rates of backlog redemption of over-aged assets, and the degree of network “risk” in retaining over-aged assets or commercial risk in pre-emptively replacing assets. Through historical application of this model, Endeavour Energy has determined that the following key modelling parameters best reflect actual asset renewal investment behaviour:

- Major assets (subtransmission lines, zone substations, etc) are typically replaced at 110% of standard asset life, reflecting the reality of our major asset renewal practice which invariably has led to assets being kept beyond their standard lives as evidenced by the over-aged asset ratios given in Table 1;
- Overdue asset backlog redemption is spread over the next 15 years, and reflects the fact that we have been working to address the un-replaced asset backlog over the past three regulatory periods, but in that time more assets have fallen due for replacement; and
- We are continuing to adjust the investment risk parameters to deliver an overall asset base that has a WARL that continues to decline over time, albeit slowly. This has been the feature of our historical investment profile.

2.4.3.4 MODEL PROJECTION LIMITATIONS

Modelling approaches used to determine expenditure high-level expenditure projections are by their very nature limited in that they are based on a series of assumptions of asset condition and capability, or use generic relationships of average growth investment requirements per unit of additional load. Models are not able to capture the subtlety and nuance of needs-based asset

management decision making that invariably is undertaken prior to any actual investment being made.

The key benefit of the modelling approach is in the creation of high-level or macro views of investment needs over several years. The nuances of asset management and network needs are smoothed and filtered in the historical data used to support and calibrate the models, either by the length of the modelling time period or by the "height" of the view. Given this, it is unlikely that a model will accurately reflect actual investment need in any one year, or in any one category, or for any one asset class. The filtering effect of a longer-term modelling time period or of a higher asset class or investment driver view will, however, provide insight into longer-term investment needs if calibrated appropriately.

Further, the structure of the models does not offer sufficient granularity at asset-class or investment driver-level, as it is not sufficiently precise to reflect actual asset condition or network capability. Instead, high-level asset and network characteristics (such as age profiles, average capacities, etc) are used. Consequently, the model outcomes for an asset class or an investment driver for any one year will not be representative of actual investment need that would otherwise be determined through asset management planning processes.

Direct comparison of modelled projections with actual plans at this level of detail in any one year will therefore be erroneous. For this reason, Endeavour Energy only uses the model projections to frame overall investment requirements over a sufficiently long time period (5 to 10 years), or at a sufficiently high-level (such as overall investment driver – growth or renewal).

In addition, high-level modelling may not reflect the optimisation of investment requirements of different drivers or of different asset classes as would normally occur through actual investment planning and governance processes. As noted elsewhere, this optimisation process is the business-as-usual practice within Endeavour Energy. This modelling shortcoming is a particular characteristic of the REPEX model, but it is noted that the calibration mechanism treats this to some extent by referencing projections to historical actual expenditure. In the VDA, this optimisation is achieved natively through the fully integrated nature of the model itself, thus allowing the WARL trend to be used as the appropriate calibration parameter.

2.4.4 MODELLING OUTCOMES

The various investment levels generated by the alternate modelling scenarios compared to the investment levels proposed in the current Portfolio Investment Plan of needs-based investment requirements (PIP FY19) are given in the Figure 10 and Figure 11 below.

The three modelling scenarios that have been carried out are:

1. Constant WARL (Long Term WARL) – representing an investment level required to allow the network to have a steady remaining life;
2. Condition Based (Asset Need) – representing Endeavour Energy's view of network investment required based on the condition of the network; and
3. Proposed Regulatory Capex – representing Endeavour Energy's Regulatory Proposal.

Further details of these scenarios can be found in the Repex Proposal.

FIGURE 10 - NETWORK INVESTMENT LEVELS – ASSET RENEWAL

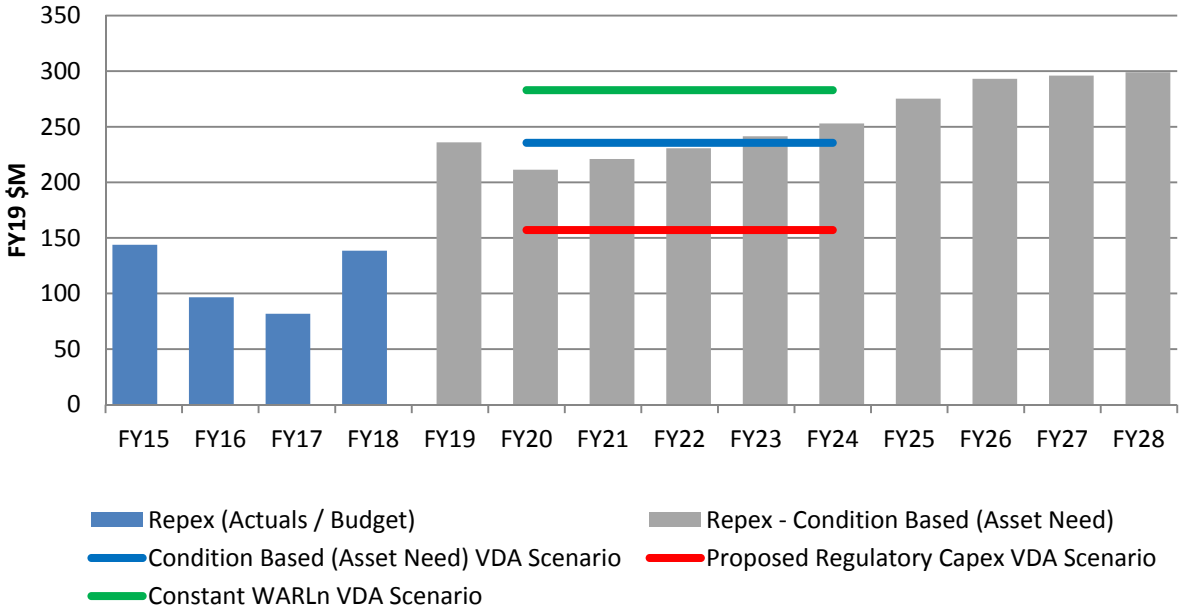
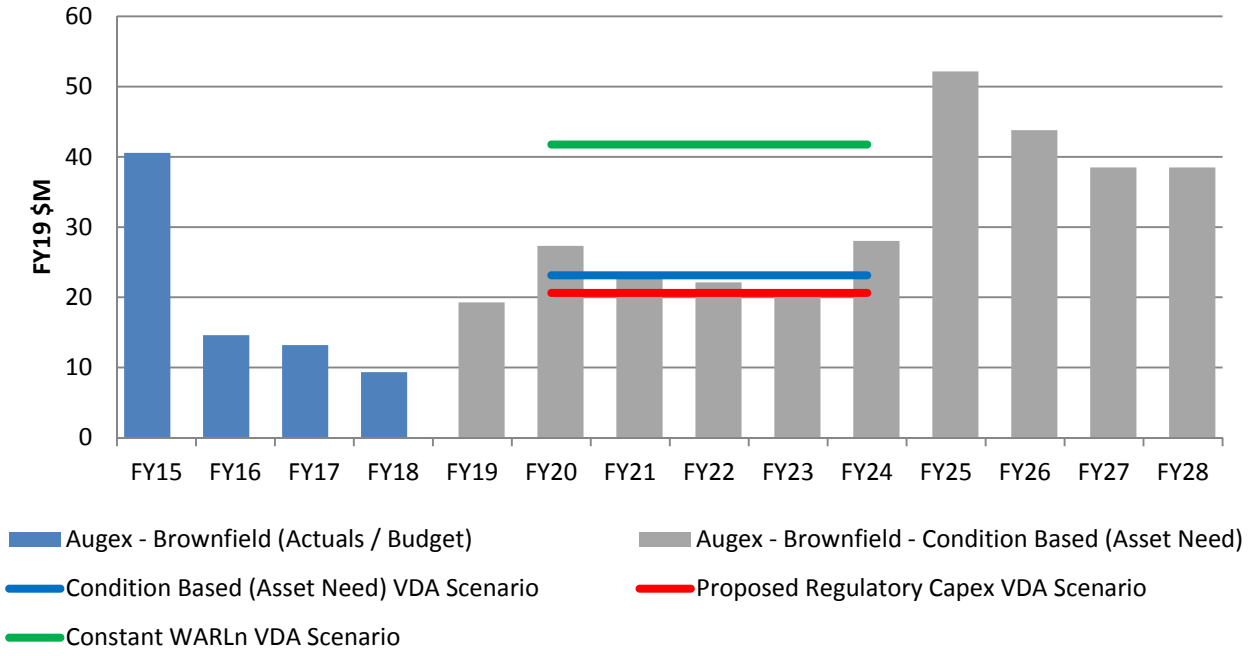


FIGURE 11 - NETWORK INVESTMENT LEVELS – BROWNFIELD GROWTH



2.4.5 NETWORK OUTCOMES

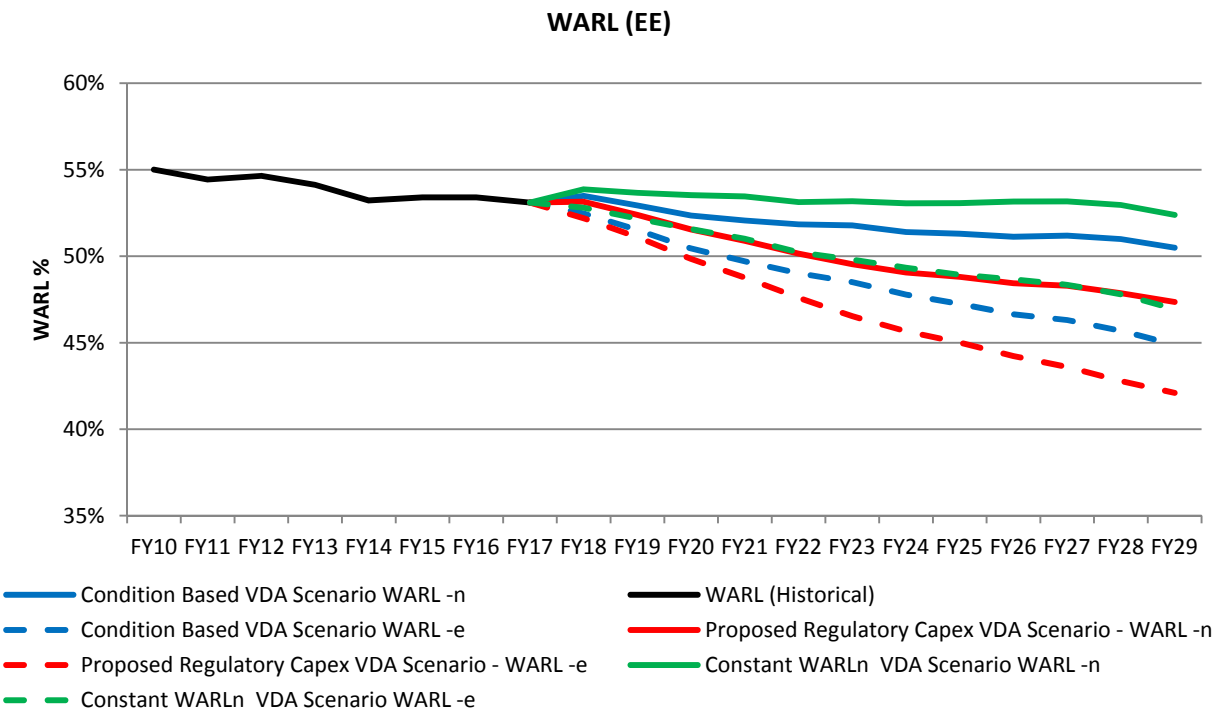
A feature of asset renewal driven expenditure projection is that the current level of asset renewal investment in the existing asset base is resulting in an overall slow decline in the $WARL_n$ trend.

With $WARL_n$ as a calibration key, this implies that the current level of investment will be unable to maintain current network outcomes into the long-term without changes to Endeavour Energy's approach to managing asset and network risk. Without such changes this would represent a longer-term strategic underinvestment in asset renewal. This has the potential to impact on CAPEX and OPEX expenditure levels and reliability performance outcomes within future regulatory periods. Notwithstanding this, the currently forecast decline in $WARL_n$ based on the capital investment projections are still what Endeavour Energy considers to be acceptable over the medium term, but will nevertheless require redress through other means.

Any additional asset end-of-life risk thus introduced through this projected decline is being managed through our 'Commercial Asset Management' approach, which targets renewal investment towards assets at the end of their life rather than at any particular age. A detailed risk analysis and condition assessment is undertaken as part of the process of developing capital asset renewal programs, with the programs this developed targeting the end-of-life of assets that are at or beyond the average age of replacement for that asset class.

Further, the increasing efficiency of delivery of renewal works is allowing for additional renewal works to be undertaken for the same historical level of investment which will also have an arresting influence on the decline in $WARL_n$, thereby further addressing future network risk.

FIGURE 12 – WEIGHTED AVERAGE REMAING LIFE PROJECTIONS – $WARL_e$ & $WARL_n$



2.5 ASSET MANAGEMENT PROGRAMS & PLANS OVERVIEW

Capital expenditure programs to address the asset and network need are implemented through a suite of asset management plans contained within this Strategic Asset Management Plan. The supporting plans are:

- Strategic Asset Renewal Plan;
- Transmission Network Planning Review;
- Growth Servicing Strategy;
- Distribution Works Program;
- Reliability Works Program; and
- Metering Asset Management Plan.

The SAMP assists the company to achieve its purpose from an asset management position through the following expenditure categories:

- Augex;
- Repex;
- Customer Connection;
- Reliability; and

- Other systems.

It is noted that the AER has provided only three main RIN categories: Augex, Repex and Customer Connections. Hence for RIN purposes, reliability and other systems are allocated under Repex.

Table 2 gives an overview of the SAMP programs and the objective that they are intended to manage. A more detailed discussion of each element detailed in the table is provided in the relevant sections of this document.

TABLE 2 – NETWORK ASSET MANAGEMENT STRATEGY ELEMENTS

AER Category	Managed By	Program Description	Section
Augex	Major Projects Program (TNPR)	Manages supply security at transmission and substation level	0
	Distribution Works Program (DNSR & DWP)	Manages supply security at distribution system level	3.1.3
	Low Voltage Development	Manages supply security at low voltage level	3.1.4
	Automation Growth	Manages operational risk zone and transmission level	0
Repex	Strategic Asset Renewal Plan (SARP)	Manages the replacement of assets that have reached the end of their effective life	3.2.1
	Essential Spares	Manages the purchase of essential spares	3.2.2
Customer Connection	Customer Connection	Ensures appropriate capacity added to network for new connections	3.3
Reliability*	Reliability Works Program (RWP)	Manages reliability works through network augmentation/improvements	3.4
Other System*	Metering (MAMP)	Manages the performance of the regulated metering asset	3.5.3
	Power Quality Program	Tracks quality of supply throughout the network to highlight areas for improvement	3.5.1
	Efficiency (Network Technology Strategy)	Implementation of Technology initiatives and programs for efficiency improvements	3.5.2
	Low Voltage Development	Manages supply security at low voltage level	3.1.4

*For RIN purposes, these categories are allocated to Repex.

A key function of the SAMP is to prioritise the asset management projects and programs of expenditure and to discuss and document the trade-offs that are made in developing the year ahead and ten-year network expenditure forecasts. In combination with the SAMP, a Workforce Plan helps to ensure the efficient and timely delivery of projects and programs.

Achievement of these objectives requires both capital investment and maintenance expenditure on the network assets. It also requires the development and implementation of business initiatives aimed at developing the organisation's culture and people to maximise their impact on performance, to improve business processes and to utilise technology to the maximum effect.

Effective achievement of the strategic network objectives requires an assessment of the impact on network outcomes that each proposed project or work program will have. Individual plans are developed in the key expenditure areas based on asset need. The SAMP uses a risk-based project prioritisation framework, with appropriate input from relevant stakeholders, to integrate and prioritise these plans into an overall capital and operating expenditure program.

By understanding the relative risks associated with the individual component projects and programs, the SAMP also enables the effective evaluation of capital and operating expenditure trade-offs.

End-to-end oversight of this process is provided by the Executive Network Asset Management Committee and the Investment Governance Committee of the Executive. Together the oversight from these committee's ensures that the content of the asset management plans are prudent and efficient, recognising the company's customer value objective and ensuring that the proposed expenditure is subject to appropriate scrutiny in the planning and delivery phases.

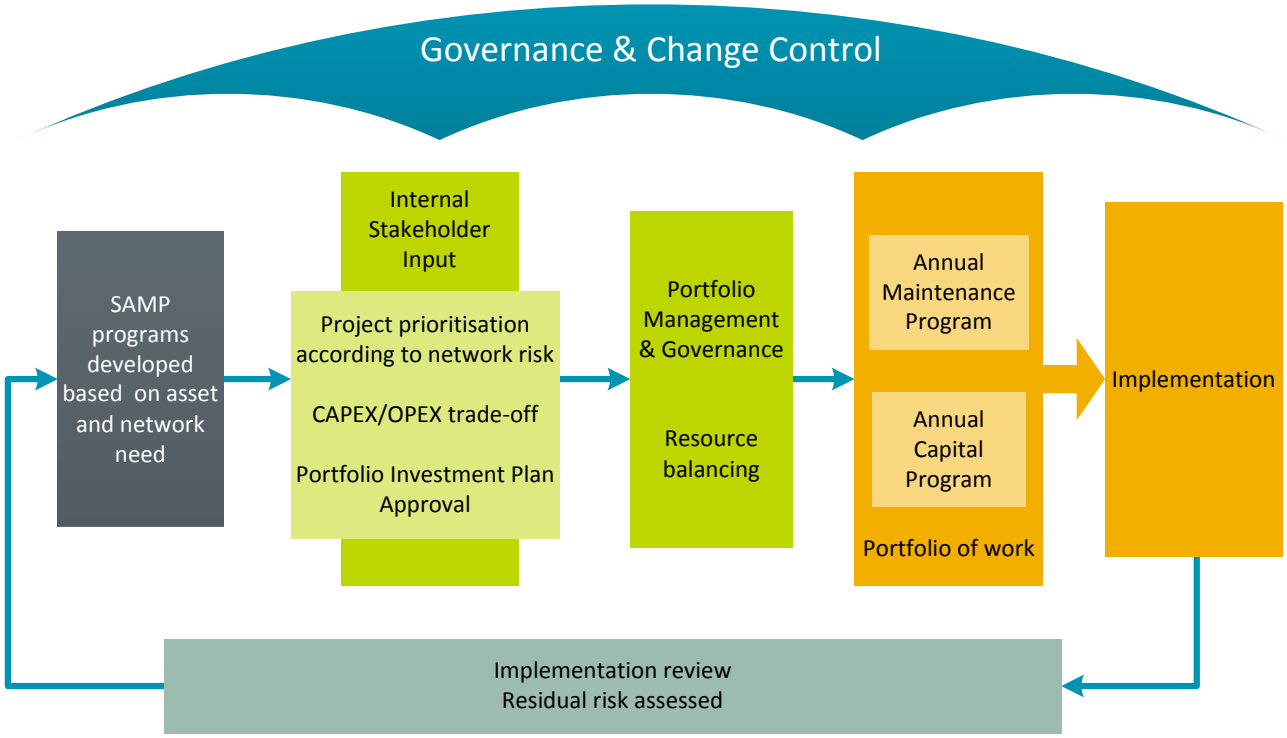
2.6 PROGRAM INTEGRATION

A key function of this Strategic Asset Management Plan is to discuss and document the trade-offs that are made in developing the year ahead and ten-year network expenditure forecasts.

Effective achievement of the strategic network objectives requires an assessment of the impact on network outcomes that each proposed project or work program will have. Resources are then assigned to those projects and programs where the best cost benefit will be achieved.

Figure 13 shows the high level asset management processes used to achieve the desired outcomes from the network expenditure programs.

FIGURE 13 – NETWORK ASSET MANAGEMENT PROCESSES



Individual plans are developed in the key expenditure areas based on asset need. The SAMP uses a project prioritisation framework to integrate and prioritise these plans into an overall expenditure program with appropriate input from relevant stakeholders.

Organisational resource constraints are then applied to the program to determine the year-ahead capital and maintenance works programs.

An annual review is carried out of the degree to which each program has achieved its objectives and the residual network risk provides an input into the process for the following year.

End to end oversight of this process is provided by the Investment Governance Committee of the Executive, which ensures that expenditure is subject to appropriate scrutiny in the planning and delivery process.

The risk management framework currently used to optimise the Regulatory Period works program is implemented using the software application CASH (Capital Allocation Selection Hierarchy).

3.0 ASSET & NETWORK NEED

3.1 SERVICING GROWTH IN DEMAND – AUGEX

Plans for managing the growth in demand on the network are informed by ten-year spatial forecasts of summer and winter peak demand. These forecasts include an understanding of proposed industrial, commercial and residential developments gained from developers and planning authorities such as the NSW Department of Planning and Environment and the Greater Sydney Commission.

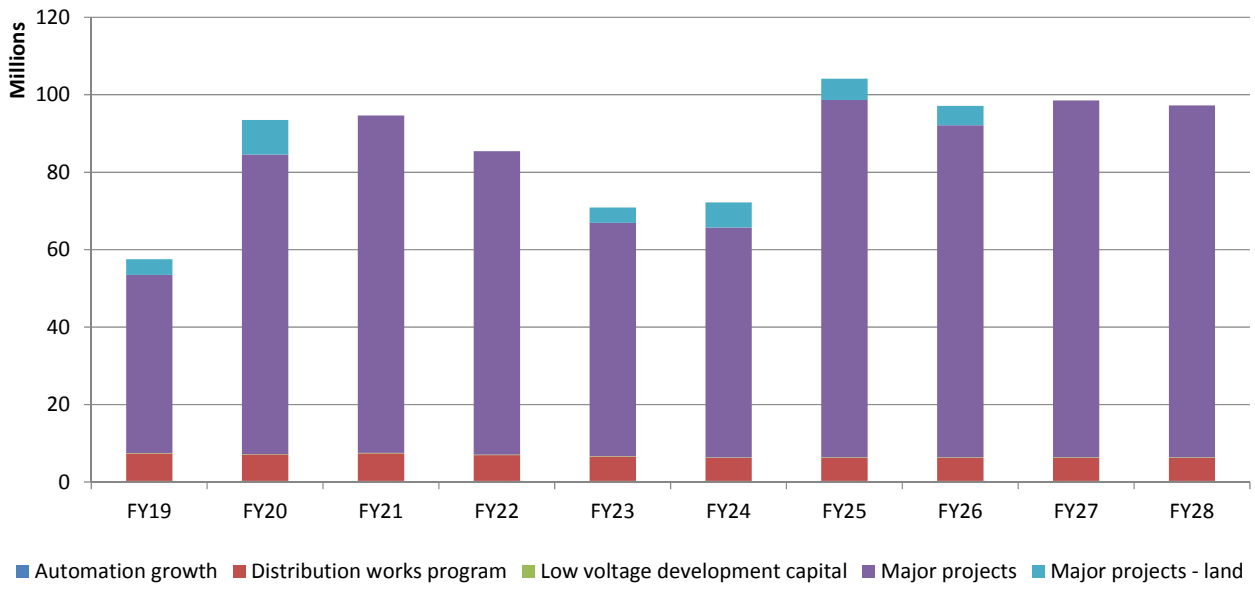
Distinctions are drawn in the augmentation planning process between the work necessary to facilitate the connection of new customers and the work necessary to increase the capacity of the network due to organic growth in demand from existing customers. The latter category of work lends itself to the use of demand management techniques to avoid or defer capital expenditure. A further distinction is drawn between the work necessary to enable the connection of customers in greenfield areas and the connection of customers in areas where network assets already exist as the establishment of significant new infrastructure to service greenfield areas is of strategic importance to the efficient long term development of the network.

An emerging trend in the development sector is government initiatives to rezone and revitalise existing urban areas as ‘urban activation precincts’.

An important component of the plans to manage growth in demand is the use of demand management to avoid or defer the need for capital intensive network augmentation. Endeavour Energy has a demand management strategy to utilise technology and processes, where they have proven to be cost effective at reducing peak demand, to defer investment in network augmentation. Accordingly, evaluation of the potential viability of demand management in constrained areas is an integral part of the planning process.

Figure 14 shows the 10 year projection for Augex based expenditure.

FIGURE 14 - AUGEX EXPENDITURE PROJECTION



3.1.1 MAJOR PROJECTS (PR)

Endeavour Energy's network planning policies and standards are based on probabilistic planning principles. Single contingency scenarios (N-1) are considered, however the level of supply security provided will be subject to the outcomes of a reliability risk and cost benefit analysis specific to that situation. Impacts on reliability are considered due to:

- A need to comply with Reliability Standards in Schedules 2 and 3 of the Licence Conditions; and
- Corporate objectives to maintain existing levels of overall reliability performance.

Looking forward, the main driver of the Major Projects Program is to service some of the fastest growing areas in NSW. In particular, the North West and South West Growth Centres, which are high priorities for the NSW Department of Planning as key planks in its Metropolitan Urban Development Strategy. These two areas will eventually accommodate over 250,000 new dwellings in areas which are currently only served by minimal rural electricity infrastructure. Finalisation of the plans for the Western Sydney Airport will crystallise key drivers for the Broader Western Sydney Employment Area which is adjacent to the South West Growth Centre.

The Major Projects program is also influenced by trends in the way in which customers use electricity. Endeavour Energy's network area includes Western Sydney. This region is subject to higher temperatures than the coastal and mountainous parts of the greater Sydney region. The prevalence of air conditioning means demand peaks at the times when equipment thermal ratings are at their lowest. Peak demand forecasts take into account the impact of energy efficiency requirements for new dwelling construction (BASIX), solar PV installations and improvements in appliance efficiency.

Major projects are intended to address capacity constraints that arise on the sub-transmission network under peak demand conditions. The constraints may occur either under system normal or single contingency scenarios. The sub-transmission network includes transmission substations, zone substations and sub-transmission lines from 33kV to 132kV. The principal inputs into the process of developing major projects are the summer and winter demand forecasts. The demand forecasts are produced on an annual basis and forecast the load on each zone substation under winter and summer peak demand conditions over a ten-year period. These forecasts take into account both trends in historic base load growth as well as known individual developments.

The Transmission Network Planning Review (TNPR) study is conducted on an annual basis and investigates the capability of Endeavour Energy's 132kV, 66kV and 33kV sub-transmission network to supply the forecast demands over a ten-year period. The intention of the review is to identify capacity constraints that load growth will cause to develop on the network.

Each identified network constraint is analysed further to confirm a need to look at investment options. This includes:

- Verification of ratings including cyclic and emergency ratings; and
- Probabilistic risk assessment.

If a constraint is confirmed as likely to require remedial action, it will be the subject of a Network Investment Options (NIO) study which considers a range of network and non-network alternatives to alleviating the constraint. These studies are carried out by cross-functional teams to ensure that the best overall solution is developed. In particular, the NIO process ensures that any identified asset renewal issues on the constrained network elements are addressed as part of the final solution.

Financial evaluations are carried out on proposed options to ensure that the preferred option in each case represent a sound investment decision, prior to finalising the proposed solution for approval.

3.1.2 AUTOMATION GROWTH (AG)

A new program has been created to cover SCADA and technical developments to mitigate operational and/or capacity risks in the various locations across the network. These developments are typically requested by System Control in response to new identified risks as they arise. Examples of SCADA and technical developments to be covered under this program include: post contingency load shedding and load transfers or changeover operations.

3.1.3 DISTRIBUTION WORKS PROGRAM – DWP (HV, EH)

The high voltage distribution network forms the link between zone substations and distribution substations, to supply the majority of Endeavour Energy's customers. It provides a means of connecting these loads as well as allowing flexible switching of loads between feeders and between zone substations during contingency situations and during planned works.

To ensure equipment ratings are not exceeded and to allow the flexibility to switch loads between feeders in the event of a fault, Endeavour Energy specifies a maximum design loading for distribution feeders with reference to SDI501 Network Configuration Standard. Over time, through natural growth on the network, the actual loading on some feeders will exceed the design rating. The Distribution Network Status Report (DNSR) reviews the load on every feeder on an annual basis and identifies constraints those loads impose. The Distribution Works Program (DWP) details the works required to overcome the identified constraints and gains approval for the expenditure for those works.

In addition to distribution feeders operating beyond their design capacity, the DWP also focuses on issues such as supply quality (for example, steady state voltage levels), operational flexibility, and safety (principally associated with rating issues).

Endeavour Energy's distribution network planning standards allow for distribution feeders to operate with demand of up to 80% of feeder thermal capacity. Some flexibility in adherence to the standard is allowed where it is uneconomic to comply and where operational risks can be managed.

The Distribution Works Program includes input from the following sources:

- Operations Group / Distribution Network Standards. Projects in this category target compliance to network policies and standards in regards to operational flexibility, customer reliability, load transfer capability and safety.
- Network Environmental Group. The DWP includes a section for environmental enhancement works which focuses on works designed to reduce the impact on the environment of the Endeavour Energy network.

Distribution works required as a direct result of a customer application for a new or augmented load connection are funded and managed through the New Customer Connection process.

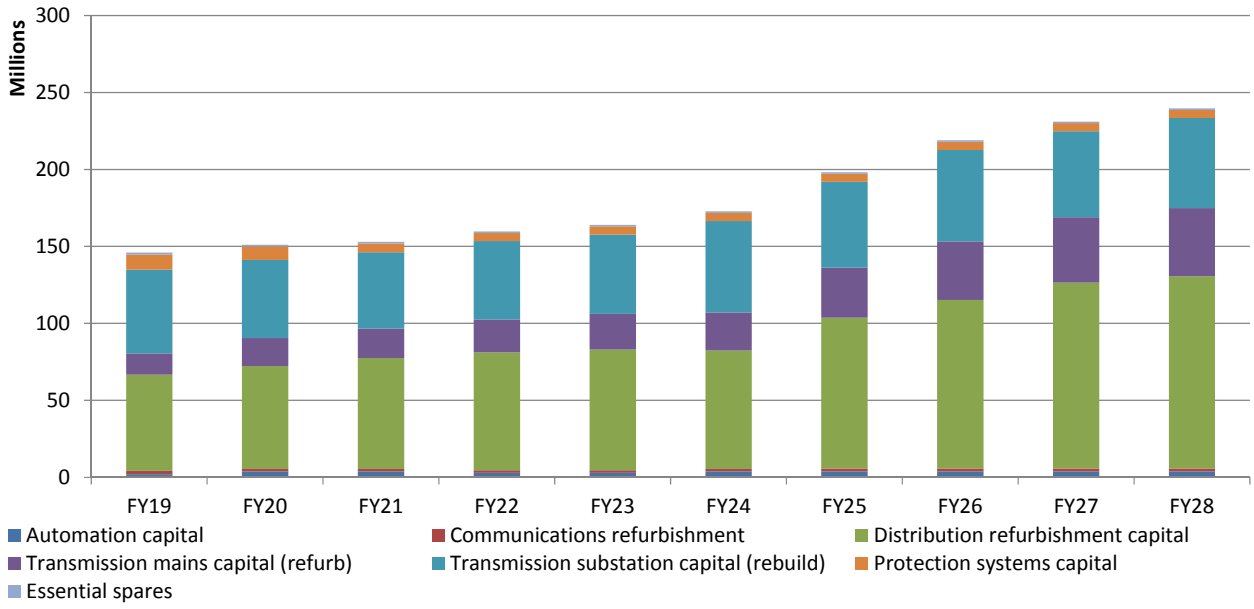
3.1.4 LOW VOLTAGE DEVELOPMENT (LV)

The Low Voltage Development program covered under Augex covers overloaded distribution substation uprates. Load growth and changes in electricity utilisation by customers occasionally results in overloading of low voltage distribution transformers. In recognition of this situation, a program of monitoring maximum demand and temperature has been implemented. The results are assessed and a transformer is replaced with a larger capacity if required.

3.2 MANAGING THE NETWORK SUSTAINABLY – REPEX

The Repex category covers Endeavour Energy's Strategic Asset Renewal Plan as well as its Essential Spares program. Figure 15 shows the 10 year projection for Repex based expenditure.

FIGURE 15 – REPEX EXPENDITURE PROJECTION



3.2.1 STRATEGIC ASSET RENEWAL PLAN – SARP (TS, TM, DS, AU, CC, PS)

Many elements of Endeavour Energy's electrical network were constructed during the infrastructure booms in the 1960s through to the 1980s. As many of these network elements are now reaching the end of their useful lives, Endeavour Energy is faced with the challenge of replacing large numbers of assets in an economically efficient manner while ensuring that age-related equipment failures do not adversely impact on the safety or reliability of the network.

An ageing asset base will eventually display declining performance and increased operating expenditure requirements, particularly as individual assets reach the end of their operating life. Due to the quantities involved, significant reinvestment is needed to maintain network performance standards and levels of safety. The objective of the asset renewal strategy is to achieve an appropriate balance between age or condition-related equipment failures and sustainable capital and maintenance expenditure levels. To avoid unmanageable levels of failure and emergency investment, strategies are required to plan the renewal of the electrical network in a timely way, cognisant of the need to avoid creating shocks in resource requirements. This approach also enables the planning of consistent levels of capital expenditure, which supports the objective of avoiding price shocks for customers.

To address this need, Endeavour Energy has long adopted a strategic approach to asset renewal planning. This approach has several facets including:

- High level asset renewal expenditure modelling;
- The development of bottom-up short-term expenditure projections for various asset classes based on asset condition; and
- The alignment over time of the bottom-up and high level expenditure projections to achieve asset age objectives.

This work is collated and articulated in the annual Strategic Asset Renewal Plan (SARP).

Endeavour Energy adopts a range of approaches for identifying assets that are candidates for renewal, ranging from simple inspection and condition-based maintenance regimes through to detailed technical analysis of key asset indicators. Except in rare instances of low critically consumable assets, electrical network assets will generally be renewed prior to their failure, where failure of an asset is defined as not fulfilling its performance requirements.

This approach ensures that:

- Destructive failures that may compromise safety standards, cause damage to other assets and high repair and/or emergency repair costs are avoided;
- Unplanned interruptions to customer supplies are minimised;
- Interruptions to planned work programs are minimised; and
- Efficient management of financial, material and human resources occur.

The optimal time for replacement is estimated for each asset or asset class, based on actual experience, data, and analysis of expected remaining life and likely failure modes. In determining the end of an asset's life, the following factors may be considered:

- The likely or possible failure modes of the asset;
- The asset's criticality in the network (the "customer damage factor" should it fail);
- The renewal needs of other related and/or affected assets;
- The performance of the asset against its performance criteria;
- The operation and maintenance costs and trends of the assets; and
- Cost, functionality and performance of the replacement technology.

Some assets may be renewed because of the inherent inefficiencies in continuing to maintain the assets in a cost effective manner. Typical examples include circuit breakers, which require intensive mechanical maintenance with specialist skills and hard to procure replacement parts. Further, it is often efficient to bring forward the replacement of some assets, in order to smooth resource requirements and avoid unmanageable peaks in cost, human and material resource requirements.

The programs and projects developed by Endeavour Energy reflect a combination of the differing approaches to the timing of asset renewal. Various factors will influence whether each project or program falls into the "strategic renewal" area or the "critical replacement" area. As noted above, there are currently significant numbers of key assets that are approaching the end of their lives. These assets need to be programmed for replacement in a strategic manner in order to manage the resource and network implications of their reaching the end of their life.

The "critical replacement" approach is typically applied where Endeavour Energy has unique major assets of high replacement value, eg 132/33kV power transformers. Typically, these assets are maintained and nurtured to a point where it is clear that the need for the replacement of the asset is imminent. To manage the risks and associated potential impacts of this approach requires a program with a long-term planning horizon that reflects the risks and lead-times associated with renewal of these assets.

Using the range of approaches outlined above, Endeavour Energy establishes short-term renewal programs based on available data supplemented with expert knowledge of the imminent end-of-life of the assets in question. These short-term programs are integrated into longer term renewal programs to provide accurate expenditure projections and enable the efficient integration of renewal, growth-driven and other asset management activities. The development of programs in this way is fully documented in Endeavour Energy's SARP which is published annually. The process for developing the SARP involves a number of stages including the following:

- Identifying specific short-term (1-2 year) renewal needs through analysis of asset age, asset condition and performance analysis and taking account of the consequence of failure;
- Formulating a long-term position on renewal needs using asset renewal expenditure modelling;
- Collating and integrating short term and long term renewal expenditure needs in the SARP;
- Prioritising renewal expenditure; and

- Integration and prioritisation against other expenditure in the network investment program, especially to identify and eliminate growth and renewal project overlaps.

The replacement strategy is also responsive to the changes that have occurred over the past few years. These include:

- The slowing of economic growth in both Endeavour Energy's supply area and the broader economy, together with the uncertainty resulting from increased electricity prices and the global financial position. This has resulted in load forecasts reducing from the expectations set in the Regulatory Submission; and
- The reliability performance of the network has improved.

3.2.2 ESSENTIAL SPARES (SP)

This program includes the purchase of essential spares for Endeavour Energy's network. Essential spares are assets or components of assets which are difficult to procure or have long procurement lead times and are required for equipment which is critical to the operation of the network. Essential spares are kept on hand for use in emergencies.

Essential spares include free-standing items (complete high cost items eg power transformers and circuit breakers), major components (spares for free standing eg bushings) and minor components (relays, springs, circuit breaker contacts).

Endeavour Energy's company policy states that the company will ensure that spares for critical assets are appropriately managed so that they are available at short notice to ensure that the security of the network can be restored promptly after a system asset failure.

The purpose of this program is to ensure that an adequate inventory of essential spares is procured and available.

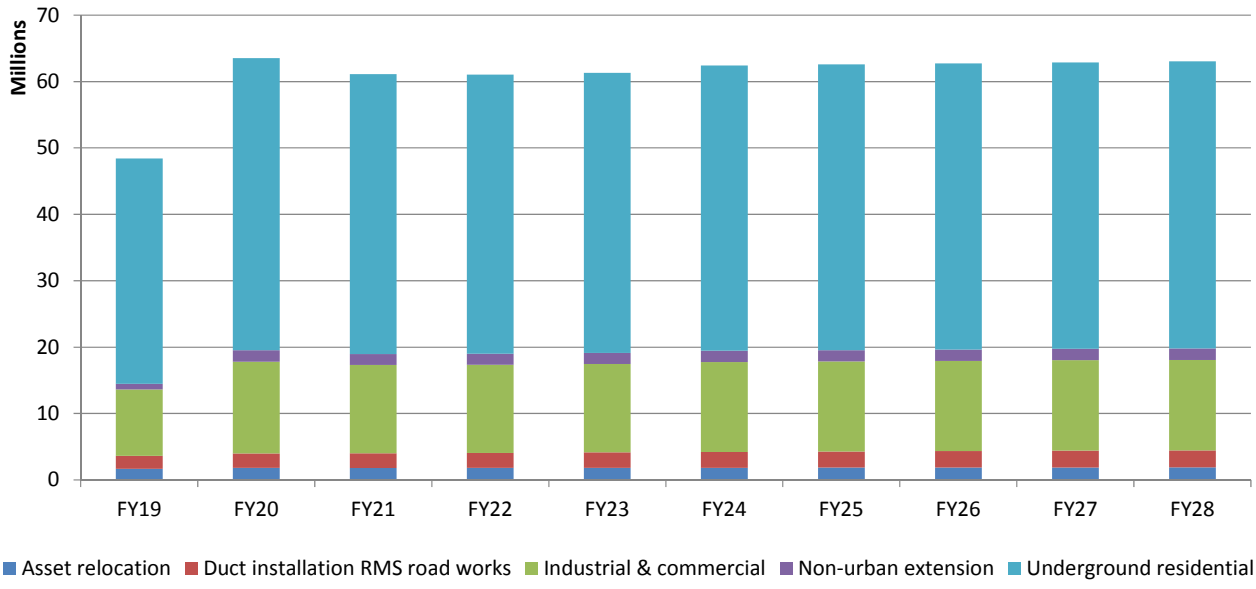
3.3 CUSTOMER CONNECTIONS

Endeavour Energy invests capital to augment and extend the network to allow the connection of new customers and to relocate assets at the request of external parties.

The connections expenditure presented in the SAMP excludes customer funded capital contributions for connection assets and relocations. Endeavour Energy is currently experiencing high levels of activity for connections resulting in record levels of capital contributions in excess of $160m per annum. Endeavour Energy is required to maintain and operate these additional assets.

The forecast capital expenditure on new customer connections is shown in Figure 16.

FIGURE 16 – CUSTOMER CONNECTION EXPENDITURE PROJECTION



3.3.1 NEW CUSTOMER CONNECTIONS (IC, NU, UR)

Endeavour Energy considers the cost of connecting new customers in three broad categories:

- Industrial and commercial;
- Non-urban; and
- Underground Residential Developments.

The New Connections program is developed annually in each of these areas from a consideration of the forecast growth in customer numbers, as well as information from councils and developers concerning their upcoming land development plans.

Endeavour Energy has planning standards in place that define, amongst other things, the technical requirements for the connection of different load types and sizes to ensure that appropriate levels of supply security and reliability are provided to new customers. This also ensures that the connection of new loads does not adversely impact the security or reliability of the supply to existing customers.

Rules for the funding of connection assets are defined by Endeavour Energy policies. In general, the load applicant will fund the cost of the specific dedicated network assets required to service that customer. However, the connection may also require the installation or augmentation of shared or upstream assets. The intention of the New Connections allocation is to fund the works associated with shared network assets.

3.3.2 ASSET RELOCATIONS (AR)

The cost of relocating existing network assets to allow for works such as road widening or construction is generally funded wholly by the party requesting the relocation. Endeavour Energy may, however, increase the scope of the proposed relocation to achieve a desired network outcome. In these cases, the cost associated with the increased scope is borne by Endeavour Energy.

3.3.3 DUCT INSTALLATIONS (DU)

A new duct installation program has been introduced in the SAMP as a strategic initiative to capture opportunities to install ducts in strategic locations when the opportunity arises through planned third party road works in the area. Road Authorities consult with Endeavour Energy regularly in relation to planned works and as part of this consultation, Endeavour Energy determines if any underground cable works will be required in the affected sections of roadway in the short to medium term. A duct installation project is initiated if there are plans for Endeavour Energy to lay underground cables in the affected portions of the roadway. This significantly minimises Endeavour Energy's civil and traffic management costs when the cables are installed. It also minimises public inconvenience, disruption of other services and stakeholder dissatisfaction.

3.4 MEET CUSTOMERS' RELIABILITY NEEDS

Endeavour Energy must operate within the reliability obligations of its Licence Conditions as regulated by the Independent Pricing and Regulatory Tribunal (IPART). IPART is the safety and reliability regulator for NSW electricity networks.

The Licence Conditions additionally requires the quarterly reporting (end of March, June, September and December) of overall feeder category performance, both SAIDI and SAIFI against feeder category performance standard limits as defined in Schedule 2. Additionally it requires quarterly reporting of any feeders which exceed the individual feeder standards as defined in Schedule 3. There are also associated timeframes for the creation of investigation reports for non-compliant feeders including the development of any associated operational, network or non-network improvement actions and projects.

Endeavour Energy targets compliance to the NSW licence conditions feeder category performance standards (Schedule 2) and the management of feeders which are non-compliant to the individual feeder performance standard (Schedule 3).

Endeavour Energy's Reliability Works Program is a bi-annual program of targeted improvement projects aligned to the Licence Conditions. It is focussed on:

Feeders that have been identified as non-compliant with the Individual Feeder Standards in accordance with the Licence Conditions.

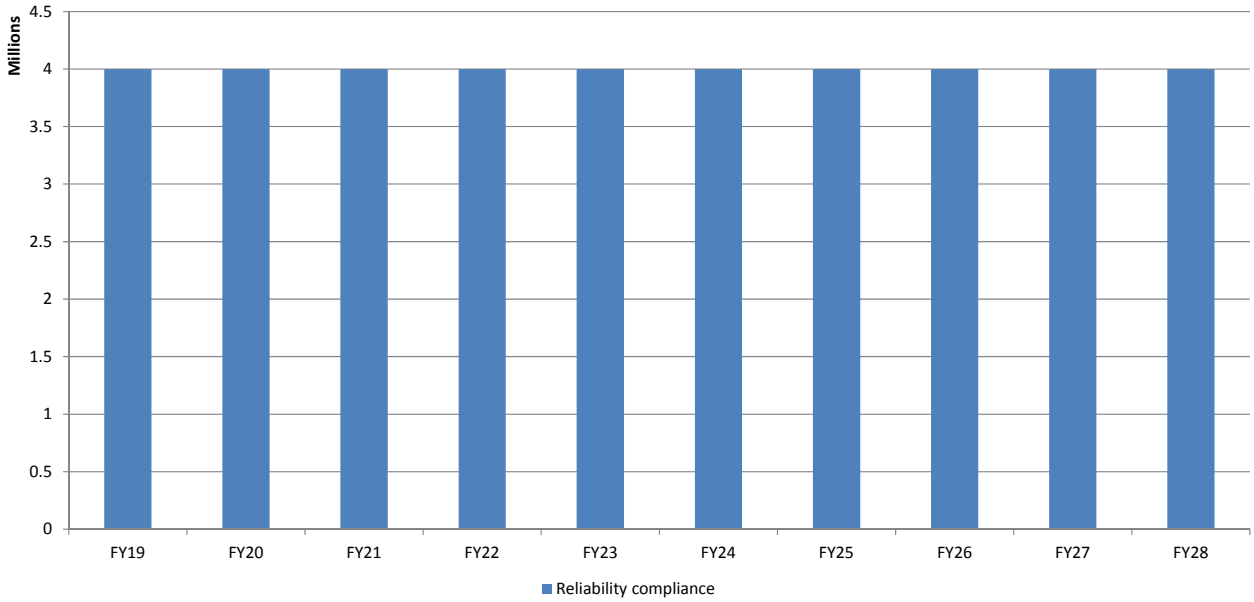
Localised unsatisfactory performance instigated by a justifiable customer or ministerial complaints. These are typically associated with feeders at risk of non-compliance or historically non-compliant to Individual Feeder Standards

Endeavour Energy applies a cost benefit analysis test to Licence Compliance investment. This analysis considers the Value of Customer Reliability (VCR) as published by AEMO.

In its final determination, the AER has only allowed for expenditure for reliability improvement with respect to compliance to the NSW Reliability and Performance Licence Conditions. The AER has determined that reliability expenditure to realise any further specific gain in reliability improvement will need to be self-funded with consideration to potential penalties or rewards under the STPIS.

The forecast capital expenditure on Endeavour Energy's reliability program is shown in Figure 17

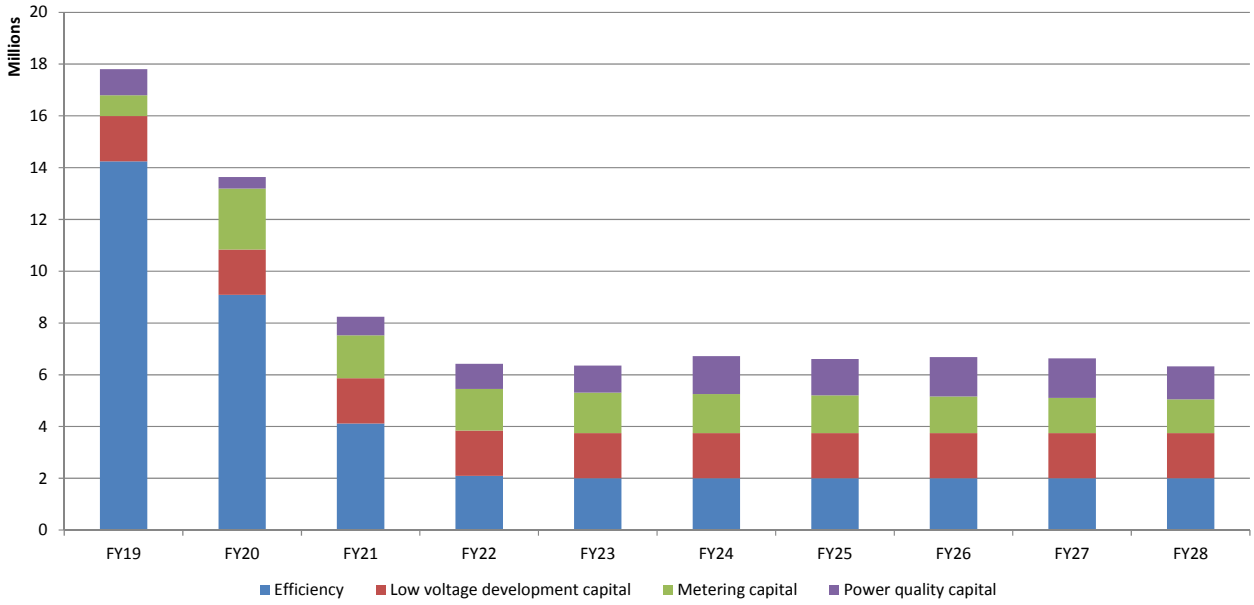
FIGURE 17 – RELIABILITY EXPENDITURE PROJECTION



3.5 OTHER SYSTEMS

Endeavour Energy's Capex includes a number of programs classed under the Other System category. The forecast capital expenditure for Other System Capex is shown in Figure 18.

FIGURE 18 – OTHER SYSTEM EXPENDITURE PROJECTION



3.5.1 POWER QUALITY (PQ)

Power quality is one aspect of the generalised term "Quality of Supply" that refers to electrical disturbances that can affect customer equipment. These disturbances are categorised as voltage sags / swells, voltage fluctuations (flicker), harmonics, unbalance and power factor.

There is an increasing need to effectively manage power quality as simultaneously loads are becoming more sensitive, requiring "digital quality" power, and there is a proliferation of power electronic devices which are causing waveform distortion in all areas of the network. In other words, there is both a tendency for more disturbances to the steady sinusoidal waveform and an increased sensitivity to those disturbances.

Endeavour provides large customers or customers with significantly distorting equipment with power quality allocations for harmonics, flicker and unbalance according to the NER and AS61000 series of standards and technical reports. This forms the basis of ensuring overall power quality performance is maintained within planning levels. Planning levels are set such that there is a margin between the planning level and typical customer equipment immunity.

Endeavour Energy takes part in the Power Quality Audit (PQA), conducted each year by the Australian Power Quality and Reliability Centre (APQRC). This allows for establishing Endeavour Energy's predicted compliance level for various power quality parameters, benchmarking of performance against other participating utilities as well as highlight areas where improvement efforts may be focused.

In order to obtain the data necessary for power quality management, dedicated power quality monitors are installed at zone and transmission substations. Smart meters installed at customer installations and distribution substation monitors can also obtain some power quality data.

3.5.2 EFFICIENCY AND THE USE OF NEW TECHNOLOGY (EF)

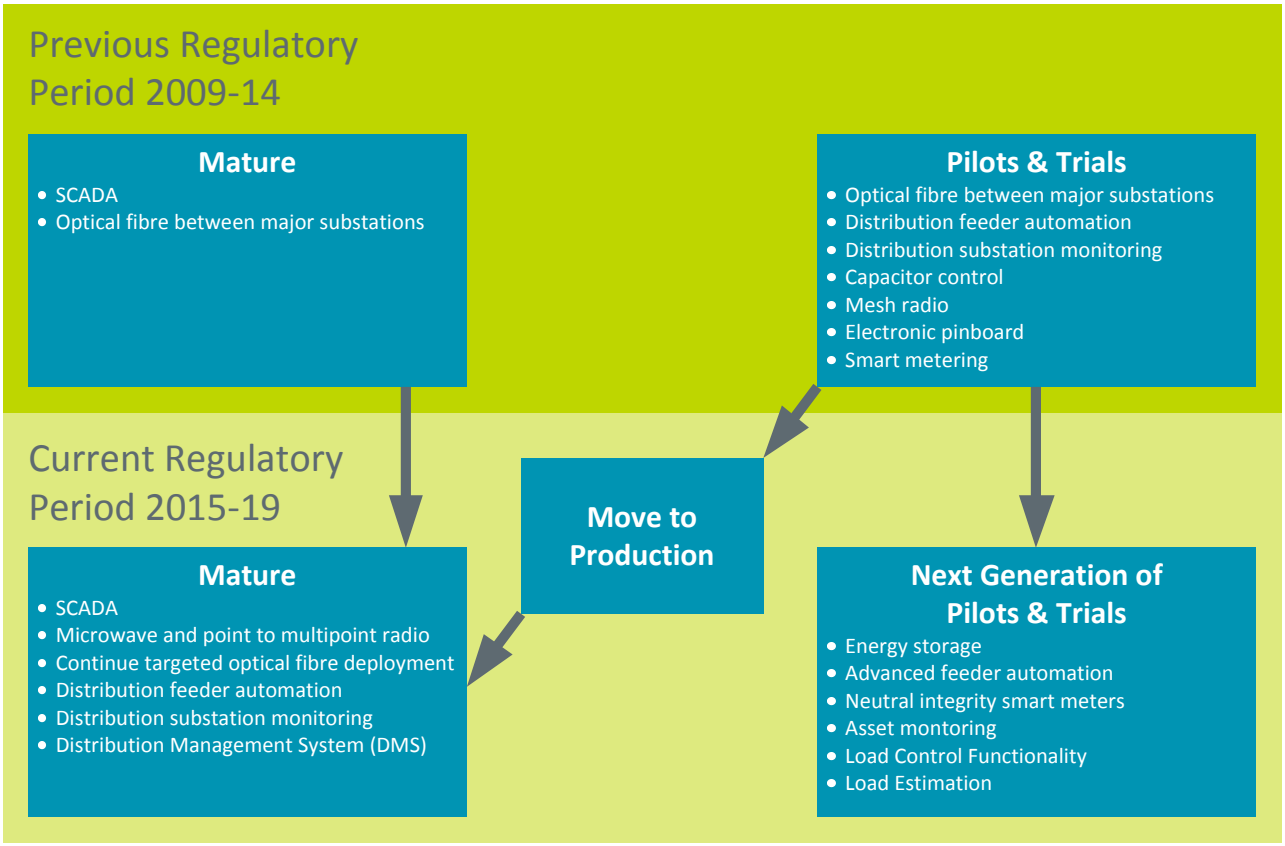
This strategy recognises that technology has a role to play in enabling the achievement of improving efficiency of the network and its operation and management. Over the previous regulatory period there have been price reductions in telecommunications which make the implementation of technology-enabled networks (future grids) viable. In the course of the current regulatory period, the Company will start to leverage future grid technologies where these provide proven, cost-effective alternatives to traditional network solutions.

Increasingly the electrical network is becoming more complex with the growing penetration of embedded generation, both at the small customer level with embedded renewables and potentially electric vehicles and also with larger embedded sources such as is already occurring across Endeavour Energy's franchise area. Similarly, with the development of battery technologies, it is anticipated that over the course of the next regulatory period there will be an increase in the viability and penetration of battery storage. This two-way power flow will dramatically increase the complexity of managing, operating and maintaining a network originally designed for the one-way power flow.

A further driver of the use of technology is the need to improve the productivity of a range of processes across the human resources, finance and network asset management functions as well as for mobile and field-based teams.

Endeavour Energy has been and continues to evaluate operational technology solutions for their applicability and cost effectiveness to address network management issues on the Company's network. The focus of this work is generally on understanding how a range of technologies that have proven their effectiveness in similar situations elsewhere may be utilised within Endeavour Energy's network to add value in the future. Figure 19 shows the range of technologies that are currently under consideration and those that are already considered to be suitable for use in the network.

FIGURE 19 – NETWORK OPERATIONAL TECHNOLOGY PRODUCT DEVELOPMENT



The use of network operational technology is supported by an information technology program that has a three-fold focus:

- Running the business. IT asset management is to provide a stable, scalable and cost effective platform with disaster recovery capability on which to build solutions that deliver sustainable and reliable system and network performance. Ongoing investment and effort is required across all platforms to maintain an acceptable performance level of business applications, manage the risk around supportability and the ability of acquiring competitive skills in the market place;
- Improving the Business. IT asset management is also driven by investment in new applications, systems and devices used by the business to achieve their cost and risk

outcomes. Investment in technological advancements is needed to support and enable business initiatives to realise benefits in productivity and efficiency. Key opportunities include extending field force automation, elimination of manual processing and improving access to accurate data to support decision making in the field and in the office; and

- Transforming the business to meet new challenges. This type of investment follows innovations and developments in the wider IT industry and the increasing level of technical literacy of Endeavour Energy's customers, service providers and electricity consumers.

Within this framework, IT initiatives are developed across the range of organisational functions, including network asset management and are prioritised to support the achievement of corporate objectives in a cost effective manner.

3.5.3 METERING (MC)

The standard control service portion of Endeavour Energy's metering program covers the renewal of relays and demand management technology.

The relay renewal program replaces load control equipment on customer's switchboards which has reached the end of its life. The provision of load control devices will allow customers to have off-peak electricity usage. Load control devices allow Endeavour Energy to control loads to better manage demand on the network. Appliances such as hot water heaters on off-peak circuits can be controlled to run during periods of lower energy demand rather than peak demand. Load control will allow Endeavour Energy to defer capital investments for network augmentation that would otherwise be required to provide for the required demand.

The demand management program provides equipment to support Endeavour Energy's demand management initiatives. These initiatives include DMIA trials, constraint driven projects and targeted broad based initiatives. The funding from this program is primarily for demand response products and systems and some customer technology products for trial like energy storage, power factor correction, inverters, air conditioner control and smart home control devices.

3.5.4 LOW VOLTAGE DEVELOPMENT (LV)

The Low Voltage Development program covers various aspects of low voltage planning, including supply security, operability and power quality. An important aspect of achieving an acceptable standard of power quality is to ensure that development of the low voltage network meets the needs of the load that it is required to service. This part of the network is often subject to small increases in demand or changing nature of load that individually do not impact the network and are often not even advised to Endeavour Energy. Cumulatively however, this growth or changing nature in demand can overload the low voltage network and distribution substations or lead to other power quality related non-compliances. This element of the SAMP is intended to address these issues.

The following programs are included under this category:

- Quality of supply reactive projects;
- Low voltage planning reactive projects; and
- Distribution monitoring and LV feeder monitoring.

4.0 SAMP EXPENDITURE PROGRAMS

4.1 CAPEX PROGRAM

Table 3 provides details of the ten-year forecast of capital expenditure requirements for Endeavour Energy's network.

It should be noted that the detailed program of projects provided is not intended to represent the capital works program in any particular year but the timings shown for projects are intended to allow the projects to be completed in time to meet their "network need" dates.

The expenditure given in Table 3 is in real FY19 terms.

TABLE 3 – CAPEX PROGRAM FY18 – FY27

Program/Project		FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	Total
Augex												
PR	**Major Projects**											
PR081	Collimore Park ZS establishment								5.576	11.152	11.152	27.880
PR110	Edmondson Park ZS establishment	2.187	1.888	0.006								4.081
PR113	Augment feeder 308 Nepean to Douglas Park	0.518	6.072									6.590
PR170	Holsworthy 33/11kV ZS establishment								4.082	8.164	8.164	20.410
PR190	Eschol Park ZS establishment								4.208	8.416	8.416	21.040
PR249	Establish Penrith Lakes 33/11kV Zone Substation						3.610	14.440				18.050
PR258	Menangle Park 66/11kV ZS establishment	3.800	3.500									7.300
PR270	West Epping Zone Substation establishment								6.472	12.944	12.944	32.360
PR278	Kemps Creek new BSP associated works									2.140	2.140	4.280
PR292	South Marsden Park (industrial) 132/11kV ZS establishment	14.500	9.561									24.061
PR423	Maryland ZS establishment			4.167	8.334	8.334						20.834
PR425	Austral ZS establishment (interim initially)			2.380								2.380
PR427	Leppington North ZS establishment	10.000	2.911	0.285								13.196
PR433	Rossmore ZS establishment										10.000	10.000
PR435	Catherine Fields North ZS establishment (interim)							5.652	11.304	11.304		28.260
PR437	Catherine Fields 11kV feeder works	0.530										0.530
PR439	North Bringelly ZS establishment								4.420	8.840	8.840	22.100
PR444	Culburra Beach development (33kV fdr and single transformer ZS)									3.665	3.665	7.330
PR499	Southpipe (Oakdale Estate) ZS 132/11kV establishment		5.452	12.904	8.904							27.260
PR620	West Dapto ZS establishment				2.467	4.934	4.934					12.335
PR653	Avondale (South West Dapto) 132/11kV ZS establishment								5.000	5.000	5.000	15.000
PR656	Leppington South ZS establishment (permanent)	10.900	12.195	1.904								24.999
PR657	Calderwood ZS establishment (interim initially)	0.200	7.851	7.851								15.902
PR673	Liverpool ZS 11kV switchboard extension & distribution works	0.950										0.950
PR677	South Penrith Zone Substation		4.615	13.230	10.230							28.075
PR698	Marsden Park (residential) 132/11kV ZS - stage 2		3.463	5.463								8.925
PR700	Riverstone east ZS establishment				4.129	8.258	8.258					20.645
PR702	Penrith ZS 11kV transformer cable constraints	0.050										0.050
PR710	Feeder 868 rebuild & rearrangement South32	0.022										0.022
PR713	Box Hill 132/22kV ZS establishment		4.964	15.928	13.928							34.820
PR722	Camellia TS connection works for Ausgrid	0.187	0.031	0.096								0.314
PR723	Supply to Luddenham Science Park		6.104	18.208	16.208							40.520
PR724	Establish Mt Gilead ZS				3.854	7.708	7.708					19.270
PR728	Western Sydney Employment Lands ZS				4.696	9.392	9.392					23.480
PR729	Cheriton Avenue 3rd transformer								7.480			7.480
PR732	Feeder 214/215 contraints		4.725	4.725								9.450
PR733	Bringelly ZS augmentation								4.134	8.268	8.268	20.670
PR739	South Gilead (South Campbelltown)						3.854	7.708	7.708			19.270

Program/Project		FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	Total
PR740	AFIC upgrade Minto, Prospect, Kingswood	1.900										1.900
PR742	North Bomaderry ZS establishment				3.692	7.384	7.384					18.460
PR744	Termeil ZS establishment					3.973	3.973					7.945
PR745	Austral Permanent ZS establishment							11.295	11.295			22.590
PR746	Sydney University - Western Sydney Employment Lands ZS establishment									12.240	12.240	24.480
PR748	Establish permanent Catherine Park ZS				1.913	3.827	3.827					9.567
PR749	Nepean ZS augmentation							7.102				7.102
PR750	Feeder 512 augmentation	0.280										0.280
PR751	Parklea ZS to Bella Vista ZS load transfer		4.000									4.000
PR752	Kemps Creek 132kV conversion							20.762	8.898			29.660
PR754	Augment Westmead Zone Substation					6.418	6.418	6.040				18.875
PR755	Narellan ZS busbar augmentation							7.280				7.280
PR756	Luddenham ZS augmentation							11.970	5.130			17.100
	Major Projects Total	**46.024**	**77.332**	**87.144**	**78.355**	**60.227**	**59.357**	**92.249**	**85.707**	**92.133**	**90.829**	**769.358**
PRL	**Major Projects – Land**											
PR248	Penrith Lakes ZS site acquisition					1.000						1.000
PR599	Penrith CBD ZS site purchase	3.720										3.720
PR430	North Rossmore ZS site purchase					3.000						3.000
PR432	Rossmore ZS site purchase						3.000					3.000
PR438	North Bringelly ZS site purchase						3.500					3.500
PR602	Riverstone West site purchase								5.000			5.000
PR603	Eschol Park ZS site purchase							3.000				3.000
PR659	Avondale (South West Dapto) 132/11kV Zone Substation establishment site purchase							2.500				2.500
PR703	Riverstone East site purchase		6.000									6.000
PR704	Oakdale (Southpipe) site purchase	0.300										0.300
PR717	Acquire improved site for West Dapto ZS		2.000									2.000
PR727	Luddenham ZS site purchase		0.976									0.976
	Major Projects – Land Total	**4.020**	**8.976**			**4.000**	**6.500**	**5.500**	**5.000**			**33.996**
AG	**Automation growth**	**0.300**	**0.300**	**0.300**	**0.300**	**0.300**	**0.300**	**0.300**	**0.300**	**0.300**	**0.300**	**3.000**
HVW	**HV development works**	**7.058**	**6.801**	**7.103**	**6.647**	**6.275**	**5.947**	**6.000**	**6.000**	**6.000**	**6.000**	**63.831**
LV	**Low Voltage Development**											
LV001	Overloaded distribution sub uprates	0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120	1.200
	Low Voltage Development Total	**0.120**	**0.120**	**0.120**	**0.120**	**0.120**	**0.120**	**0.120**	**0.120**	**0.120**	**0.120**	**1.200**
	Augex Total	**57.522**	**93.528**	**94.668**	**85.422**	**70.922**	**72.224**	**104.169**	**97.127**	**98.553**	**97.249**	**871.384**
Repex												
TS	**Transmission Substation Refurbishment**											
TS004	132kV circuit breaker replacement	0.903	0.362	0.362	0.362	0.362	0.362	0.362	0.362	0.362	0.362	4.161
TS005	33kV circuit breaker replacement	3.410	0.852	0.852	0.852	0.852	0.852	0.852	0.852	0.852	0.852	11.074
TS007	11kV circuit breaker replacement			0.350	0.350							0.700

Program/Project		FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	Total
TS008	Battery replacement	1.254	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	12.054
TS009	Auxiliary switchgear replacement	0.817	1.000	1.000	1.000	1.000	1.000	0.750				6.567
TS015	Replacement of surge arrester in zone and sub-transmission substations	0.132	0.110	0.110	0.110	0.110	0.044	0.044	0.044	0.044	0.044	0.792
TS016	VT and CT replacement	1.095	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	7.395
TS017	Transformer Renewals Total	0.600	0.600	0.600	0.600	0.600	0.600	0.600	0.600	0.600	0.600	6.000
TS024	Building and amenities refurbishment	0.500	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	18.500
TS025	Asbestos and other hazardous material reporting, management and removal	0.650	0.520	0.520	0.520	0.520	0.520	0.520	0.520	0.520	0.520	5.330
TS026	Noise attenuation in ZS and TS		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	9.000
TS027	Substation switchyard lighting improvement		0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120	1.080
TS031	Substation safety fence upgrade program	0.300	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	1.200
TS032	Substation security systems		0.150	0.150	0.150							0.450
TS033	Substation fire hydrant installations	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	2.000
TS034	Substation deluge showers and fire blankets	0.160	0.160	0.160	0.160	0.160	0.160	0.160	0.160	0.160	0.160	1.600
TS035	Substation oil containment program - bund walls	0.210	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.840
TS036	Substation earthing	0.998	1.000	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	5.998
TS049	Circuit Breakers Renewals Total		0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.405
TS050	POW switching for capacitors					0.600						0.600
TS055	66kV circuit breaker replacement	0.258	0.258	0.258	0.258	0.258	0.258	0.258	0.258	0.258	0.258	2.580
TS057	Substation insulation co-ordination	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	1.500
TS086	Busbar support and isolator replacement	0.325	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	1.176
TS116	Roof refurbishment for control and switch rooms	0.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	14.000
TS122	Leabons Lane Zone Substation renewal	0.075										0.075
TS127	Castle Hill Zone Substation renewal	0.163										0.163
TS128	Capacitor bank refurbishment	1.270										1.270
TS144	Substation fire stopping measures	0.198	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.792
TS146	Marayong Zone Substation renewal	13.051	6.698									19.749
TS155	Sussex Inlet Zone Substation - stage 2 renewal	2.400	3.663	3.771								9.834
TS163	Unanderra Zone Substation renewal				4.000	5.000	6.000					15.000
TS165	Greystanes Zone Substation renewal						6.970	6.970	7.000			20.940
TS167	Carlingford Transmission Substation control building replacement		4.500	4.500	4.500							13.500
TS173	11kV switchboard truck replacement program	2.894										2.894
TS174	West Wollongong Zone Substation 11kV renewal			3.000	4.000	5.500						12.500
TS177	Substation battery duplication	1.582	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.600	10.182
TS179	33kV wall bushing replacement	0.038	0.120	0.120	0.180	0.180	0.180	0.180	0.180	0.180	0.180	1.538
TS180	Transformer fire wall installation	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	2.000
TS181	11kV capacitor bank refurbishment	0.888										0.888
TS184	Blaxland Zone Substation reinstatement	0.692										0.692
TS185	Penrith TS civil development	2.102	2.000									4.102
TS187	Mobile substation No 2 refurbishment	0.270										0.270
TS188	Bossley Park ZS civil refurbishment	0.200										0.200
TS199	Future sub-transmission substation renewal programs		4.000	6.000	6.000	6.000	12.000	12.500	17.000	20.500	23.500	107.500
TS600	Power transformer replacement		10.000	12.000	12.000	14.000	14.000	16.000	16.000	16.000	16.000	126.000
TS615	Gerringong ZS 33kV No 2 transformer replacement	0.007										0.007
TS616	Camellia TS transformer replacement and 33kV busbar rearrangement	2.609										2.609

Program/Project		FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	Total
TS617	Prospect ZS transformer replacement	2.449										2.449
TS618	Albion Park ZS transformer replacement	2.458										2.458
TS700	11kV zone substation switchboard replacement		6.250	6.875	6.875	7.500	7.500	7.500	7.500	7.500	7.500	65.000
TS701	North Rocks ZS 11kV switchboard replacement	2.100										2.100
TS702	Kellyville ZS 11kV switchboard replacement	1.890										1.890
TS703	Horsley Park ZS 11kV switchboard replacement	2.610										2.610
TS704	Port Central ZS 11kV switchboard replacement	1.740										1.740
	Transmission Substation Refurbishment Total	**54.347**	**50.688**	**49.573**	**50.862**	**51.587**	**59.391**	**55.641**	**59.421**	**55.921**	**58.521**	**545.953**
TM	**Transmission Mains Refurbishment**											
TM012	Sub-transmission pole replacement	2.500	3.720	3.720	3.720	3.720	4.920	4.920	4.920	4.920	4.920	41.980
TM014	Renewal of 33kV and 66kV gas and oil filled cables						0.720	0.765	1.530	1.485	1.485	5.985
TM015	Subtransmission tower replacement	1.600	1.600	1.600	4.000	5.600	5.600	5.600	5.600	5.600	5.600	42.400
TM027	Steel tower asbestos removal	3.013										3.013
TM030	Feeder 7028 replacement	0.500	1.650	2.200	2.200	2.200	2.200					10.950
TM132	Sub-transmission pilot cable renewal program		0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950	8.550
TM134	Wollongong - Port Kembla pilot cable replacement		1.615	1.615	1.615	1.615	1.615	1.615	1.615	1.615	1.615	14.535
TM135	Optical fibre protection and communication upgrades in the Blue Mountains		0.650	0.650	0.650	0.650	0.650	0.650	0.650	0.650	0.650	5.850
TM137	Optical fibre protection and communication upgrades in the Macarthur area		1.280	1.280	1.280	1.280	1.280	1.280	1.280	1.280	1.280	11.520
TM138	132kV optical fibre ring completion	0.005										0.005
TM171	Replacement of corroded earthwires	2.000	1.340	1.000	0.900	0.900	0.900	0.900	0.900	0.900	0.900	10.640
TM172	Earthwire replacement due to fault rating		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	9.000
TM174	Hardex earthwire replacement		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	9.000
TM302	Oil filled cable auxiliary equipment refurbishment			0.072					0.072			0.144
TM303	Guilford and Camellia 132kV cables oil testing and flushing	0.465		0.090					0.090			0.645
TM401	South Coast 33kV overhead line refurbishment	0.998	1.080	1.080	1.200	1.200	1.200	1.200	1.200	1.200	1.200	11.558
TM419	Future sub-transmission feeder refurbishment works							9.200	13.700	18.400	20.200	61.500
TM801	Steel tower painting program							0.800	0.800	0.800	0.800	3.200
TM803	Steel tower below ground rectification work	2.600	2.100	2.100	2.100	2.100	2.100	2.100	2.100	2.100	2.100	21.500
TM805	Earthing refurbishment of lines 940/941	0.178	0.280	0.280	0.280	0.280	0.020	0.020	0.020	0.020	0.020	1.398
TM809	Subtransmission line earthing refurbishment			0.600	0.600	0.600	0.600	0.600	0.600	0.600	0.600	4.800
	Transmission Mains Capital Refurbishment Total	**13.860**	**18.265**	**19.237**	**21.495**	**23.095**	**24.755**	**32.600**	**38.027**	**42.520**	**44.320**	**278.174**
DS	**Distribution Refurbishment**											
DS002	Pole substation refurbishment	0.735	0.735	0.735	0.735	0.788	0.840	0.893	0.945	0.945	0.945	8.295
DS005	Distribution pole replacement	10.800	11.330	12.100	12.870	13.640	14.410	15.180	16.720	17.490	17.490	142.030
DS006	LV CONSAC cable replacement	6.000	6.950	8.700	9.750	10.550	10.550	10.550	10.550	10.550	10.550	94.700
DS007	Service wire replacement program	9.167	9.200	9.300	9.300	9.450	9.800	10.300	11.300	12.300	12.900	103.017
DS008	Traffic black spot remediation	1.700	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	10.700
DS011	HV distribution steel mains replacement	4.800	4.800	4.800	4.800	5.600	5.600	6.400	6.400	6.400	6.400	56.000
DS014	LV cable network renewal		0.650	1.950	2.340	2.340	1.300	1.300	1.300	1.300	1.300	13.780
DS301	Ground substation refurbishment program	0.510	0.510	0.510	0.850	0.850	1.020	1.275	1.275	1.275	1.275	9.350
DS302	Distribution transformer replacement program	1.170	1.170	1.170	1.170	1.463	1.463	1.755	1.755	1.755	1.755	14.625
DS305	Compact LV switchgear replacement	0.508	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	5.008
DS307	Holec MD4 epoxy switchgear replacement	4.035	5.950	6.300	7.875	7.875	7.875	7.875	7.875	7.875	7.875	71.410

Program/Project		FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	Total
DS308	HV RGB12 switchgear replacement	0.598										0.598
DS312	Miscellaneous substation renewal expenditure	0.750	3.500	3.500	3.500	3.500	3.500	4.000	4.000	4.000	4.000	34.250
DS315	Low voltage switchgear replacement	0.354	0.708	0.708	0.708	0.708	0.708	0.708	0.708	0.708	0.708	6.726
DS317	Future distribution substation renewals							9.200	13.700	18.400	20.200	61.500
DS318	Distribution substation earthing refurbishment	0.676	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	3.106
DS405	Air break switch replacement	6.146	3.690	3.690	3.690	3.690	3.690	3.690	3.690	3.690	3.690	39.356
DS409	Miscellaneous mains renewal expenditure	0.750	1.100	1.150	1.150	1.200	1.200	1.400	1.400	1.400	1.400	12.150
DS413	Low mains remediation	1.800	1.625	1.625	1.625	1.625	1.625	0.975	0.975	0.975	0.975	13.825
DS414	Copper distribution mains replacement	5.600	1.440	2.400	2.400	2.400	2.400	2.400	2.400	2.400	2.400	26.240
DS415	LV mains replacement	0.550	0.880	1.100	1.210	1.210	1.100	1.100	1.100	1.100	1.100	10.450
DS416	Asbestos service fuse replacement	0.261	0.261									0.522
DS417	Distribution access track reconstruction	0.500	0.440	1.408	1.892	1.892						6.132
DS418	Pole top structure/hardware refurbishment	5.000	10.000	9.000	9.000	8.000	8.000	8.000	8.000	8.000	8.000	81.000
DS420	Future distribution feeder refurbishment works							9.200	13.700	18.400	20.200	61.500
	Distribution Refurbishment Capital Total	**62.411**	**66.709**	**71.916**	**76.635**	**78.550**	**76.851**	**97.971**	**109.563**	**120.733**	**124.933**	**886.271**
AU	**Automation**											
AU004	Substation SCADA RTU replacement	1.044	1.840	1.840	1.840	1.840	1.840	1.840	1.840	1.840	1.840	17.604
AU013	SCADA master station development software	1.000	2.000	2.000	1.000	1.000	2.000	2.000	2.000	2.000	2.000	17.000
	Automation Total	**2.044**	**3.840**	**3.840**	**2.840**	**2.840**	**3.840**	**3.840**	**3.840**	**3.840**	**3.840**	**34.604**
CC	**Communications**											
CC002	Communications development SCADA	0.750	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	5.250
CC007	SCADA radio repeaters	0.870	0.696	0.696	0.696	0.696	0.696	0.696	0.696	0.696	0.696	7.134
CC020	Microwave refurbishment and extension	0.550	0.450	0.450	0.450	0.450	0.450	0.650	0.650	0.650	0.650	5.400
	Communications Total	**2.170**	**1.646**	**1.646**	**1.646**	**1.646**	**1.646**	**1.846**	**1.846**	**1.846**	**1.846**	**17.784**
PS	**Protection Refurbishment**											
PS008	Substation protection relay refurbishment	3.600	4.218	4.218	4.218	4.218	4.218	4.218	4.218	4.218	4.218	41.562
PS011	Protection refurbishment (miscellaneous)	0.895	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	7.195
PS012	Distribution feeder safety improvement	4.616	3.100									7.716
PS013	Feeder differential relay replacement	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	3.300
PS014	Under frequency load shedding	0.500	0.550	0.550								1.600
	Protection Refurbishment Total	**9.941**	**8.898**	**5.798**	**5.248**	**5.248**	**5.248**	**5.248**	**5.248**	**5.248**	**5.248**	**61.373**
SP	**Essential spares**	**1.239**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**10.239**
	Total Repex	**146.012**	**151.046**	**153.010**	**159.726**	**163.966**	**172.731**	**198.146**	**218.945**	**231.108**	**239.708**	**1834.398**
Customer Connection												
AR	**Asset relocation**	**1.675**	**1.818**	**1.809**	**1.816**	**1.825**	**1.838**	**1.846**	**1.854**	**1.862**	**1.878**	**18.222**
DU	**Duct installation RMS road works**	**1.955**	**2.153**	**2.207**	**2.262**	**2.318**	**2.376**	**2.436**	**2.497**	**2.559**	**2.559**	**23.321**
IC	**Industrial & commercial**	**10.000**	**13.837**	**13.286**	**13.262**	**13.309**	**13.547**	**13.570**	**13.590**	**13.611**	**13.652**	**131.664**
NU	**Non urban extension**	**0.850**	**1.732**	**1.667**	**1.664**	**1.670**	**1.699**	**1.702**	**1.705**	**1.708**	**1.714**	**16.110**
UR	**Underground residential**	**33.940**	**43.970**	**42.124**	**42.034**	**42.179**	**42.962**	**43.026**	**43.083**	**43.140**	**43.255**	**419.712**
	Customer Connection Total	**48.420**	**63.508**	**61.093**	**61.038**	**61.302**	**62.423**	**62.579**	**62.728**	**62.880**	**63.058**	**609.028**

Program/Project		FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	Total
Reliability												
RC	**Reliability compliance**	**4.000**	**4.000**	**4.000**	**4.000**	**4.000**	**4.000**	**4.000**	**4.000**	**4.000**	**4.000**	**40.000**
	Reliability Total	**4.000**	**4.000**	**4.000**	**4.000**	**4.000**	**4.000**	**4.000**	**4.000**	**4.000**	**4.000**	**40.000**
Other System												
LV	**Low Voltage Development**											
LV002	Quality of supply reactive projects	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	5.000
LV003	LV planning reactive projects	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	10.000
LV005	Dsub monitoring & LV feeder monitoring for solar PV	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	2.500
	Low Voltage Development Total	**200.302**	**220.424**	**219.973**	**226.634**	**231.138**	**241.023**	**266.595**	**287.543**	**299.858**	**308.636**	**2502.126**
PQ	**Power Quality**											
PQ001	Permanent power quality monitoring	0.615	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	1.515
PQ004	Power quality monitoring replacement	0.400	0.342	0.618	0.873	0.948	1.365	1.300	1.430	1.430	1.170	9.874
	Power Quality Total	**1.015**	**0.442**	**0.718**	**0.973**	**1.048**	**1.465**	**1.400**	**1.530**	**1.530**	**1.270**	**11.389**
EF	**Efficiency**											
EF001	Distribution management system	12.000	8.585	3.617	0.093							24.295
EF002	Technology pilots	0.553	0.500	0.500	2.000	2.000	2.000	2.000	2.000	2.000	2.000	15.553
EF003	Battery energy storage system pilot	1.692										1.692
	Efficiency Total	**14.245**	**9.085**	**4.117**	**2.093**	**2.000**	**2.000**	**2.000**	**2.000**	**2.000**	**2.000**	**41.540**
MC	**Metering**											
MC105	Relays - renewal	0.300	0.958	0.907	0.857	0.806	0.756	0.706	0.655	0.605	0.554	7.104
MC109	Demand management technology	0.500	1.400	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750	7.900
	Metering Total	**0.800**	**2.358**	**1.657**	**1.607**	**1.556**	**1.506**	**1.456**	**1.405**	**1.355**	**1.304**	**15.004**
	Other System Total	**17.810**	**13.635**	**8.242**	**6.423**	**6.354**	**6.721**	**6.605**	**6.685**	**6.634**	**6.324**	**85.433**
Overheads												
SW	**Network Switching Total**	**3.278**	**6.284**	**6.382**	**6.686**	**6.495**	**6.715**	**7.424**	**7.684**	**7.944**	**8.086**	**66.978**
OH	**Capitalised Overheads Total**	**73.255**	**73.106**	**73.273**	**73.775**	**73.462**	**73.821**	**76.861**	**77.233**	**77.593**	**77.784**	**750.165**
	Overheads Total	**76.533**	**79.390**	**79.655**	**80.462**	**79.957**	**80.536**	**84.285**	**84.917**	**85.537**	**85.870**	**817.142**
	Total Capex	**350.296**	**405.108**	**400.668**	**397.071**	**386.501**	**398.634**	**459.784**	**474.402**	**488.712**	**496.209**	**4257.385**

4.1.1 CAPEX SUMMARY

Figure 20 and Table 4 below show the 10-year forecast for CAPEX by different program categories.

FIGURE 20 – 10-YEAR CAPEX FORECAST SUMMARY BY PROGRAM

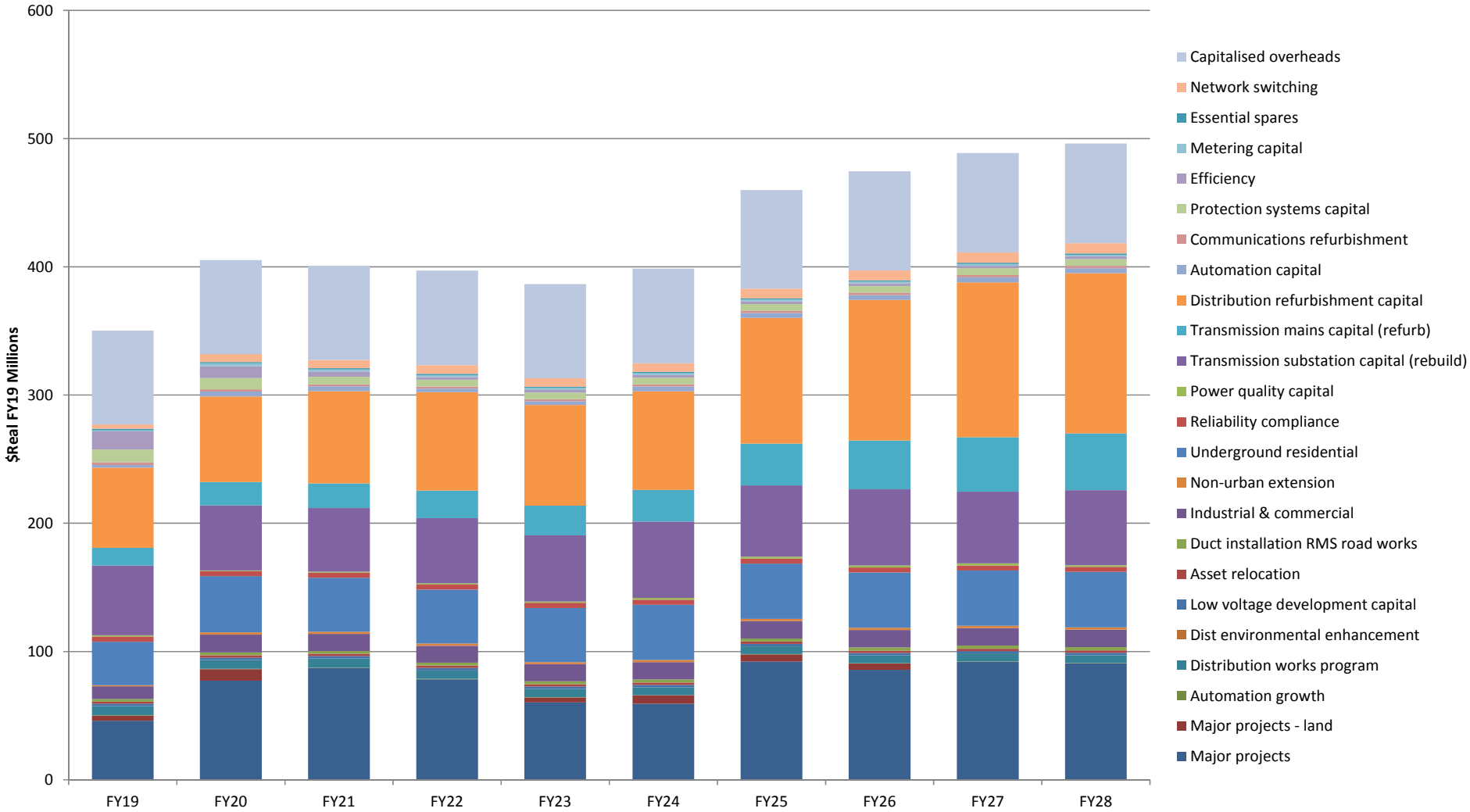


TABLE 4 – 10-YEAR CAPEX FORECAST SUMMARY BY PROGRAM

Program/Project		FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	Total
Augex												
PR	Major Projects	46.024	77.332	87.144	78.355	60.227	59.357	92.249	85.707	92.133	90.829	769.358
PRL	Major Projects – Land	4.020	8.976			4.000	6.500	5.500	5.000			33.996
AG	Automation growth	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	3.000
HVW	HV development works	7.058	6.801	7.103	6.647	6.275	5.947	6.000	6.000	6.000	6.000	63.831
LV	Low Voltage Development	0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120	1.200
	Augex Total	**57.522**	**93.528**	**94.668**	**85.422**	**70.922**	**72.224**	**104.169**	**97.127**	**98.553**	**97.249**	**871.384**
Repex												
TS	Transmission Substation Refurbishment	54.347	50.688	49.573	50.862	51.587	59.391	55.641	59.421	55.921	58.521	545.953
TM	Transmission Mains Refurbishment	13.860	18.265	19.237	21.495	23.095	24.755	32.600	38.027	42.520	44.320	278.174
DS	Distribution Refurbishment	62.411	66.709	71.916	76.635	78.550	76.851	97.971	109.563	120.733	124.933	886.271
AU	Automation	2.044	3.840	3.840	2.840	2.840	3.840	3.840	3.840	3.840	3.840	34.604
CC	Communications	2.170	1.646	1.646	1.646	1.646	1.646	1.846	1.846	1.846	1.846	17.784
PS	Protection Refurbishment	9.941	8.898	5.798	5.248	5.248	5.248	5.248	5.248	5.248	5.248	61.373
SP	Essential spares	1.239	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	10.239
	Repex Total	**146.012**	**151.046**	**153.010**	**159.726**	**163.966**	**172.731**	**198.146**	**218.945**	**231.108**	**239.708**	**1834.398**
Customer Connection												
AR	Asset relocation	1.675	1.818	1.809	1.816	1.825	1.838	1.846	1.854	1.862	1.878	18.222
DU	Duct installation RMS road works	1.955	2.153	2.207	2.262	2.318	2.376	2.436	2.497	2.559	2.559	23.321
IC	Industrial & commercial	10.000	13.837	13.286	13.262	13.309	13.547	13.570	13.590	13.611	13.652	131.664
NU	Non urban extension	0.850	1.732	1.667	1.664	1.670	1.699	1.702	1.705	1.708	1.714	16.110
UR	Underground residential	33.940	43.970	42.124	42.034	42.179	42.962	43.026	43.083	43.140	43.255	419.712
	Customer Connection Total	**48.420**	**63.508**	**61.093**	**61.038**	**61.302**	**62.423**	**62.579**	**62.728**	**62.880**	**63.058**	**609.028**
Reliability												
RC	Reliability compliance	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	40.000
	Reliability Total	**4.000**	**4.000**	**4.000**	**4.000**	**4.000**	**4.000**	**4.000**	**4.000**	**4.000**	**4.000**	**40.000**
Other System												
LV	Low Voltage Development	1.750	1.750	1.750	1.750	1.750	1.750	1.750	1.750	1.750	1.750	17.500
PQ	Power Quality	1.015	0.442	0.718	0.973	1.048	1.465	1.400	1.530	1.530	1.270	11.389
EF	Efficiency	14.245	9.085	4.117	2.093	2.000	2.000	2.000	2.000	2.000	2.000	41.540
MC	Metering	0.800	2.358	1.657	1.607	1.556	1.506	1.456	1.405	1.355	1.304	15.004
	Other System Total	**17.810**	**13.635**	**8.242**	**6.423**	**6.354**	**6.721**	**6.605**	**6.685**	**6.634**	**6.324**	**85.433**
Overheads												
SW	Network Switching Total	3.278	6.284	6.382	6.686	6.495	6.715	7.424	7.684	7.944	8.086	66.978
OH	Capitalised Overheads Total	73.255	73.106	73.273	73.775	73.462	73.821	76.861	77.233	77.593	77.784	750.165
	Overheads Total	**76.533**	**79.390**	**79.655**	**80.462**	**79.957**	**80.536**	**84.285**	**84.917**	**85.537**	**85.870**	**817.142**
Capex Total		**350.296**	**405.108**	**400.668**	**397.071**	**386.501**	**398.634**	**459.784**	**474.402**	**488.712**	**496.209**	**4257.385**

The 10-year forecast for Capex is summarised by AER categories in Figure 21, Table 5 and Figure 22 below.

FIGURE 21 – 10-YEAR CAPEX FORECAST SUMMARY BY AER CATEGORY

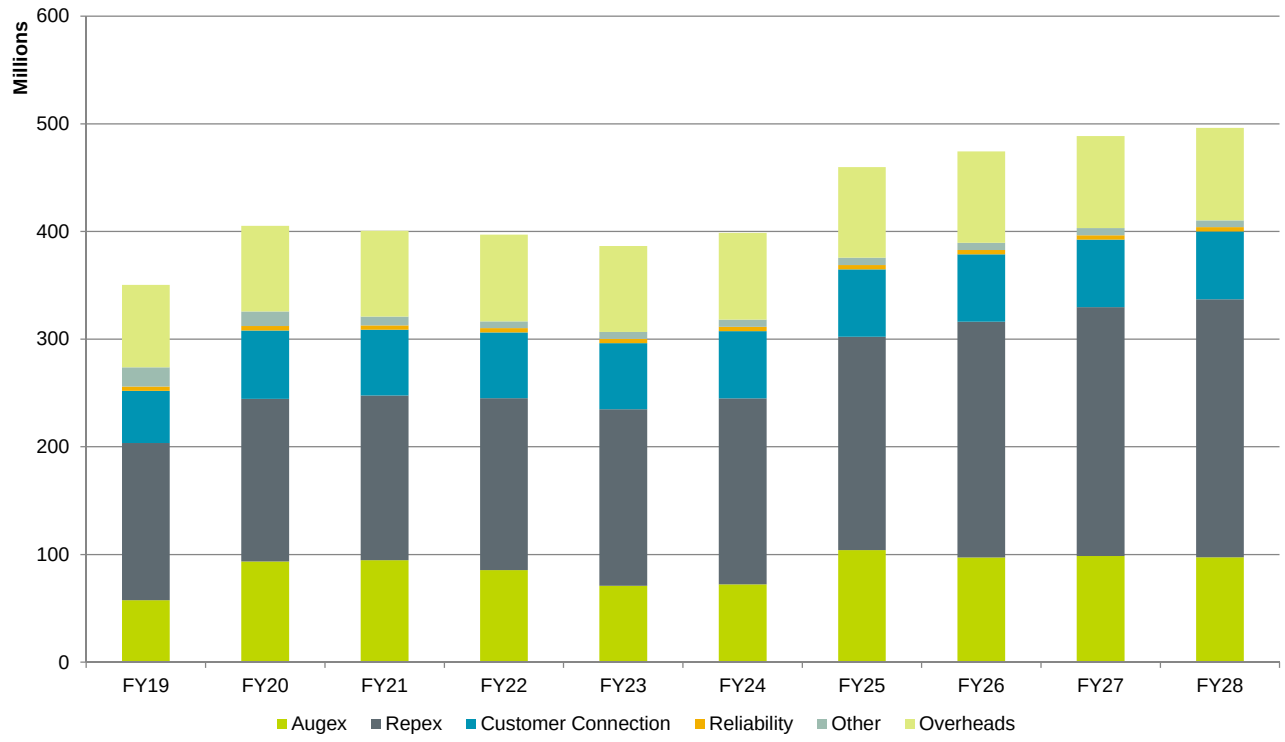
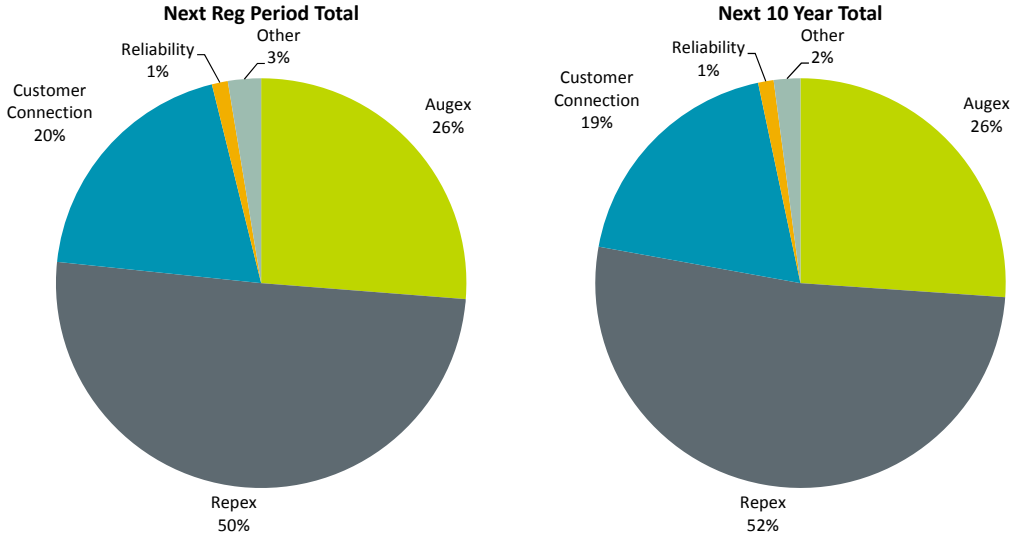


TABLE 5 – 10-YEAR CAPEX FORECAST SUMMARY BY AER CATEGORY

Description	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28
Augex	57.5	93.5	94.7	85.4	70.9	72.2	104.2	97.1	98.6	97.2
Repex	146.0	151.0	153.0	159.7	164.0	172.7	198.1	218.9	231.1	239.7
Customer Connection	48.4	63.5	61.1	61.0	61.3	62.4	62.6	62.7	62.9	63.1
Reliability	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Other System	17.8	13.6	8.2	6.4	6.4	6.7	6.6	6.7	6.6	6.3
Overheads	76.5	79.4	79.7	80.5	80.0	80.5	84.3	84.9	85.5	85.9
Total	**350.3**	**405.1**	**400.7**	**397.1**	**386.5**	**398.6**	**459.8**	**474.4**	**488.7**	**496.2**

FIGURE 22 – CAPEX FORECAST PERCENTAGES BY AER CATEGORY



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5.0 APPENDICES

APPENDIX A: RISK ASSESSED PROJECT PRIORITY LISTING

The Capital Allocation Selection Hierarchy (CASH) model was used as an efficient, consistent, and transparent process for assessing and prioritising risk across network programs and projects. This appendix summarises the risk scores for Endeavour Energy's projects and programs.

In order to facilitate effective prioritisation of expenditure, each proposed program is broken down into pre-prioritised subcomponents of Short Term need (high priority or immediate requirements), Medium Term need (medium priority or short-term requirement but able to be risk-manageable prior to replacement) and Long Term need (low priority, future or strategic renewal requirement). This categorisation serves two purposes, ensuring that:

1. Each program pertaining to a particular asset group is provided with funding to address at least their most immediate and significant risks; and
2. The impact on the long-term risk profile of any under-investment due to constraints on expenditure is transparent and observable.

Condition assessment and engineering judgement is used to stratify each program in this manner, with the following features:

- Short-term need includes the elements of programs already committed as well as those required to address newly identified high-priority risks;
- Medium-term need includes those assets with known issues that are introducing risk that will need to be treated in a relatively short period (2 - 3 years) but can be managed in the meantime;
- Long-term needs relate to the removal of redundant or no longer fit-for purpose asset technologies in order to satisfy broader organisational objectives such as compliance with standards and regulatory requirements, and managing technical obsolescence etc.

Program/Project Description		Division	Expenditure Category*	Rank	Weighted Rank	Percent	Plant
AG	Automation - operational/capacity risk	Program - Short Term Need	Augex	190	2850	85.12%	AGs
AR	Asset relocation	Program - Short Term Need	Customer Connection	140	2100	97.63%	ARs
AU004	Substation SCADA RTU replacement	Program - Short Term Need	Repex	220	3300	67.93%	AU004s
AU013	SCADA master station development software	Program - Short Term Need	Repex	310	4650	26.01%	AU013s
CC002	Communications development SCADA	Program - Short Term Need	Repex	150	2250	93.89%	CC002s
CC007	SCADA radio repeaters	Program - Short Term Need	Repex	270	4050	49.38%	CC007s
CC020	Microwave refurbishment and extension	Program - Short Term Need	Repex	230	3450	65.03%	CC020s
DS002	Pole substation refurbishment	Program - Short Term Need	Repex	280	4200	44.83%	DS002s
DS005	Distribution pole replacement	Program - Short Term Need	Repex	310	4650	26.01%	DS005s
DS006	LV CONSAC cable replacement	Program - Short Term Need	Repex	230	3450	65.03%	DS006s
DS007	Service wire replacement program	Program - Short Term Need	Repex	300	4500	33.91%	DS007s
DS008	Traffic black spot remediation	Program - Short Term Need	Repex	150	2250	93.89%	DS008s
DS011	HV distribution steel mains replacement	Program - Short Term Need	Repex	280	4200	44.83%	DS011s
DS014	LV cable network renewal	Program - Short Term Need	Repex	230	3450	65.03%	DS014s
DS301	Ground substation refurbishment program	Program - Short Term Need	Repex	240	3600	57.03%	DS301s
DS302	Distribution transformer replacement program	Program - Short Term Need	Repex	270	4050	49.38%	DS302s
DS305	Compact LV switchgear replacement	Program - Short Term Need	Repex	240	3600	57.03%	DS305s
DS307	Holec MD4 epoxy switchgear replacement	Program - Short Term Need	Repex	280	4200	44.83%	DS307s
DS308	HV RGB12 switchgear replacement	Program - Short Term Need	Repex	280	4200	44.83%	DS308s
DS312	Miscellaneous substation renewal expenditure	Program - Short Term Need	Repex	230	3450	65.03%	DS312s
DS315	Low voltage switchgear replacement	Program - Short Term Need	Repex	280	4200	44.83%	DS315s
DS317	Future distribution substation renewals	Program - Short Term Need	Repex	180	2700	85.78%	DS317s
DS318	Distribution substation earthing refurbishment	Program - Short Term Need	Repex	340	5100	12.43%	DS318s
DS405	Air break switch replacement	Program - Short Term Need	Repex	280	4200	44.83%	DS405s
DS409	Miscellaneous mains renewal expenditure	Program - Short Term Need	Repex	290	4350	37.20%	DS409s
DS413	Low mains remediation	Program - Short Term Need	Repex	230	3450	65.03%	DS413s
DS414	Copper distribution mains replacement	Program - Short Term Need	Repex	260	3900	52.04%	DS414s
DS415	LV mains replacement	Program - Short Term Need	Repex	190	2850	85.12%	DS415s
DS416	Asbestos service fuse replacement	Program - Short Term Need	Repex	200	3000	75.87%	DS416s
DS417	Distribution access track reconstruction	Program - Short Term Need	Repex	290	4350	37.20%	DS417s
DS418	Pole top structure/hardware refurbishment	Program - Short Term Need	Repex	330	4950	15.67%	DS418s
DS420	Future distribution feeder refurbishment works	Program - Short Term Need	Repex	180	2700	85.78%	DS420s
DU	Duct installation RMS road works	Program - Short Term Need	Customer Connection	170	2550	87.83%	DUs
EF001	Distribution management system	Program - Short Term Need	Other	260	3900	52.04%	EF001s
EF002	Technology pilots	Program - Short Term Need	Other	230	3450	65.03%	EF002s
EF003	Battery energy storage system pilot	Program - Short Term Need	Other	230	3450	65.03%	EF003s
EH	Dist environmental enhancement program	Program - Short Term Need	Other	190	2850	85.12%	EHs
HVW	HV development works	Program - Short Term Need	Augex	350	5250	9.70%	HVWs
IC	Industrial & commercial	Program - Short Term Need	Customer Connection	200	3000	75.87%	ICs
LV001	Overloaded distribution sub uprates	Program - Short Term Need	Augex	330	4950	15.67%	LV001s
LV002	Quality of supply reactive projects	Program - Short Term Need	Other	300	4500	33.91%	LV002s
LV003	LV planning reactive projects	Program - Short Term Need	Other	300	4500	33.91%	LV003s

Program/Project Description		Division	Expenditure Category*	Rank	Weighted Rank	Percent	Plant
LV005	Dsub monitoring & LV feeder monitoring for solar PV	Program - Short Term Need	Other	250	3750	53.16%	LV005s
MC105	Relays - renewal	Program - Short Term Need	Other	100	1500	98.95%	MC105s
MC109	Demand management technology	Program - Short Term Need	Other	80	1200	99.11%	MC109s
NU	Non urban extension	Program - Short Term Need	Customer Connection	120	1800	98.19%	NUs
PQ001	Permanent power quality monitoring	Program - Short Term Need	Other	300	4500	33.91%	PQ001s
PQ004	Power quality monitoring replacement	Program - Short Term Need	Other	200	3000	75.87%	PQ004s
PR081	Collimore Park ZS establishment	Major Project - Future/Planning Stage	Augex	210	1050	99.79%	PR081
PR110	Edmondson Park ZS establishment	Major Project - Committed Project	Augex	170	2550	87.83%	PR110
PR113	Augment feeder 308 Nepean to Douglas Park	Major Project - Prior to Approval	Augex	340	3400	65.08%	PR113
PR170	Holsworthy 33/11kV ZS establishment	Major Project - Future/Planning Stage	Augex	40	200	100.00%	PR170
PR190	Eschol Park ZS establishment	Major Project - Future/Planning Stage	Augex	80	400	100.00%	PR190
PR248	Penrith Lakes ZS site acquisition	Major Project - Committed Project	Augex	140	2100	97.63%	PR248
PR249	Establish Penrith Lakes 33/11kV Zone Substation	Major Project - Prior to Approval	Augex	140	1400	98.95%	PR249
PR258	Menangle Park 66/11kV ZS establishment	Major Project - Prior to Approval	Augex	170	1700	98.63%	PR258
PR270	West Epping Zone Substation establishment	Major Project - Future/Planning Stage	Augex	50	250	100.00%	PR270
PR278	Kemps Creek new BSP associated works	Major Project - Future/Planning Stage	Augex	20	100	100.00%	PR278
PR292	South Marsden Park (industrial) 132/11kV ZS establishment	Major Project - Prior to Approval	Augex	210	2100	97.63%	PR292
PR423	Maryland ZS establishment	Major Project - Prior to Approval	Augex	80	800	99.80%	PR423
PR425	Austral ZS establishment (interim initially)	Major Project - Prior to Approval	Augex	160	1600	98.84%	PR425
PR427	Leppington North ZS establishment	Major Project - Committed Project	Augex	210	3150	71.03%	PR427
PR430	North Rossmore ZS site purchase	Major Project - Future/Planning Stage	Augex	40	200	100.00%	PR430
PR432	Rossmore ZS site purchase	Major Project - Future/Planning Stage	Augex	40	200	100.00%	PR432
PR433	Rossmore ZS establishment	Major Project - Future/Planning Stage	Augex	160	800	99.80%	PR433
PR435	Catherine Fields North ZS establishment (interim)	Major Project - Future/Planning Stage	Augex	140	700	100.00%	PR435
PR437	Catherine Fields 11kV feeder works	Major Project - Prior to Approval	Augex	240	2400	89.74%	PR437
PR438	North Bringelly ZS site purchase	Major Project - Future/Planning Stage	Augex	20	100	100.00%	PR438
PR439	North Bringelly ZS establishment	Major Project - Future/Planning Stage	Augex	40	200	100.00%	PR439
PR444	Culburra Beach development (33kV fdr and single transformer ZS)	Major Project - Future/Planning Stage	Augex	110	550	100.00%	PR444
PR499	Southpipe (Oakdale Estate) ZS 132/11kV establishment	Major Project - Prior to Approval	Augex	140	1400	98.95%	PR499
PR599	Penrith CBD ZS site purchase	Major Project - Prior to Approval	Augex	210	2100	97.63%	PR599
PR602	Riverstone West site purchase	Major Project - Prior to Approval	Augex	70	700	100.00%	PR602
PR603	Eschol Park ZS site purchase	Major Project - Future/Planning Stage	Augex	100	500	100.00%	PR603
PR620	West Dapto ZS establishment	Major Project - Future/Planning Stage	Augex	110	550	100.00%	PR620
PR653	Avondale (South West Dapto) 132/11kV ZS establishment	Major Project - Future/Planning Stage	Augex	110	550	100.00%	PR653
PR656	Leppington South ZS establishment (permanent)	Major Project - Prior to Approval	Augex	230	2300	92.40%	PR656
PR657	Calderwood ZS establishment (interim initially)	Major Project - Prior to Approval	Augex	170	1700	98.63%	PR657
PR659	Avondale (South West Dapto) 132/11kV Zone Substation establishment site purchase	Major Project - Future/Planning Stage	Augex	60	300	100.00%	PR659

Program/Project Description		Division	Expenditure Category*	Rank	Weighted Rank	Percent	Plant
PR673	Liverpool ZS 11kV switchboard extension & distribution works	Major Project - Committed Project	Augex	360	5400	6.20%	PR673
PR677	South Penrith Zone Substation	Major Project - Prior to Approval	Augex	210	2100	97.63%	PR677
PR698	Marsden Park (residential) 132/11kV ZS - stage 2	Major Project - Prior to Approval	Augex	200	2000	97.63%	PR698
PR700	Riverstone east ZS establishment	Major Project - Future/Planning Stage	Augex	120	600	100.00%	PR700
PR702	Penrith ZS 11kV transformer cable constraints	Major Project - Committed Project	Augex	250	3750	53.16%	PR702
PR703	Riverstone East site purchase	Major Project - Prior to Approval	Augex	120	1200	99.11%	PR703
PR704	Oakdale (Southpipe) site purchase	Major Project - Prior to Approval	Augex	160	1600	98.84%	PR704
PR710	Feeder 868 rebuild & rearrangement South32	Major Project - Committed Project	Augex	70	1050	99.79%	PR710
PR713	Box Hill 132/22kV ZS establishment	Major Project - Prior to Approval	Augex	170	1700	98.63%	PR713
PR717	Acquire improved site for West Dapto ZS	Major Project - Committed Project	Augex	140	2100	97.63%	PR717
PR722	Camellia TS connection works for Ausgrid	Major Project - Committed Project	Augex	170	2550	87.83%	PR722
PR723	Supply to Luddenham Science Park	Major Project - Future/Planning Stage	Augex	210	1050	99.79%	PR723
PR724	Establish Mt Gilead ZS	Major Project - Prior to Approval	Augex	200	2000	97.63%	PR724
PR727	Luddenham ZS site purchase	Major Project - Committed Project	Augex	210	3150	71.03%	PR727
PR728	Western Sydney Employment Lands ZS	Major Project - Future/Planning Stage	Augex	160	800	99.80%	PR728
PR729	Cheriton Avenue 3rd transformer	Major Project - Future/Planning Stage	Augex	210	1050	99.79%	PR729
PR732	Feeder 214/215 contraints	Major Project - Prior to Approval	Augex	220	2200	93.89%	PR732
PR733	Bringelly ZS augmentation	Major Project - Future/Planning Stage	Augex	140	700	100.00%	PR733
PR739	South Gilead (South Campbelltown)	Major Project - Future/Planning Stage	Augex	110	550	100.00%	PR739
PR740	AFIC upgrade Minto, Prospect, Kingswood	Major Project - Future/Planning Stage	Augex	150	750	100.00%	PR740
PR742	North Bomaderry ZS establishment	Major Project - Future/Planning Stage	Augex	100	500	100.00%	PR742
PR744	Termeil ZS establishment	Major Project - Future/Planning Stage	Augex	270	1350	98.96%	PR744
PR745	Austral Permanent ZS establishment	Major Project - Future/Planning Stage	Augex	160	800	99.80%	PR745
PR746	Sydney University - Western Sydney Employment Lands ZS establishment	Major Project - Future/Planning Stage	Augex	80	400	100.00%	PR746
PR748	Establish permanent Catherine Park ZS	Major Project - Prior to Approval	Augex	240	2400	89.74%	PR748
PR749	Nepean ZS augmentation	Major Project - Future/Planning Stage	Augex	250	1250	98.96%	PR749
PR750	Feeder 512 augmentation	Major Project - Prior to Approval	Augex	230	2300	92.40%	PR750
PR751	Parklea ZS to Bella Vista ZS load transfer	Major Project - Prior to Approval	Augex	360	3600	57.03%	PR751
PR752	Kemps Creek 132kV conversion	Major Project - Future/Planning Stage	Augex	340	1700	98.63%	PR752
PR754	Augment Westmead Zone Substation	Major Project - Future/Planning Stage	Augex	360	1800	98.19%	PR754
PR755	Narellan ZS busbar augmentation	Major Project - Future/Planning Stage	Augex	360	1800	98.19%	PR755
PR756	Luddenham ZS augmentation	Major Project - Future/Planning Stage	Augex	80	400	100.00%	PR756
PS008	Substation protection relay refurbishment	Program - Short Term Need	Repex	240	3600	57.03%	PS008s
PS011	Protection refurbishment (miscellaneous)	Program - Short Term Need	Repex	150	2250	93.89%	PS011s
PS012	Distribution feeder safety improvement	Program - Short Term Need	Repex	310	4650	26.01%	PS012s
PS013	Feeder differential relay replacement	Program - Short Term Need	Repex	240	3600	57.03%	PS013s
PS014	Under frequency load shedding	Program - Short Term Need	Repex	170	2550	87.83%	PS014s
RC	Reliability compliance	Program - Short Term Need	Reliability	400	6000	3.28%	RCs
SP	Essential spares	Program - Short Term Need	Repex	160	2400	89.74%	SPs
TM012	Sub-transmission pole replacement	Program - Short Term Need	Repex	310	4650	26.01%	TM012s

Program/Project Description		Division	Expenditure Category*	Rank	Weighted Rank	Percent	Plant
TM014	Renewal of 33kV and 66kV gas and oil filled cables	Program - Short Term Need	Repex	180	2700	85.78%	TM014s
TM015	Subtransmission tower replacement	Program - Short Term Need	Repex	310	4650	26.01%	TM015s
TM027	Steel tower asbestos removal	Major Project - Committed Project	Repex	260	3900	52.04%	TM027
TM030	Feeder 7028 replacement	Major Project - Committed Project	Repex	200	3000	75.87%	TM030
TM132	Sub-transmission pilot cable renewal program	Program - Short Term Need	Repex	160	2400	89.74%	TM132s
TM134	Wollongong - Port Kembla pilot cable replacement	Program - Short Term Need	Repex	110	1650	98.81%	TM134s
TM135	Optical fibre protection and communication upgrades in the Blue Mountains	Program - Short Term Need	Repex	110	1650	98.81%	TM135s
TM137	Optical fibre protection and communication upgrades in the Macarthur area	Program - Short Term Need	Repex	110	1650	98.81%	TM137s
TM138	132kV optical fibre ring completion	Major Project - Committed Project	Repex	110	1650	98.81%	TM138
TM171	Replacement of corroded earthwires	Program - Short Term Need	Repex	270	4050	49.38%	TM171s
TM172	Earthwire replacement due to fault rating	Program - Short Term Need	Repex	170	2550	87.83%	TM172s
TM174	Hardex earthwire replacement	Program - Short Term Need	Repex	240	3600	57.03%	TM174s
TM302	Oil filled cable auxiliary equipment refurbishment	Program - Short Term Need	Repex	200	3000	75.87%	TM302s
TM303	Guilford and Camellia 132kV cables oil testing and flushing	Program - Short Term Need	Repex	260	3900	52.04%	TM303s
TM401	South Coast 33kV overhead line refurbishment	Program - Short Term Need	Repex	240	3600	57.03%	TM401s
TM419	Future sub-transmission feeder refurbishment works	Program - Short Term Need	Repex	150	2250	93.89%	TM419s
TM801	Steel tower painting program	Program - Short Term Need	Repex	170	2550	87.83%	TM801s
TM803	Steel tower below ground rectification work	Program - Short Term Need	Repex	310	4650	26.01%	TM803s
TM805	Earthing refurbishment of lines 940/941	Program - Short Term Need	Repex	270	4050	49.38%	TM805s
TM809	Subtransmission line earthing refurbishment	Program - Short Term Need	Repex	150	2250	93.89%	TM809s
TS004	132kV circuit breaker replacement	Program - Short Term Need	Repex	240	3600	57.03%	TS004s
TS005	33kV circuit breaker replacement	Program - Short Term Need	Repex	240	3600	57.03%	TS005s
TS007	11kV circuit breaker replacement	Program - Short Term Need	Repex	230	3450	65.03%	TS007s
TS008	Battery replacement	Program - Short Term Need	Repex	370	5550	5.43%	TS008s
TS009	Auxiliary switchgear replacement	Program - Short Term Need	Repex	190	2850	85.12%	TS009s
TS015	Replacement of surge arrester in zone and sub-transmission substations	Program - Short Term Need	Repex	190	2850	85.12%	TS015s
TS016	VT and CT replacement	Program - Short Term Need	Repex	240	3600	57.03%	TS016s
TS017	Power transformer refurbishment	Program - Short Term Need	Repex	140	2100	97.63%	TS017s
TS024	Building and amenities refurbishment	Program - Short Term Need	Repex	200	3000	75.87%	TS024s
TS025	Asbestos and other hazardous material reporting, management and removal	Program - Short Term Need	Repex	160	2400	89.74%	TS025s
TS026	Noise attenuation in ZS and TS	Program - Short Term Need	Repex	210	3150	71.03%	TS026s
TS027	Substation switchyard lighting improvement	Program - Short Term Need	Repex	140	2100	97.63%	TS027s
TS031	Substation safety fence upgrade program	Program - Short Term Need	Repex	230	3450	65.03%	TS031s
TS032	Substation security systems	Program - Short Term Need	Repex	150	2250	93.89%	TS032s
TS033	Substation fire hydrant installations	Program - Short Term Need	Repex	160	2400	89.74%	TS033s
TS034	Substation deluge showers and fire blankets	Program - Short Term Need	Repex	120	1800	98.19%	TS034s
TS035	Substation oil containment program - bund walls	Program - Short Term Need	Repex	110	1650	98.81%	TS035s

Program/Project Description		Division	Expenditure Category*	Rank	Weighted Rank	Percent	Plant
TS036	Substation earthing	Program - Short Term Need	Repex	370	5550	5.43%	TS036s
TS049	Tunnelboard refurbishment	Program - Short Term Need	Repex	150	2250	93.89%	TS049s
TS050	POW switching for capacitors	Program - Short Term Need	Repex	150	2250	93.89%	TS050s
TS055	66kV circuit breaker replacement	Program - Short Term Need	Repex	240	3600	57.03%	TS055s
TS057	Substation insulation co-ordination	Program - Short Term Need	Repex	160	2400	89.74%	TS057s
TS086	Busbar support and isolator replacement	Program - Short Term Need	Repex	200	3000	75.87%	TS086s
TS116	Roof refurbishment for control and switch rooms	Program - Short Term Need	Repex	280	4200	44.83%	TS116s
TS122	Leabons Lane Zone Substation renewal	Major Project - Committed Project	Repex	230	3450	65.03%	TS122
TS127	Castle Hill Zone Substation renewal	Major Project - Committed Project	Repex	230	3450	65.03%	TS127
TS128	Capacitor bank refurbishment	Program - Short Term Need	Repex	280	4200	44.83%	TS128s
TS144	Substation fire stopping measures	Program - Short Term Need	Repex	160	2400	89.74%	TS144s
TS146	Marayong Zone Substation renewal	Major Project - Prior to Approval	Repex	230	2300	92.40%	TS146
TS155	Sussex Inlet Zone Substation - stage 2 renewal	Major Project - Prior to Approval	Repex	210	2100	97.63%	TS155
TS163	Unanderra Zone Substation renewal	Major Project - Future/Planning Stage	Repex	150	750	100.00%	TS163
TS165	Greystanes Zone Substation renewal	Major Project - Future/Planning Stage	Repex	150	750	100.00%	TS165
TS167	Carlingford Transmission Substation control building replacement	Major Project - Prior to Approval	Repex	180	1800	98.19%	TS167
TS173	11kV switchboard truck replacement program	Program - Short Term Need	Repex	290	4350	37.20%	TS173s
TS174	West Wollongong Zone Substation 11kV renewal	Major Project - Future/Planning Stage	Repex	290	1450	98.95%	TS174
TS177	Substation battery duplication	Program - Short Term Need	Repex	330	4950	15.67%	TS177s
TS179	33kV wall bushing replacement	Program - Short Term Need	Repex	210	3150	71.03%	TS179s
TS180	Transformer fire wall installation	Program - Short Term Need	Repex	140	2100	97.63%	TS180s
TS181	11kV capacitor bank refurbishment	Program - Short Term Need	Repex	270	4050	49.38%	TS181s
TS184	Blaxland Zone Substation reinstatement	Major Project - Committed Project	Repex	300	4500	33.91%	TS184
TS185	Penrith TS civil development	Major Project - Committed Project	Repex	230	3450	65.03%	TS185
TS187	Mobile substation No 2 refurbishment	Program - Short Term Need	Repex	190	2850	85.12%	TS187s
TS188	Bossley Park ZS civil refurbishment	Major Project - Committed Project	Repex	200	3000	75.87%	TS188
TS199	Future sub-transmission substation renewal programs	Program - Short Term Need	Repex	180	2700	85.78%	TS199s
TS600	Power transformer replacement	Program - Short Term Need	Repex	340	5100	12.43%	TS600s
TS615	Gerringong ZS 33kV No 2 transformer replacement	Major Project - Committed Project	Repex	340	5100	12.43%	TS615
TS616	Camellia TS transformer replacement and 33kV busbar rearrangement	Major Project - Committed Project	Repex	340	5100	12.43%	TS616
TS617	Prospect ZS transformer replacement	Major Project - Committed Project	Repex	340	5100	12.43%	TS617
TS618	Albion Park ZS transformer replacement	Major Project - Committed Project	Repex	340	5100	12.43%	TS618
TS700	11kV zone substation switchboard replacement	Program - Short Term Need	Repex	290	4350	37.20%	TS700s
TS701	North Rocks ZS 11kV switchboard replacement	Major Project - Committed Project	Repex	290	4350	37.20%	TS701
TS702	Kellyville ZS 11kV switchboard replacement	Major Project - Committed Project	Repex	290	4350	37.20%	TS702
TS703	Horsley Park ZS 11kV switchboard replacement	Major Project - Committed Project	Repex	290	4350	37.20%	TS703
TS704	Port Central ZS 11kV switchboard replacement	Major Project - Committed Project	Repex	290	4350	37.20%	TS704
UR	Underground residential	Program - Short Term Need	Customer Connection	190	2850	85.12%	URs

*For RIN purposes, the categories of Reliability and Other are allocated to the AER's Repex category.

APPENDIX B: SUMMARY SCOPE OF THE CAPEX PROGRAM

A summary scope of all the projects in the SAMP is provided on the following page along with ten-year expenditure forecasts. Expenditure is in real FY19 terms.

Augex

AG Automation - operational/capacity risk

SCADA or Distribution automation schemes to manage operational load at risk at various locations. This includes post contingency load shedding, load transfers or changeover operations, for example an overload relief scheme for a constrained sub-transmission line.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	3.000

HVW HV development works

The scope of this program includes augmentation works on the high voltage distribution network to mitigate the following risks and constraints:
- Voltage constraints, to maintain adequate voltage regulation for customers
- Conductor fault rating exceedance, to ensure safe operation of the network with respect to fault withstand capability of conductors
- Overloaded conductors, to address thermal capacity constraints of the high voltage distribution network
- Non-compliance with Distribution Network Standards
- Additional HV isolation points to minimise interruptions to customers during planned and unplanned outages.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
7.058	6.801	7.103	6.647	6.275	5.947	6.000	6.000	6.000	6.000	63.831

LV001 Overloaded distribution sub uprates

Load growth and changes in electricity utilisation by customers occasionally results in overloading of low voltage distribution transformers. In recognition of this situation, a maximum demand monitoring program has been implemented. The procedure, actions and timing of this program is detailed in SMI 116 - MDI readings and identification of overloaded transformers. Hence this program covers the expenditure requirements of overloaded distribution substation uprates.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120	1.200

PR081 Collimore Park ZS establishment

Establish new zone substation at Collimore Park for growth in Liverpool CBD.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	0.000	0.000	0.000	0.000	5.576	11.152	11.152	27.880

PR110 Edmondson Park ZS establishment

New Zone Substation to be established to cater for new residential development at Edmonson Park for 7330 lots and new town centre.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
2.187	1.888	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.081

PR113 Augment feeder 308 Nepean to Douglas Park

Address load at risk upon loss of feeder 851 or 852. The constraint has arisen in part due to more unpredictable output from Appin/Tower generation. Investigations are under way into demand management solutions as an alternative, including ensuring more certainty of generator output.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.518	6.072	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	6.590

PR170 Holsworthy 33/11kV ZS establishment

Establish Holsworthy ZS to off-load Anzac Village ZS when surplus Defence land is developed for industrial use and normal service limitations for Anzac Village service area are exceeded. Will strengthen 33kV source for the Holsworthy Defence Base.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.082	8.164	8.164	20.410

PR190 Eschol Park ZS establishment

This project will be driven by developers of new residential land release areas at Eagle Vale and Blairmount. There is an estimated 1500 new dwellings. The substation will also assist in managing distribution constraints.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.208	8.416	8.416	21.040

PR248 Penrith Lakes ZS site acquisition

Acquire ZS site for future Penrith Lakes Development. Investigate possible transmission line routes.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	1.000

PR249 Establish Penrith Lakes 33/11kV Zone Substation

Establish new 33/11kV zone substation to supply Penrith Lakes Development.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	0.000	0.000	3.610	14.440	0.000	0.000	0.000	18.050

PR258 Menangle Park 66/11kV ZS establishment

This project will provide an interim solution to meet the demands of the Menangle Park residential release area prior to establishment of a permanent zone substation.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
3.800	3.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	7.300

PR270 West Epping Zone Substation establishment

Establish 66/11kV West Epping Zone substation to address Dundas constraints.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	0.000	0.000	0.000	0.000	6.472	12.944	12.944	32.360

PR278 Kemps Creek new BSP associated works

Establish 132kV feeders from Kemps Creek BSP. Establishment of BSP by Transgrid will be dependent on growth in the SW Sector.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.140	2.140	4.280

PR292 South Marsden Park (industrial) 132/11kV ZS establishment

Establish a permanent zone substation to service the Marsden Park Industrial Precinct which has an ultimate load of 50MVA.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
14.500	9.561	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	24.061

PR423 Maryland ZS

Establish new zone substation in SW Sector precincts of Lowes Creek/Marylands.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	4.167	8.334	8.334	0.000	0.000	0.000	0.000	0.000	20.834

PR425 Austral ZS establishment (interim initially)

Associated with PR424. The Austral residential release area was rezoned in early 2013 and will ultimately have 8454 residential lots. NSW Department of Planning are actively supporting development in this precinct.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	2.380	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.380

PR427 Leppington North ZS establishment

Leppington North greenfield release area was rezoned in early 2013 and will ultimately have 7476 lots and a major town centre.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
10.000	2.911	0.285	0.000	0.000	0.000	0.000	0.000	0.000	0.000	13.196

PR430 North Rossmore ZS site purchase

This site will enable a future substation to be built for the North Rossmore release area estimated to be 6500 lots.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	0.000	3.000	0.000	0.000	0.000	0.000	0.000	3.000

PR432 Rossmore ZS site purchase

This site will enable a future substation to be built for the Rossmore release area estimated to be 9000 lots.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	0.000	0.000	3.000	0.000	0.000	0.000	0.000	3.000

PR433 Rossmore ZS establishment

Establish new 132/11kV zone substation for greenfield development in the Rossmore Precinct.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	10.000	10.000

PR435 Catherine Fields North ZS establishment (interim)

Site acquisition for the future Catherine Fields North release area. This site has strategic value being at a 132kV tee, it will also serve as a future 132kV switching station to enable optimise use of capacity in the network. May also supply 3500 lots in the future Leppington Precinct.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	0.000	0.000	0.000	5.652	11.304	11.304	0.000	28.260

PR437 Catherine Fields 11kV feeder works

Establish the first stages of a zone substation at Catherine Field. The nearby release areas including Catherine Field, The Hermitage and Gregory Hills will ultimately produce 7300 lots.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.530	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.530

PR438 North Bringelly ZS site purchase

Acquire site for a future North Bringelly zone substation. The North Bringelly release area is projected to have 5000 lots and 5.1km2 of industrial/commercial land.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	0.000	0.000	3.500	0.000	0.000	0.000	0.000	3.500

PR439 North Bringelly ZS establishment

Establish new 132/11kV zone substation for greenfield development in the North Bringelly precinct.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.420	8.840	8.840	22.100

PR444 Culburra Beach development (33kV fdr and single transformer ZS)

Small rural standard zone substation to facilitate greenfield development at Culburra Beach in the order of 8MVA. Option to consider low cost pad mount 33/11kV 5MVA substations.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.665	3.665	7.330

PR499 Southpipe (Oakdale Estate) ZS 132/11kV establishment

The timing of this zone substation will depend on the pace and amount of development in the Oakdale industrial precinct.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	5.452	12.904	8.904	0.000	0.000	0.000	0.000	0.000	0.000	27.260

PR599 Penrith CBD ZS site purchase

To enable a future zone substation to cater for long term growth in the Penrith CBD and potentially the Panthers development.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
3.720	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.720

PR602 Riverstone West site purchase

This land is required to facilitate conversion of Riverstone ZS from 33kV to 132kV when the load requires. The Riverstone Scheduled lands could ultimately yield of 7500 lots plus associated commercial development.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	0.000	0.000	0.000	0.000	5.000	0.000	0.000	5.000

PR603 Eschol Park ZS site purchase

Associated with PR190. Site to enable the proposed Eschol Park Zone Substation to be established for the Eagle Vale and Blairmount development areas.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	0.000	0.000	0.000	3.000	0.000	0.000	0.000	3.000

PR620 West Dapto ZS establishment

Proposed substation to service greenfield development in the West Dapto area, which will ultimately yield 16,000 dwellings.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	2.467	4.934	4.934	0.000	0.000	0.000	0.000	12.335

PR653 Avondale (South West Dapto) 132/11kV ZS establishment

Establish 132/11kV Avondale Zone Substation to supply greenfield residential development.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	0.000	0.000	0.000	0.000	5.000	5.000	5.000	15.000

PR656 Leppington South ZS establishment (permanent)

This proposed project provides capacity for the South and East Leppington Release areas. It will be undertaken when capacity of the interim South Leppington ZS is exhausted.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
10.900	12.195	1.904	0.000	0.000	0.000	0.000	0.000	0.000	0.000	24.999

PR657 Calderwood ZS establishment (interim initially)

This proposed new substation will supply the Calderwood urban development area within Shellharbour Council. It will ultimately yield 4800 lots.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.200	7.851	7.851	0.000	0.000	0.000	0.000	0.000	0.000	0.000	15.902

PR659 Avondale (South West Dapto) 132/11kV Zone Substation establishment site

Proposed substation to service greenfield development in the West Dapto area, which will ultimately yield 16,000 dwellings, and to service 1200 dwellings at Tallawarra.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	0.000	0.000	0.000	2.500	0.000	0.000	0.000	2.500

PR673 Liverpool ZS 11kV switchboard extension & distribution works

This project seeks to resolve the constraints on the 11kV distribution network and cater for future growth on the Liverpool CBD.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.950	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.950

PR677 South Penrith Zone Substation

Associated with PR599. A future zone substation to cater for long term growth in the Penrith CBD and potentially, the Panthers development.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	4.615	13.230	10.230	0.000	0.000	0.000	0.000	0.000	0.000	28.075

PR698 Marsden Park (residential) 132/11kV ZS - stage 2

Augment Marsden Park (Residential) ZS from single transformer/feeder to N-1 security. This will ensure a secure and reliable supply for a growing area which is part of the NW Growth Sector.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	3.463	5.463	0.000	0.000	0.000	0.000	0.000	0.000	0.000	8.925

PR700 Riverstone east

Establish new zone substation in NW Sector to service precincts of Riverstone East and Box Hill.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	4.129	8.258	8.258	0.000	0.000	0.000	0.000	20.645

PR702 Penrith ZS 11kV transformer cable constraints

As a result of the redevelopment of Penrith TS, the cover of the 11kV cables of the existing 132/11kV transformers No 5 and No 6 was increased to 2.5m. These transformer cables supply the adjacent Penrith ZS. Consequently the de-rating of these cables has limited the output of the transformers. This project replaces the transformer cables to accommodate the future load growth at Penrith ZS.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.050	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.050

PR703 Riverstone East site purchase

Acquire new zone substation site in NW Sector to service precincts of Riverstone East and Box Hill.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	6.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	6.000

PR704 Oakdale (Southpipe) site purchase

Acquire new zone substation site to facilitate new industrial park development.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.300	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.300

PR710 Feeder 868 rebuild & rearrangement South32

66kV feeder rearrangement for feeder 868 and reconfigured metering for South32.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.022	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.022

PR713 Box Hill 132/22kV ZS establishment

Establish new 132/22kV Box Hill ZS.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	4.964	15.928	13.928	0.000	0.000	0.000	0.000	0.000	0.000	34.820

PR717 Acquire improved site for West Dapto ZS

Acquire new zone subsation site for the future West Dapto ZS.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	2.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.000

PR722 Camellia TS connection works for Ausgrid

Project management, secondary systems enhancements and commissioning works associated with Connection of Ausgrid zones subations Auburn and Lidcombe.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.187	0.031	0.096	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.314

PR723 Supply to Luddenham Science Park

Establish a new zone substation for a new Science Park proposed at Luddenham.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	6.104	18.208	16.208	0.000	0.000	0.000	0.000	0.000	0.000	40.520

PR724 Establish Mt Gilead ZS

Establish new Zone Substation to supply the Mt Gilead precinct in the Greater Macarthur South release area.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	3.854	7.708	7.708	0.000	0.000	0.000	0.000	19.270

PR727 Luddenham ZS site purchase

Purchase land from Water NSW for the existing Luddenham ZS which Endeavour Energy is currently leasing.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.976	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.976

PR728 Western Sydney Employment Lands ZS

Establish a new zone subsation within the Broader Western Sydney Employment area.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	4.696	9.392	9.392	0.000	0.000	0.000	0.000	23.480

PR729 Cheriton Avenue 3rd transformer

Install 3rd Transformer at Cheriton Avenue ZS.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	0.000	0.000	0.000	0.000	7.480	0.000	0.000	7.480

PR732 Feeder 214/215 contraints

Potential scope is to reinstate out of service 132kV Feeder 229 to enhance supply security for the 132kV network in the North West sector. The scope is likely to include establishment of fibre links and protection upgrades.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	4.725	4.725	0.000	0.000	0.000	0.000	0.000	0.000	0.000	9.450

PR733 Bringelly ZS augmentation

Scope is to convert Bringelly ZS to a full 132/11kV standard ZS. Bringelly ZS is currently a hybrid ZS with 33kV and 132kV supplies.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.134	8.268	8.268	20.670

PR739 South Gilead (South Campbelltown)

Establish new 66/11kV zone substation.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	0.000	0.000	3.854	7.708	7.708	0.000	0.000	19.270

PR740 AFIC upgrade Minto, Prospect, Kingswood

Upgrade AFIC equipment at Minto, Prospect and Kingswood ZS.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
1.900	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.900

PR742 North Bomaderry

Establish new 33/11kV zone substation and associated 33kV feeders.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	3.692	7.384	7.384	0.000	0.000	0.000	0.000	18.460

PR744 Termeil ZS

Establish new 132/11kV rural zone substation (15MVA).

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	0.000	3.973	3.973	0.000	0.000	0.000	0.000	7.945

PR745 Austral Permanent ZS

Establish new 132/11kV zone substation.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	0.000	0.000	0.000	11.295	11.295	0.000	0.000	22.590

PR746 Sydney University - Western Sydney Employment Lands

Establish new 132/11kV zone substation.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	12.240	12.240	24.480

PR748 Establish permanent Catherine Park ZS

Establish 132/11kV zone substation to service growth in the Catherine Field precinct.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	1.913	3.827	3.827	0.000	0.000	0.000	0.000	9.567

PR749 Nepean ZS augmentation

Augment Nepean ZS with 3rd transformer.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	0.000	0.000	0.000	7.102	0.000	0.000	0.000	7.102

PR750 Feeder 512 augmentation

Augment part of feeder 512 (tee to Kemps Creek) to address load at risk.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.280	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.280

PR751 Parklea ZS to Bella Vista ZS load transfer

Augment distribution network and establish 11/22kV autotransformers to enable load transfers from Bella Vista to Parklea.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	4.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.000

PR752 Kemps Creek 132kV conversion

Convert Kemps Creek to 132/11kV ZS to supply greenfield industrial growth in the Western Sydney Priority Growth area.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	0.000	0.000	0.000	20.762	8.898	0.000	0.000	29.660

PR754 Augment Westmead Zone Substation

Augment Westmead ZS to cater for expansion of Westmead Hospital, Western Sydney University and high density development.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	0.000	6.418	6.418	6.040	0.000	0.000	0.000	18.875

PR755 Narellan ZS busbar augmentation

Narellan ZS firm capacity is limited by the busbar arrangement and unequal impedance of transformers. Establish new bus section to relieve these operational limitations.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	0.000	0.000	0.000	7.280	0.000	0.000	0.000	7.280

PR756 Luddenham ZS augmentation

Augment Luddenham Zone Substation to cater for surrounding load growth and address load at risk.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	0.000	0.000	0.000	11.970	5.130	0.000	0.000	17.100

Repex

AU004 Substation SCADA RTU replacement

Replacement of substation remote terminal units (RTUs) that have reached the end of their life.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
1.044	1.840	1.840	1.840	1.840	1.840	1.840	1.840	1.840	1.840	17.604

AU013 SCADA master station development software

This program covers the updating of the SCADA master station software and hardware enhancements in response to developments in the network and in master station technology.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
1.000	2.000	2.000	1.000	1.000	2.000	2.000	2.000	2.000	2.000	17.000

CC002 Communications development SCADA

This program involves the installation and refurbishment of digital radios in substations, recloser's and other SCADA communications equipment such as GRN and PMR mobile radios. It also covers design of SCADA communications including radio surveys.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.750	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	5.250

CC007 SCADA radio repeaters

This program includes the installation of new high capacity UHF radio base stations to complement the roll-out of remote devices under program CC002. It also provides for new SCADA radio base stations and links as required, the refurbishment of existing SCADA radio sites and the upgrading of cyber security at substations & base station sites and the upgrading of radio repeater stations to accommodate the substation DC system monitoring project TS177.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.870	0.696	0.696	0.696	0.696	0.696	0.696	0.696	0.696	0.696	7.134

CC020 Microwave refurbishment and extension

Program CC020 is both an upgrade and condition based program to refurbish parts of the existing microwave communications network.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.550	0.450	0.450	0.450	0.450	0.450	0.650	0.650	0.650	0.650	5.400

DS002 Pole substation refurbishment

This is a safety driven condition based program for distribution pole substations which covers the replacement of deteriorated drop-out fuse carriers, porcelain surge arresters and dropper cables. The program also includes the installation of wildlife proof shrouding on the transformer bushings and surge arresters, installation of safety chains to the transformers and the refurbishment of earthing connections and bonds.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.735	0.735	0.735	0.735	0.788	0.840	0.893	0.945	0.945	0.945	8.295

DS005 Distribution pole replacement

This program includes the replacement or reinstatement of poles in the distribution network when they are condemned in accordance with standard MMI0001 Pole and line inspection and treatment procedures.

The program covers the replacement of timber poles with CCA treated timber poles or with concrete poles and the nailing of poles to extend their life.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
10.800	11.330	12.100	12.870	13.640	14.410	15.180	16.720	17.490	17.490	142.030

DS006 LV CONSAC cable replacement

Program DS006 is a condition based program to replace low voltage (LV) CONSAC cable (concentric neutral solid aluminium conductor) with XPLE cable in areas where the CONSAC is found to be in poor condition, considered at risk of failure and/or presents a safety hazard for workers or the public. These works may also include the replacement of parallel street light cables and columns in conjunction with the CONSAC replacement where required.

Associated LV switchboards or distribution substations may be identified for replacement along with the CONSAC works. These tasks are not included in this program and will be costed to their relevant programs subject to appropriate assessments.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
6.000	6.950	8.700	9.750	10.550	10.550	10.550	10.550	10.550	10.550	94.700

DS007 Service wire replacement program

This is a condition based program which covers the renewal of overhead (OH) service mains to single residential dwellings.

The implementation of this program is enhancing customer's safety by ensuring the integrity of the neutral, rectifying customer defects and service clearance issues, replacing obsolete connection boxes and installing earth stakes where required. All works are in accordance with the current network standards which ensures the installations have a risk level As Low As Reasonably Possible (ALARP) once the work are complete.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
9.167	9.200	9.300	9.300	9.450	9.800	10.300	11.300	12.300	12.900	103.017

DS008 Traffic black spot remediation

This program covers the renewal of the electricity network in traffic black spot locations identified by the NSW Roads & Maritime Services (RMS) as having records of repeated motor vehicle accidents involving roadside poles. Work may include the relocation of poles and mains away from the road carriageway and/or under-grounding sections of overhead mains.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
1.700	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	10.700

DS011 HV distribution steel mains replacement

This program covers the replacement of steel HV distribution mains in bushfire prone areas which exhibit rust, pitting or corrosion and/or have failed and been repaired previously. The steel conductors are generally replaced with ACSR conductors but in some specific situations AAAC or ABC or CCT may also be used as a replacement conductor system.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
4.800	4.800	4.800	4.800	5.600	5.600	6.400	6.400	6.400	6.400	56.000

DS014 LV cable network renewal

This is a new condition based program which covers the replacement of the low voltage underground distribution network where required across the network. The initial stage of the program includes the replacement of LV mains, pillars and streetlight columns and service connections at Lapstone.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.650	1.950	2.340	2.340	1.300	1.300	1.300	1.300	1.300	13.780

DS301 Ground substation refurbishment program

This is a condition based program which covers the planned replacement of ground-mounted, indoor, kiosk and padmount substations which have reached the end of their lives.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.510	0.510	0.510	0.850	0.850	1.020	1.275	1.275	1.275	1.275	9.350

DS302 Distribution transformer replacement program

This is a condition based program which covers the replacement of distribution transformers that have reached the end of their lives and have been assessed as at risk of failure based on the results of condition assessments carried out during routine inspections. The upgrade of overloaded transformers is covered under program LV001 Overloaded Distribution Substations upgrade.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
1.170	1.170	1.170	1.170	1.463	1.463	1.755	1.755	1.755	1.755	14.625

DS305 Compact LV switchgear replacement

This is a condition based program which covers the replacement of deteriorated Compact brand low voltage (LV) switchgear. The sites for replacement are prioritised based on condition, age and the type of customers supplied by the substation.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.508	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	5.008

DS307 Holec MD4 epoxy switchgear replacement

The purpose of this program is to replace MD4 switchgear in 11kV switching stations, padmount substations and indoor and ground substations when they fail partial discharge tests carried out in accordance with substation maintenance instruction SMI101 Minimum requirements for maintenance of distribution equipment.

MD4 switchgear has also been used as auxiliary switchgear in a number of zone substations. Replacement of these units is covered by program TS009.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
4.035	5.950	6.300	7.875	7.875	7.875	7.875	7.875	7.875	7.875	71.410

DS308 HV RGB12 switchgear replacement

This program covers the replacement of 11kV RGB12 epoxy switchgear which as a type experiences mechanical operational problems and discharge issues indicative of approaching the end of its life. All RGB12 switches in the distribution network are included in the program.

RGB12 is also used as auxiliary switchgear in zone substations and the renewal of this equipment is addressed in program TS009.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.598	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.598

DS312 Miscellaneous substation renewal expenditure

This program covers approved refurbishment expenditure associated with distribution substations that falls outside of the current distribution substation renewal programs or cuts across multiple distribution substation renewal programs.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.750	3.500	3.500	3.500	3.500	3.500	4.000	4.000	4.000	4.000	34.250

DS315 Low voltage switchgear replacement

This is a condition-based program which covers the replacement of the deteriorated LV switchboards within Endeavour Energy's LV distribution network. The initial focus is on HH type switchboards. These present safety hazards and are the first priority for replacement. Other types of LV switchboards will be included into the program as required by their condition.

This program does not include Compact type LV switchboards which are addressed by program DS305.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.354	0.708	0.708	0.708	0.708	0.708	0.708	0.708	0.708	0.708	6.726

DS317 Future distribution substation renewals

The proposed scope of this project includes renewal of distribution substation assets which have reached the end of their effective service life.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	0.000	0.000	0.000	9.200	13.700	18.400	20.200	61.500

DS318 Distribution substation earthing refurbishment

This program is to address earthing hazards for distribution assets to reduce network safety risks through the installation of a CMEN system and will target identified high risk sites, address risk from increasing urban encroachment and replace aged and unserviceable earthing grids.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.676	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	3.106

DS405 Air break switch replacement

This is a condition based program which covers the replacement of air-break switches with high failure rates and switches which have failed or whose condition is poor indicating imminent failure.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
6.146	3.690	3.690	3.690	3.690	3.690	3.690	3.690	3.690	3.690	39.356

DS409 Miscellaneous mains renewal expenditure

This program covers approved refurbishment expenditure associated with distribution mains that falls outside of the current distribution mains renewal programs or cuts across multiple distribution mains renewal programs.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.750	1.100	1.150	1.150	1.200	1.200	1.400	1.400	1.400	1.400	12.150

DS413 Low mains remediation

This is a condition based program which covers the remediation work required to address mains which infringe Australian Standard AS/NZS 7000 ground safety clearances and therefore pose a safety hazard to the public.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
1.800	1.625	1.625	1.625	1.625	1.625	0.975	0.975	0.975	0.975	13.825

DS414 Copper distribution mains replacement

This is a condition based program which covers the replacement of copper distribution mains which have reached the end of their life and are at risk of failure and/or have failed and been repaired previously. The copper conductors are replaced with aluminium conductors (AAC or AAAC) in all parts of Endeavour Energy's distribution network.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
5.600	1.440	2.400	2.400	2.400	2.400	2.400	2.400	2.400	2.400	26.240

DS415 LV mains replacement

This program covers the refurbishment or replacement of low voltage distribution mains including underground cables, overhead mains, under and over awning mains and associated services which have reached the end of their life or are unsafe and whose replacement is not covered by other more specific programs or projects.

The program excludes the replacement of CONSAC cable, service mains and LV cable networks which have their own specific programs DS006, DS007 and DS014 respectively.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.550	0.880	1.100	1.210	1.210	1.100	1.100	1.100	1.100	1.100	10.450

DS416 Asbestos service fuse replacement

The scope of works includes the replacement and disposal of Henley type fuses that are Asbestos Containing Material (ACM) on switchboards identified under Service Mains Program DS007 and also under the Metering Testing and Replacement Program.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.261	0.261	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.522

DS417 Distribution access track reconstruction

This project covers the refurbishment of access tracks which are in need of upgrading due to their inability to provide for the safe passage of maintenance vehicles. It also includes the environmental remediation costs associated with these works.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.500	0.440	1.408	1.892	1.892	0.000	0.000	0.000	0.000	0.000	6.132

DS418 LV Pole top structure/hardware refurbishment

The overhead distribution network consists of high voltage, low voltage and service overhead lines, poles and pole top hardware. This program includes the replacement of pole hardware in the low voltage distribution network when they are defected in accordance with standard MMI0001 Pole and line inspection and treatment procedures.

High voltage and transmission voltage pole top hardware replacements are addressed by DS421 and TM033 respectively.

These pole top hardware replacement programs do not include pole replacements or overhead service line hardware which are addressed by program's DS005 and DS007.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
5.000	10.000	9.000	9.000	8.000	8.000	8.000	8.000	8.000	8.000	81.000

DS420 Future distribution feeder refurbishment works

The scope of this program includes the redevelopment of distribution feeders which have reached the end of their effective service lives.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	0.000	0.000	0.000	9.200	13.700	18.400	20.200	61.500

PS008 Substation protection relay refurbishment

PS008 is an ongoing program for the replacement of protection relays and associated panel equipment as it reaches the end of its life as evidenced by risk of malfunction, technological redundancy or non-conformance with current standards of network safety and/or reliability.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
3.600	4.218	4.218	4.218	4.218	4.218	4.218	4.218	4.218	4.218	41.562

PS011 Protection refurbishment (miscellaneous)

PS011 provides for the short-term implementation of protection scheme upgrades, operational and reliability improvements. These opportunities generally become apparent as a result of system studies, system incidents or operational requests. PS011 also includes protection upgrade works which are required as a result of TransGrid upgrading or replacing the protection schemes on their 132kV feeders which supply EE's network.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.895	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	7.195

PS012 Distribution feeder safety improvement

This is a multi-year phased project to install modern numerical protection relays into distribution feeder protection systems at zone substations.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
4.616	3.100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	7.716

PS013 Feeder differential relay replacement

The installation of feeder differential protection schemes on feeders where there is optical fibre available provide the communications channels required.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	3.300

PS014 Under frequency load shedding

The installation of underfrequency load shedding relays on additional 11kV and 22kV feeders throughout the network.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.500	0.550	0.550	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.600

SP Essential spares

This program includes the purchase of essential spares for Endeavour Energy's network.

Essential spares are assets or components of assets which are difficult to procure or have long procurement lead times and are required for equipment which is critical to the operation of the network. Essential spares are kept on hand for use in emergencies.

Essential spares include free-standing items (complete high cost items eg power transformers and circuit breakers), major components (spares for free standing eg bushings) and minor components (relays, springs, circuit breaker contacts).

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
1.239	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	10.239

TM012 Sub-transmission pole replacement

This program includes the replacement of timber poles in Endeavour Energy's sub-transmission lines as they reach the end of their life and are condemned in accordance with the Company's mains maintenance instruction MMI0001 "Pole and line inspection and treatment procedures".

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
2.500	3.720	3.720	3.720	3.720	4.920	4.920	4.920	4.920	4.920	41.980

TM014 Renewal of 33kV and 66kV gas and oil filled cables

Replacement of 33 kV and 66kV gas and oil-filled cables with XLPE cables in accordance with the condition and expected remaining life of the cables.

The 66kV capacitor cables and two short 66kV cables to Ausgrid's feeders within Carlingford TS and Feeder 7032 cables from Outer Harbour TS are the only remaining oil-filled cables for renewal under TM014.

All gas filled cables have been replaced.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	0.000	0.000	0.720	0.765	1.530	1.485	1.485	5.985

TM015 Subtransmission tower replacement

This program includes the replacement of subtransmission line steel towers with poles when the towers reach the end of their life.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
1.600	1.600	1.600	4.000	5.600	5.600	5.600	5.600	5.600	5.600	42.400

TM027 Steel tower asbestos removal

Removal of the asbestos hazard presented by the 9 steel towers in lines 980/981 and 985/989 which are coated with a paint containing asbestos.

This project is to conclude in 2018/19 and will be removed from the next SARP.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
3.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.013

TM030 Feeder 7028 replacement

This project includes the replacement of 33kV feeder 7028, Bellambi TS to Helensburgh ZS.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.500	1.650	2.200	2.200	2.200	2.200	0.000	0.000	0.000	0.000	10.950

TM132 Sub-transmission pilot cable renewal program

Completion of optical fibre links, installation of MPLS communications and SCADA connectivity to the optical fibre network in Western Sydney.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950	8.550

TM134 Wollongong - Port Kembla pilot cable replacement

This project is intended to address the renewal needs of the pilots which provide protection systems for the 33kV feeders which supply the network of zone substations in the Wollongong – Port Kembla area by replacing that network with an optical fibre network.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	1.615	1.615	1.615	1.615	1.615	1.615	1.615	1.615	1.615	14.535

TM135 Optical fibre protection and communication upgrades in the Blue Mountains

This project includes an optical fibre network between the zone and transmission substations in the Blue Mountains, including a broadband communications link between TransGrid's Wallerawang Power Station and Penrith TS.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.650	0.650	0.650	0.650	0.650	0.650	0.650	0.650	0.650	5.850

TM137 Optical fibre protection and communication upgrades in the Macarthur area

This project includes the extension of high speed feeder differential protection schemes to substations in the Macarthur area.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	1.280	1.280	1.280	1.280	1.280	1.280	1.280	1.280	1.280	11.520

TM138 132kV optical fibre ring completion

This project provides an optical fibre link between East Parramatta SS and Camellia TS to complete the optical fibre ring between Sydney West BSP and Carlingford TS.

The project is expected to be completed in 2017/18 with project close-out tasks forecast to run into 2018/19.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.005

TM171 Replacement of corroded earthwires

The replacement of steel overhead earthwires which are at risk of failure due to loss of strength due to corrosion damage.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
2.000	1.340	1.000	0.900	0.900	0.900	0.900	0.900	0.900	0.900	10.640

TM172 Earthwire replacement due to fault rating

The augmentation of overhead earthwires to ensure adequate fault ratings.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	9.000

TM174 Hardex earthwire replacement

Project TM174 includes the replacement of the earthwire function of Hardex pilot wires which have reached their end of their life with an aluminium earthwire or with OPGW.

In 2015 a scoping study was undertaken to determine the condition of the remaining Hardex in the network. This study found that the remaining Hardex is in good mechanical condition and that there is likely to be no requirement for replacement of Hardex due to its mechanical condition in the next 10 year period. However it is noted that Hardex may be replaced for reasons other than corrosion such as inadequate fault rating and failure of its protection communication functionality.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	9.000

TM302 Oil filled cable auxiliary equipment refurbishment

The purpose of this project is to assess the condition of the auxiliary equipment (oil pressure meters, pressure gauges and alarm panels) for the 132kV fluid-filled cables which supply the Parramatta, Granville and Clyde areas and to refurbish or replace as necessary to ensure the ongoing reliability of these cables.

These works will be carried out in conjunction with the fluid sampling and testing being carried out under Project TM303.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.072	0.000	0.000	0.000	0.000	0.072	0.000	0.000	0.144

TM303 Guilford and Camellia 132kV cables oil testing and flushing

This program includes the periodic sampling, testing and flushing of the insulating fluid in the 132kV fluid-filled cables which supply the Parramatta, Granville and Clyde areas.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.465	0.000	0.090	0.000	0.000	0.000	0.000	0.090	0.000	0.000	0.645

TM401 South Coast 33kV overhead line refurbishment

This program covers the refurbishment of overhead 33kV feeders on the South Coast.

This program is managed by Southern Region and includes a plan of pole-top inspections and replacement of insulators and fittings at suspension poles with the remainder of the pole tops assessed and replaced based on the found condition.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.998	1.080	1.080	1.200	1.200	1.200	1.200	1.200	1.200	1.200	11.558

TM419 Future sub-transmission feeder refurbishment works

The scope of this program includes the redevelopment of sub-transmission feeders which have reached the end of their effective service lives.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	0.000	0.000	0.000	9.200	13.700	18.400	20.200	61.500

TM801 Steel tower painting program

The scope of this program includes the painting of Endeavour Energy's steel lattice tower structures which are not already painted or which require re-painting or completion of previous painting works, based on their condition.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	0.000	0.000	0.000	0.800	0.800	0.800	0.800	3.200

TM803 Steel tower below ground rectification work

The scope of this program includes the refurbishment of the foundations of steel towers across the network.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
2.600	2.100	2.100	2.100	2.100	2.100	2.100	2.100	2.100	2.100	21.500

TM805 Earthing refurbishment of lines 940/941

Refurbishment of the earthing on the towers in the 132kV double circuit line 940/941 between Mt Victoria and Lawson Transmission Substation.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.178	0.280	0.280	0.280	0.280	0.020	0.020	0.020	0.020	0.020	1.398

TM809 Subtransmission line earthing refurbishment

This program provides for the replacement or refurbishment of earthing systems on subtransmission lines which have been lost or reduced in effectiveness due to corrosion over time.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.600	0.600	0.600	0.600	0.600	0.600	0.600	0.600	4.800

TS004 132kV circuit breaker replacement

Replacement of 132 kV circuit breakers that have reached the end of their effective service lives and are not planned to be replaced by other major renewal or growth projects.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.903	0.362	0.362	0.362	0.362	0.362	0.362	0.362	0.362	0.362	4.161

TS005 33kV circuit breaker replacement

Replacement of 33kV circuit breakers that have reached the end of their effective service lives and are not planned to be replaced by other major renewal or growth projects.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
3.410	0.852	0.852	0.852	0.852	0.852	0.852	0.852	0.852	0.852	11.074

TS007 11kV circuit breaker replacement

This program includes the replacement of the remaining indoor 11kV bulk-oil circuit breakers which are installed in outdoor cubicles in zone substations. The program of replacing oil circuit breaker trucks with vacuum trucks is included in the separate program TS173 and replacing whole indoor 11kV switchboards is in program TS700.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.350	0.350	0.000	0.000	0.000	0.000	0.000	0.000	0.700

TS008 Battery replacement

This program covers the replacement of battery banks and associated battery chargers and DC panels in sub-transmission and zone substations and switching stations as they reach the end of their effective lives.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
1.254	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	12.054

TS009 Auxiliary switchgear replacement

The purpose of this program is to replace 11kV auxiliary switchgear in zone and sub-transmission substations that have reached the end of their life.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.817	1.000	1.000	1.000	1.000	1.000	0.750	0.000	0.000	0.000	6.567

TS015 Replacement of surge arrester in zone and sub-transmission substations

This program includes the replacement of surge arresters in sub-transmission and zone substations as they reach the end of their effective lives.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.132	0.110	0.110	0.110	0.110	0.044	0.044	0.044	0.044	0.044	0.792

TS016 VT and CT replacement

The scope of this program includes the replacement of voltage transformers (VTs) and current transformers (CTs) in zone and sub-transmission substations at the end of their effective life and where not proposed to be replaced by other major renewal works in that location.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
1.095	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	7.395

TS017 Power transformer refurbishment

This program includes the refurbishment of power transformers to extend their life and to address environmental issues due to oil leaks.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.600	0.600	0.600	0.600	0.600	0.600	0.600	0.600	0.600	0.600	6.000

TS024 Building and amenities refurbishment

This program covers civil and building works associated with transmission and zone substations.

Repairs to substation buildings, amenities and switchyards which return those assets to their expected condition are considered maintenance works and are excluded from this program.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.500	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	18.500

TS025 Asbestos and other hazardous material reporting, management and removal

TS025 is an ongoing program involving the removal of asbestos and other hazardous materials from zone and sub-transmission substations and other Endeavour Energy network assets as required.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.650	0.520	0.520	0.520	0.520	0.520	0.520	0.520	0.520	0.520	5.330

TS026 Noise attenuation in ZS and TS

This project addresses issues relating to excessive noise emanating from zone and sub-transmission substations.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	9.000

TS027 Substation switchyard lighting improvement

The purpose of program TS027 is to improve the internal and external lighting levels in zone and transmission substations to achieve minimum levels of light required for safety and security.

In addition, installation of power outlets in substation switchyards and control rooms is included where required.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120	1.080

TS031 Substation safety fence upgrade program

This program refurbishes or replaces internal sub-transmission and zone substation HV enclosure fencing and external perimeter security fencing when required by its condition.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.300	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	1.200

TS032 Substation security systems

This program includes the installation or upgrading of security systems in sub-transmission and zone substation and switching stations to address the risk of unauthorised intrusion into substation switchyards and buildings.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.150	0.150	0.150	0.000	0.000	0.000	0.000	0.000	0.000	0.450

TS033 Substation fire hydrant installations

This program includes the planned upgrade of substation fire hydrant systems to the minimum standard required by current Australian Standards.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	2.000

TS034 Substation deluge showers and fire blankets

This program includes upgrading or installation of additional deluge shower facilities at existing substations to achieve compliance with current standards. This program is delivered in conjunction with TS033 Substation Fire Hydrant for scheduling efficiency and cost savings in project management and supervision.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.160	0.160	0.160	0.160	0.160	0.160	0.160	0.160	0.160	0.160	1.600

TS035 Substation oil containment program - bund walls

The program includes upgrading oil containment bunds around power transformers substations to comply with the revised Australian Standards and Endeavour Energy's Substation Design Instructions.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.210	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.840

TS036 Substation earthing

The purpose of this program is to assess sub-transmission and zone substation earthing systems and distribution bonding arrangements and to rectify any defects found to ensure compliance with Substation Design Instruction EDI 516 under system fault conditions. This includes testing for step and touch voltage hazards in the vicinity of the substation, voltages transferred from or to bonded or nearby metallic assets and earth potential rise impacts on assets with remote or MEN electric potential influence including Telstra pits, water taps, hot water systems).

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.998	1.000	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	5.998

TS049 Tunnelboard refurbishment

This program covers the refurbishment of tunnel boards in zone and transmission substations where conductors are exposed, where there is inadequate lighting or trip hazards that pose a safety risk to staff while working on the protection and control equipment mounted on the boards.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.405

TS050 POW switching for capacitors

This program includes the installation of point-on-wave circuit breakers for switching 132kV, 66kV and 33kV capacitor banks at particular substations as required.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	0.000	0.600	0.000	0.000	0.000	0.000	0.000	0.600

TS055 66kV circuit breaker replacement

Replacement of 66kV circuit breakers that have reached the end of their effective service lives and are not planned to be replaced by other major renewal or growth projects.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.258	0.258	0.258	0.258	0.258	0.258	0.258	0.258	0.258	0.258	2.580

TS057 Substation insulation co-ordination

The purpose of this program is to upgrade the insulation co-ordination at sub-transmission and zone substations where required

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	1.500

TS086 Busbar support and isolator replacement

This is an ongoing program to replace corroded busbar and disconnector support structures and replace or refurbish disconnectors and damaged insulators in sub-transmission and zone substations, which are not scheduled for replacement by other specific renewal projects.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.325	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	1.176

TS116 Roof refurbishment for control and switch rooms

This is a planned reactive program to replace or substantially refurbish sub-transmission and zone substation control building roofs when required by their condition.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	14.000

TS122 Leabons Lane Zone Substation renewal

Project TS122 includes the redevelopment of Leabons Lane Zone Substation to an indoor 33kV design. The works include the replacement of the EIB sections of the 11kV switchboard in an extension to the existing control building, the installation of an indoor 33kV switchboard and the replacement of the two power transformers with low-noise units.

This project is to be completed in 2018/19 and will be removed in the next SARP.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.075	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.075

TS127 Castle Hill Zone Substation renewal

Project TS127 was initially approved in September 2009 and included the redevelopment of Castle Hill ZS to an indoor 66kV design. However, the project scope was subsequently re-evaluated and reduced to a lower cost outdoor refurbishment approach in 2014.

This project will be completed in 2018/19 and will be removed in the next SARP.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.163	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.163

TS128 Capacitor bank refurbishment

Replacement of 33kV, 66kV and 132kV capacitors located at sub-transmission and zone substations as they reach the end of their effective life.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
1.270	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.270

TS144 Substation fire stopping measures

This program typically involves the installation of a fire sealing product and barriers to limit the spread of fire through service penetrations and in control panels. It may also include a fire resistant coating on exposed transformer cables within the bunded area and basement to limit flame propagation.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.198	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.792

TS146 Marayong Zone Substation renewal

This project includes the complete redevelopment of Marayong Zone Substation

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
13.051	6.698	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	19.749

TS155 Sussex Inlet Zone Substation - stage 2 renewal

This project proposes to replace the 11kV busbars and switchgear and the control building at Sussex Inlet ZS.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
2.400	3.663	3.771	0.000	0.000	0.000	0.000	0.000	0.000	0.000	9.834

TS163 Unanderra Zone Substation renewal

The proposed scope of this project includes the redevelopment of the 11kV part of the substation to provide a new control building, new 11kV switchboard and new protection and control and auxiliary services.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	4.000	5.000	6.000	0.000	0.000	0.000	0.000	15.000

TS165 Greystanes Zone Substation renewal

The proposed scope of this project includes the redevelopment of part or all the substation to provide a new 33kV control building with an indoor 33kV switchboard, new protection and control and auxiliary services and a new 11kV switchgear.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	0.000	0.000	6.970	6.970	7.000	0.000	0.000	20.940

TS167 Carlingford Transmission Substation control building replacement

The proposed scope of this project includes the replacement of the control building at Carlingford Transmission Substation with a new control building with new protection and control and auxiliary equipment.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	4.500	4.500	4.500	0.000	0.000	0.000	0.000	0.000	0.000	13.500

TS173 11kV switchboard truck replacement program

The replacement of oil insulated circuit breaker trucks in zone substation switchboards with vacuum units

The circuit breakers are selected for priority of replacement based on their type and inherent risk of destructive failure. Within each type, individual sites are prioritised based on history of defects, performance and the results of diagnostic tests.

The replacement of oil insulated 11kV voltage transformers and the provision or earthing trucks at sites where required are also included in this program.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
2.894	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.894

TS174 West Wollongong Zone Substation 11kV renewal

The proposed scope of this project includes the replacement of the 11kV part of the substation.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	3.000	4.000	5.500	0.000	0.000	0.000	0.000	0.000	12.500

TS177 Substation battery duplication

The purpose of this program is to address the failure of DC systems in transmission and zone substations which would result in the loss of their protection systems. The scope covers all zone substations with single battery systems and includes the duplication of the DC system. DC monitoring systems and alarms are also being installed at some sites as an interim measure.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
1.582	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.600	10.182

TS179 33kV wall bushing replacement

Replacement of the 33kV wall bushings at Outer Harbour TS which have degraded due to pollution from the coastal atmosphere and works to reduce moist saline air from entering the substation circuit breaker cubicles. Replacement of 33kV wall bushings which have reached the end of their lives at other sub-transmission substations as required.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.038	0.120	0.120	0.180	0.180	0.180	0.180	0.180	0.180	0.180	1.538

TS180 Transformer fire wall installation

Installation of fire walls to limit the spread of fire and damage to adjacent transformers and control building.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	2.000

TS181 11kV capacitor bank refurbishment

The refurbishment of 11kV ABB Abbacus capacitor banks in zone substations throughout the network.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.888	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.888

TS184 Blaxland Zone Substation reinstatement

This project includes the replacement of the 11kV switchboard at Blaxland ZS to reinstate the full capacity and functionality of the substation after a fire in the switchboard in January 2017.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.692	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.692

TS185 Penrith TS civil development

The scope of this project includes a range of civil, electrical and safety works at Penrith TS which were originally included in project PR052 but were not completed as part of the project due to financial constraints at the time.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
2.102	2.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.102

TS187 Mobile substation No 2 refurbishment

This project includes the refurbishment of the trailer which supports the mobile 132(66)/11kV substation No. 2 which was damaged by an equipment failure and a fire in 2012.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.270	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.270

TS188 Bossley Park ZS civil refurbishment

This project covers the civil refurbishment of the transformer fire walls, parts of the control building and landscaping retaining walls at Bossley Park ZS

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.200	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.200

TS199 Sub-transmission substation renewal programs

This program makes an allowance for the redevelopment of zone and transmission substations that reach the the end of their lives in the longer term. The scope also includes the civil and 11kV cable and cable box replacement works associated with 11kV feeder circuit breaker works under program TS173 and civil and cable replacement works under switchboard replacement program TS700.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	4.000	6.000	6.000	6.000	12.000	12.500	17.000	20.500	23.500	107.500

TS600 Power transformer replacement

This program includes the replacement of power transformers that are at the end of their effective life. Each transformer replacement project is given a unique number in the TS600 series so that individual projects can be managed and costs tracked more effectively.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	10.000	12.000	12.000	14.000	14.000	16.000	16.000	16.000	16.000	126.000

TS615 Gerringong ZS 33kV No 2 transformer replacement

The replacement of one 5MVA English Electric power transformer (TX No. 2) which has reached the end of its effective service life with a 10MVA unit. The project is expected to be electrically completed in 2017/18 with project close-out tasks forecast to run into 2018/19.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.007

TS616 Camellia TS transformer replacement and 33kV busbar rearrangement

The scope of works includes replacing Transformer No. 1 with a new 120MVA unit and removing Transformer No.3. The scope also includes installation of firewalls between the two 132kV power transformers and between the power transformers and the property boundary and rearrangement of the 33kV bus-sections to provide supply security from the substation.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
2.609	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.609

TS617 Prospect ZS transformer replacement

The scope of works includes the replacement of Transformers No. 1 and No. 2 at Prospect Zone Substation and the installation of firewalls around the new transformers.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
2.449	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.449

TS618 Albion Park ZS transformer replacement

The scope of works includes the replacement of Transformers No. 2 and No. 3 at Albion Park Zone Substation and the installation of firewalls around the new transformers.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
2.458	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.458

TS700 11kV zone substation switchboard replacement

This program includes the replacement of indoor 11kV switchboards with oil-insulated circuit breakers in zone substations throughout the network to improve safety in the substation control buildings.

Each switchboard replacement project is given a unique number in the TS700 series so that individual projects can be managed and costs tracked more effectively.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	6.250	6.875	6.875	7.500	7.500	7.500	7.500	7.500	7.500	65.000

TS701 North Rocks ZS 11kV switchboard replacement

This program includes the replacement of the indoor 11kV bulk-oil switchboard and associated paper insulated cables at North Rocks ZS with a new vacuum switchboard and XLPE cables. This project is part of the TS700 program.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
2.100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.100

TS702 Kellyville ZS 11kV switchboard replacement

This program includes the replacement of the indoor 11kV bulk-oil switchboard and associated paper insulated cables at Kellyville ZS with a new vacuum switchboard and XLPE cables.

This project is part of the TS700 program.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
1.890	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.890

TS703 Horsley Park ZS 11kV switchboard replacement

This program includes the replacement of the indoor 11kV bulk-oil switchboard and associated paper insulated cables at Horsley Park ZS with a new vacuum switchboard and XLPE cables.

This project is part of the TS700 program.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
2.610	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.610

TS704 Port Central ZS 11kV switchboard replacement

This program includes the replacement of the indoor 11kV bulk-oil switchboard and associated paper insulated cables at Port Central ZS with a new vacuum switchboard and XLPE cables.

This project is part of the TS700 program.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
1.740	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.740

Customer Connection

AR Asset relocation

The relocating of existing network assets to allow for road widening, construction etc. This work is generally funded wholly by the party requesting the relocation. Endeavour Energy may however increase the scope of the proposed relocation to achieve a desired network outcome. This program covers the costs associated with the increased scope.

Typically the additional scope may includes additional distribution ducts for future use, additional ducts for a future sub-transmission circuit and a higher rating for the relocated feeder than the modern equivalent standard.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
1.675	1.818	1.809	1.816	1.825	1.838	1.846	1.854	1.862	1.878	18.222

DU Duct installation RMS road works

The RMS has a $5bn capital works program for new major roads across Western Sydney. This program is to facilitate installation of new distribution or transmission ducts which are not associated with an asset relocation request during new road construction.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
1.955	2.153	2.207	2.262	2.318	2.376	2.436	2.497	2.559	2.559	23.321

IC Industrial & commercial

This program covers extensions and augmentation of the electrical network to service the connection of industrial and commercial customers. In general, the load applicant will fund the cost of the specific network assets required to service that customer, however, the connection may also require Endeavour Energy to fund distribution transformers, spare ducts and the installation or augmentation of shared upstream assets. Accordingly, the scope of the Industrial & Commercial allocation is to fund the capital expenditure associated with the customer connection works, which are not required to be funded by the Industrial & Commercial load applicant.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
10.000	13.837	13.286	13.262	13.309	13.547	13.570	13.590	13.611	13.652	131.664

NU Non urban extension

This program covers extensions and augmentation of the electrical network to service customers in non urban areas. In general, the load applicant will fund the cost of the specific network assets required to service that customer, however, the connection may also require Endeavour Energy to fund distribution transformers, spare ducts and the installation or augmentation of shared upstream assets. Accordingly, the scope of the Industrial & Commercial allocation is to fund the capital expenditure associated with the customer connection works, which are not required to be funded by the Industrial & Commercial load applicant.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.850	1.732	1.667	1.664	1.670	1.699	1.702	1.705	1.708	1.714	16.110

UR Underground residential

This program covers extensions and augmentation of the electrical network to service new Underground Residential Developments (URD). In general, the load applicant will fund the cost of the specific network assets required to service that customer, however, the connection may also require Endeavour Energy to fund distribution transformers, spare ducts and the installation or augmentation of shared, upstream assets. Accordingly, the scope of the Underground Residential Developments (URD) allocation is to fund the capital expenditure associated with the customer connection works, which are not required to be funded by the URD load applicant.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
33.940	43.970	42.124	42.034	42.179	42.962	43.026	43.083	43.140	43.255	419.712

Reliability

RC Reliability compliance

Reliability enhancement capital projects may be pursued where fault response or operational actions are not able to achieve the quantum of improvements required. Projects included in this program may typically include:
-Establishing remote controlled Auto Reclosers to segment feeders and remote controlled Load Break Switches to improve isolation and restoration times.
-Developing distribution feeder automation (DFA) schemes to automatically isolate and restore supply to unfaulted segments.
-Re-conductoring to CCT/ABC conductors to minimise exposure to high risk vegetation and foreign interference faults.
-Establishing cross feeder ties to enable back up restoration options post fault and isolation.
-Establishing drop out fuses to sectionalise problematic spur segments.
-Installing line fault indicators and cable fault indicators to improve fault location times.

This program is mainly focussed on the high voltage distribution network but includes work on the low voltage or sub-transmission network where appropriate studies have determined a capital solution is most appropriate reliability management or enhancement option.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	40.000

Other System

EF001 Distribution management system

This program aims to provide Endeavour Energy with a Distribution Management System (DMS) The DMS will involve:
- Implementation of an electronic pin-board replacing the existing paper pin board
- Implementation of field switching mobility application; and
- Integration of an electronic network model with feeder automation and distributed energy management systems.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
12.000	8.585	3.617	0.093	0.000	0.000	0.000	0.000	0.000	0.000	24.295

EF002 Technology pilots

This program is for pilot installation of technology which may be useful for improving safety or reliability performance or deferring augmentation of the network
This program is the main vehicle for Endeavour Energy to implement the technologies required for the ongoing grid transformation from centralised energy production to distributed energy resources and to enable customer participation in the operation of the network. This program enables Endeavour Energy to achieve the initial stages of work identified in the ENA's network transformation roadmap.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.553	0.500	0.500	2.000	2.000	2.000	2.000	2.000	2.000	2.000	15.553

EF003 Battery energy storage system pilot

The purpose of this project is to install a battery energy storage system as a pilot at West Dapto. This project will provide short term capacity relief to distribution feeders in the West Lakes Illawarra development area.

West Dapto Zone Substation, planned for construction in 2022, has been identified as a suitable location for the pilot. It is intended, pending successful testing of the BESS peak lopping capability, the solution will remain onsite to defer the construction of the Zone Substation.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
1.692	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.692

EH Dist environmental enhancement program

This program was for works which were designed to reduce the impact of the network on the environment.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

LV002 Quality of supply reactive projects

The LV002 project is a reactive project responding to justifiable customer power quality complaints.
Typical complaints include: voltages outside of established limits; mal-operation of equipment or distributed generation due to network voltages out of range or network signalling; noise, mal-operation or flickering of lighing due to signaling; phase imbalance etc.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	5.000

LV003 LV planning reactive projects

LV003 is used to augment the LV network on the basis of reactively identified capacity constraints, history of faults / outages or the requirement for network reconfiguration.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	10.000

LV005 Dsub monitoring & LV feeder monitoring for solar PV

This program covers the installation of monitoring devices in two areas. The first is on potentially overloaded substations to defer augmentation. The second is on feeders with a high proportion of embedded generation to monitor reverse power flows, potential islanding and compliance of voltage to Australian Standards requirements.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	2.500

MC105 Relays - renewal

This program replaces load control equipment on customer's switchboards which has reached the end of its life and includes both material and labour.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.300	0.958	0.907	0.857	0.806	0.756	0.706	0.655	0.605	0.554	7.104

MC109 Demand management technology

This program provides equipment to support Endeavour Energy's demand management initiatives. These initiatives include DMIA trials, constraint driven projects and targeted broad based initiatives. The funding from this program is primarily for demand response products and systems and some customer technology products for trial like energy storage, power factor correction, inverters, air conditioner control and smart home control devices).

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.500	1.400	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750	7.900

PQ001 Permanent power quality monitoring

Procurement, installation, and management of power quality monitors installed in sites such as transmission substations, zone substations, switching stations and LV network for the long term and statistical monitoring of power quality on the network.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.615	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	1.515

PQ004 Power quality monitoring replacement

This program will replace ageing UP-2210 power quality monitors that are installed in Endeavour Energy's zone substations, transmission substations and switching stations, as well as at select low voltage locations. The replacement program will prevent the loss of power quality data by replacing monitors as they approach their end of life. Updating older installations with new UP-2210 monitors, including updating their voltage, current and telecommunications connections, will improve monitoring system functionality, data quality and visibility to power quality performance. The old, recovered, monitors can be reused where basic or statistical monitoring is required or used as temporary spares where units have failed prior to their replacement under this program.

2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total
0.400	0.342	0.618	0.873	0.948	1.365	1.300	1.430	1.430	1.170	9.874

APPENDIX C: ABBREVIATIONS

Abbreviation	Definition
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
ALARP	As Low As Reasonably Practicable
CAIDI	Customer Average Interruption Duration Index
CAPEX	Capital Expenditure
CASH	Capital Allocation Selection Hierarchy
CPI	Consumer Price Index
DAPR	Distribution Annual Planning Report
DM	Demand Management
DMIS	Demand Management Incentive Scheme
DMIA	Demand Management Innovation Allowance
DNSP	Distribution Network Service Provider
DNSR	Distribution Network Status Report
DUOS	Distribution Use of System
DWP	Distribution Works Program
EBSS	Efficiency Benefit Sharing Scheme
ENAMC	Executive Network Asset Management Committee
FMECA	Failure Modes, Effects and Criticality Analysis
HV	High Voltage
ICT	Information and Communication Technology
LTIFR	Lost Time Injury Frequency Rate
LV	Low Voltage
MAMP	Metering Asset Management Plan
NER	National Electricity Rules
NIO	Network Investment Option
NMIP	Network Maintenance Implementation Plan
OH&S	Occupational Health & Safety
OLI/GLI	Overhead Line Inspection/Ground Line Inspection
OPEX	Operating Expenditure
OSCRP	Overhead Steel Conductor Replacement Program
OT	Operational Technology
PMO	Portfolio Management Office
PV	Photovoltaic
RCBM	Risk and Condition Base Maintenance
RCM	Reliability Centred Maintenance
RIT-D	Regulatory Investment Test for Distribution
RWP	Reliability Works Program

Abbreviation	Definition
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SAMP	Strategic Asset Management Plan
SARP	Strategic Asset Renewal Plan
SDI	Substations Design Instruction
SEF	Sensitive Earth Fault
SS	Switching Station
STPIS	Service Target Performance Incentive Scheme
TNPR	Transmission Network Planning Review
TS	Transmission Substation
WARL	Weighted Average Remaining Life
WFP	Workforce Plan
WHS	Workplace Health & Safety
ZS	Zone Substation