2019-24 Replacement Expenditure Proposal (SARP)

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Endeavour Energy

01

EXECUTIVE SUMMARY

This document provides a summary view of Endeavour Energy's Strategic Asset Renewal Plan (SARP).

Endeavour Energy's approach to asset renewal planning is supported by a long-established understanding of the future investment requirements to maintain a sustainable and reliable network asset-base.

The Strategic Asset Renewal Plan is developed annually and includes the following key stages:

- The identification of specific short-term renewal needs through asset condition and performance analysis (the 'bottom-up' approach);
- The formulation of a long-term position on renewal needs using predictive asset renewal expenditure modelling (the 'top-down' approach);
- The collation and integration of short-term and long-term renewal needs into the SARP;
- The prioritisation of renewal expenditure; and
- The integration with and prioritisation against, other expenditure in the Strategic Asset Management Plan (SAMP).

In order to comply with the Company's requirements for budgeting, "bottom-up" based projections for a 10 year period are developed each year, with the first year of the ensuing program informing the asset renewal budget for the following financial year.

In the period prior to the development of the "bottom-up" projections, high-level projections are developed. These are disseminated to inform the stakeholders in the Company of emerging trends and long-term proposals for asset re-investment, against a backdrop of strategic corporate intent. Long-term, high-level assessments of expenditure requirements in particular, are intended to quantify the effects of previous deferrals of expenditure and the need to arrest long-term consumption of the asset base.

Endeavour Energy utilises an integrated suite of network investment modelling and decision-support tools known as the Value Development Algorithm (VDA) to assist in forecasting renewal expenditure requirements from the "top-down".

The VDA provides the capability to algorithmically model investment requirements in order to determine optimal levels of investment that are linked to network outcomes. The modelling principles that underpin the VDA are similar to the current Repex and Augex models adopted by the AER.

The current model uses data from the 2017 Asset Valuation carried out by the consultancy firm KPMG. The average asset replacement costs used in the model have been revised from a combination of project historical expenditures, the KPMG valuation report, the previous SARP and previous VDA models as appropriate to each asset category.

Medium to long-term projections are based on the renewal plans developed for specific asset categories. When such plans are not available, the medium to long term estimates are based on

current replacement needs and anticipated replacement needs projected forward. This is presented in Table 1 below.

TABLE 1 – PROGRAM APPORTIONED NETWORK REQUIREMENTS

Period (years)	Term	Forecast expenditure approach
1-2	Short	Bottom-up
3-5	Medium	Bottom-up and top-down (VDA)
6-10	Long	Top-down (VDA)

The bottom-up projections and top-down VDA modelling indicates a renewal capital expenditure requirement of $1,143 million across the next regulatory period FY20 - FY24.

However, improvements planned for Endeavour Energy's IT systems and the outputs of other recently implemented smart systems are providing targeted asset condition data which will provide a mechanism for Endeavour Energy to manage additional network risk and defer capital expenditure. In addition, further efficiencies are expected to be gained through the newly established delivery alliance partnership and major projects unit. This supports the revised Repex proposal of $800 million in the SARP across the FY20 - FY24 regulatory period. These expenditure outcomes are shown in Table 2 below.

TABLE 2 - RENEWAL EXPENDITURE MODEL PROJECTIONS AND FORECASTS

Asset category	VDA model (Constant WARL short to medium term)	Asset need	FY20 – FY24 proposal	AER Repex model – historical calibrated lives	AER Repex model – benchmark average asset lives
AER Modelled	726	801	582	651	223
AER Unmodelled	452	342	218	218[1]	218[1]
Total Repex	**1,178**	**1,143**	**800**	**869**	**441**

[1] *The unmodelled component has not currently been assessed as part of the AER review process. The FY20 FY24 Proposal unmodelled component has been applied*.

In summary, Endeavour Energy is proposing a submission for Repex which is about 30% below the level modelled by both our "bottom-up" condition base asset plans and "top-down" predictive modelling to deliver value for our customers on the basis that advances in asset management systems and our asset management capability will allow us to successfully manage the risks posed by this reduction through the next regulatory period and beyond.

Endeavour Energy's FY20 - FY24 Proposal for Repex expenditure is below that of the previous applied AERs historical calibrated lives assessment method. However, it is noted that the AER's future direction scenario which is based on industry benchmark average asset lives, proposes a level of renewal expenditure which is below that proposed by Endeavour Energy.

Further information on Endeavour Energy's proposal is provided in this document, including details of the key program deliverables, structure and timescales.

02

ENDEAVOUR ENERGY'S APPROACH TO ASSET RENEWAL

2.1 HISTORICAL CONTEXT

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.

This approach facilitates the development of asset renewal expenditure plans that are based on actual asset condition needs, but are also tested against modelling outcomes to ensure that an appropriate, efficient, and sustainable level of expenditure is developed and implemented.

To assist in this approach, Endeavour Energy utilises an integrated suite of network investment modelling and decision-support tools known as the Value Development Algorithm (VDA).

The VDA provides the capability to algorithmically model investment requirements in order to determine optimal levels of investment that are linked to network outcomes. The modelling principles that underpin the VDA are similar to the current Repex and Augex models adopted by the AER. Amongst other things, the VDA has the added capability of being able to integrate growth and renewal investment driver models in order to determine cross-program impacts. It also has the ability to set asset condition variability parameters in order to assess the impact of this on projected renewal expenditure and can assess the variable impacts of deferred asset replacement and the rate of catch-up on the renewal investment projections.

Sustained commitment to this approach has ensured that the planning methodology has been continually developed and enhanced since its inception. Renewal plans and outcomes are revised annually and continually improved and short and long-term asset renewal expenditure programs are updated annually as part of the annual investment planning process, ensuring that they reflect the most recent assessments of network asset need. This ensures that any one year's program is always placed in the context of historical spend and future need, and enables the development of a detailed ongoing rolling plan of asset-specific replacement requirements.

This approach allows unmanageable levels of failure and emergency investment demands to be avoided along with "shocks" in financial and human resource requirements.

In this context Endeavour Energy has adopted a broad approach to asset renewal planning encompassing both critical (just in time) and strategic renewal approaches to ensure smooth investment requirements across years and regulatory periods, consistent with containing network risk to manageable levels.

2.2 RENEWAL PLANNING FRAMEWORK

2.1.1 COMPANY POLICY 9.2.6 - NETWORK ASSET RENEWAL

This policy outlines the principles and reasoning that underpins Endeavour Energy's asset renewal planning framework. In particular, it states that:

> *"The long term integrity, performance and value of the network are dependent upon, amongst other things, the assets of the network operating within acceptable performance standards. The Company will renew in a timely manner assets operating outside these parameters due to their condition, the risks they present to the network or their suitability consistent within other corporate objectives of network capability, reliability, safety, performance, economic efficiency and environmental management."*

Further, the policy provides the framework for the strategic planning of asset renewal to enable:

- Assets or groups of assets approaching the end of their technical or economic life to be clearly identified in a consistent manner across the company;
- Long-term programs for the renewal of these assets to be developed consistently with corporate objectives of safety, network security, network reliability, operating practices, cost efficiency, sustainability and social and environmental responsibility;
- Asset renewal requirements identified through asset maintenance activities in accordance with Company Policy 9.9.1 – Network Asset Maintenance to be included as an integral part of the Strategic Asset Renewal Plan (SARP);
- Technological advances to be systematically and rigorously introduced by the company where they support other business outcomes consistent with the need for ongoing asset renewal; and
- The development of a SARP based on the above, for incorporation within the Strategic Asset Management Plan (SAMP).

The intent of the policy is to achieve consistency in the application of the renewal planning framework and the standards by which asset renewal plans are developed.

2.1.2 CASE FOR RENEWAL

Renewal needs are identified through a number of means and from a number of sources including:

- Asset class plans;
- Asset audits and scoping studies;
- Health and safety risks;
- The maintenance process;
- Fault statistics and reports;
- The trend of repair costs and effort and feasibility of maintaining the assets;
- Diagnostic test results;
- Exceedance of operational limits;
- Environmental impact;
- Studies and analysis (including industry working groups) of particular assets taking into account their age, condition, performance, potential health & safety risks, environmental impacts or requirements for improved functionality or security;
- Company strategy (Company strategy requiring improved functionality, performance or customer service from the assets).

2.1.3 ANNUAL RENEWAL PLANNING CYCLE

As required by the policy outlined above, Endeavour Energy's asset renewal program is refreshed and updated in the course of the planning cycle each year. This includes reviewing asset condition-based renewal needs and ensures that the proposed short-term expenditure is consistent with the expected long-term renewal requirements.

Furthermore, the proposed expenditure on individual assets is validated against asset-class renewal plans on an ongoing basis. These in turn are coordinated with proposed major network projects to ensure that expenditure programs are optimised, and any potential double-counting of investment requirements is eliminated.

Asset renewal programs and projects are therefore both optimised (through the elimination of potential overlaps) and rationalised so that only those assets that are in immediate need of renewal (consistent with project lead-times) are actually programmed to be replaced.

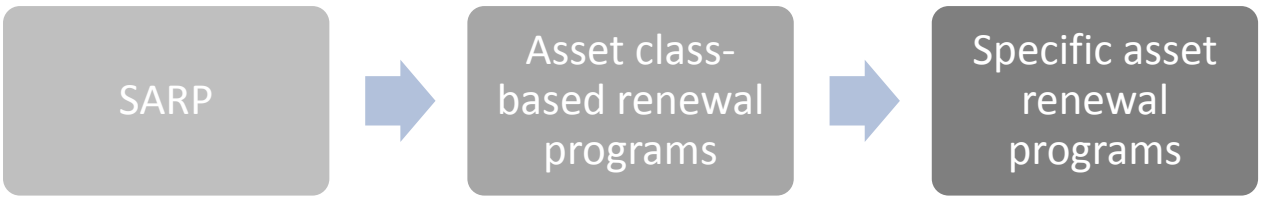
2.1.4 INTEGRATION WITH OTHER INVESTMENT PLANNING ACTIVITIES

As noted above, a key aspect of Endeavour Energy's approach to renewal planning has been the coordination of proposed investments driven by asset renewal needs with those driven by other factors such as growth related augmentation or maintaining network reliability. The strategic planning framework that leads to the development of the integrated Strategic Asset Management Plan ensures that this occurs as part of the business as usual planning cycle.

Of particular note is Endeavour Energy's approach to integrating major asset renewal projects with major growth-related projects and the integration of planning processes associated with these two investment drivers. The process used is identical to that used for the development of major augmentation projects, including governance arrangements. This approach provides investment proposals that address all relevant needs in an integrated manner and ensures that investment proposals are not only prudent, but also efficient through the elimination of potential rework that might otherwise occur in the absence of this coordination.

2.1.5 IDENTIFICATION OF RENEWAL NEEDS - PROGRAMS AND PROJECTS

There are three development strands to the renewal planning process:



The SARP provides the overarching renewal planning needs assessment and supporting information, including being the repository of the detailed asset renewal planning programs and projects. The programs and projects that go to make up the detail of the 10-year expenditure projections documented in the SARP are themselves the outcome of detailed planning assessments undertaken across the business and coordinated through the annual renewal planning cycle framework.

Endeavour Energy has a number of approaches for identifying assets for renewal, ranging from simple inspection and condition based maintenance regimes for assets such as distribution poles through to detailed technical analysis of key asset condition indicators such as that used for power transformers. As a policy requirement, electrical network assets will generally be renewed before their failure on the basis that the consequences of failures are considered too great due to network or societal impacts. This is particularly the case for circuit breakers and power transformers in critical network locations and field switchgear in public locations.

Renewal programs are developed at an asset class or asset type level. Each different asset class will have a different assessment approach reflective of the value of the asset, their criticality in the network (e.g. power transformers), their preponderance in the network (e.g. distribution air-break switches) and the availability of condition and performance data.

For example, key sub-transmission assets will have programs populated on the basis of known and detailed asset condition assessments. In some cases, this will result in isolated individual assets becoming candidates for renewal due to a specific condition or performance issue. In other cases assets of a particular manufacturer or model will emerge with type faults and these will be included in the renewal programs on the basis of the risk they present and the remediation measures that may be available.

In any event, entry into the programs is only approved following the identification of need from detailed condition assessments or following the identification of known type-faults, especially for programs where expenditure will be undertaken in the current regulatory control period.

Further, for high-value or network critical assets, asset class based strategic renewal plans have historically been developed that have facilitated the coordination of the programs for these assets with each other and with major renewal projects. This has allowed for the establishment of priorities within each program based on risk and criticality (such as that undertaken for power transformers) and has ensured that where a confluence of asset renewal needs is established at one location an optimal single-project approach is developed for renewing the affected assets.

Major asset renewal projects are developed should this confluence of needs be evident and as outlined above, coordinated with other network needs such as growth-related augmentation requirements. The combination of these approaches and their coordination within the planning framework ensures that asset-class based programs only contain candidates for renewal based on actual condition, performance or risk-based need. Major renewal projects are only developed when it is clear that there is a collective need at a particular location (such as at a zone or transmission substation) as evidenced by the asset-specific condition assessments and the renewal need planning process outlined.

2.1.6 BUSINESS CASES FOR ASSET RENEWAL

Endeavour Energy's Network Asset Renewal policy and the Investment Governance framework require that all renewal programs and projects must have an approved supporting business case prior to their entry into the works program. However, in rare cases entries without full business justification may be included in the renewal program within the regulatory control period for the purpose of capturing emerging medium to long-term renewal needs. Notwithstanding this, no expenditure is undertaken on a project or program until there is an approved business case authorising that expenditure.

The development of business cases for programs and projects follow slightly different processes and have different forms, but all conform to the same fundamental requirements, including:

- The decision to retire an asset due to it being no longer fit-for-purpose or at the end of its useful life must be clearly identified through actual condition or performance assessments and be documented in a Statement of Need;
- The decision to replace the asset is distinct from and in addition to the decision to retire the asset. This is made following due consideration of the present and expected network functionality that the asset is required to provide, including the asset rating. A range of options to address the replacement need must be considered, including "do not replace" options;
- If it is determined that the asset functionality is required to be retained, the identification and consideration of replacement options is carried out by asset management technical specialists in the case of asset class needs and by a cross-functional team of experts in the event of a major renewal project;
- Where appropriate, the requirements of the Regulatory Investment Test Distribution (RIT D) are to be met in accordance with the investment trigger thresholds for the application of the test. This includes the consideration of and market-testing for non-network options including demand management approaches where appropriate;
- The options thus identified are assessed for technical and economic merit, including a financial evaluation for each, as well as broader organisational and stakeholder impact assessments where appropriate;

- The final option is selected to meet the need at the least cost and to reduce the risks presented by the asset(s) to as low as reasonably practicable (ALARP). The investment governance arrangements of the business reflect those required under National Electricity Law for investment test requirements and sound commercial principles.

Once developed, the business case, including supporting documentation, is submitted for formal approval in accordance with the Company's investment governance procedures and rules of delegated authority.

The business cases for a program of works (such as circuit breaker replacement programs, distribution mains refurbishment programs etc.), may form a once-off approval document for a program that may span many years and even several regulatory control periods. In such cases, the scope of the works is refreshed regularly to ensure that the factors underpinning the need for the investment remain current and appropriate and that the highest priority assets and risks are being addressed.

For major projects, the business case (which may be in the form of a Network Investment Options report), is approved prior to entry into the works program.

Business cases for renewal projects and programs are maintained separately from the SARP. In this respect the information presented in the SARP is intended to provide summary information only in regards to individual asset renewal projects and programs. The retention and management of the business approval information including documentation of need, consideration of options, risks, business justification and expected network outcomes is undertaken by stakeholders in the planning and governance processes and is separate from the SARP.

2.3 DETERMINING SHORT AND LONG-TERM EXPENDITURE LEVELS

2.3.1 BALANCING RISK AND INVESTMENT

Many elements of Endeavour Energy's network were constructed during the infrastructure booms in the 1960's through to the 1980's and are now coming to the end of their useful lives.

In this context, the principal objective of the asset renewal strategy is to achieve an appropriate balance between condition-related equipment failures and sustainable capital and maintenance expenditure levels.

Endeavour Energy's strategic approach to asset renewal planning is directed by a long-established understanding of the future investment requirements to maintain a sustainable and reliable network asset-base. Any one year's expenditure program for asset renewal is not only based on specific condition and risk driven requirements, but sits in the context of a long-term strategic expenditure plan for asset reinvestment. In order to determine the appropriate short and long-term expenditure levels, Endeavour Energy's approach to proposed renewal-driven investment has several facets including:

- High level asset renewal expenditure modelling using the Value Development Algorithm (VDA);
- The development of "bottom-up" short-term expenditure projections for various asset classes based on asset condition;
- The development of long-term renewal plans and associated expenditure projections based on prioritisation methodologies for major assets and asset classes;
- A "top-down" challenge using high-level expenditure projections compared to the "bottom-up" forecasts to balance corporate objectives whilst achieving the desired network strategic outcomes;
- Collation and integration of the renewal plan in the annual Strategic Asset Renewal Plan and coordination with other investment activities through the annual Strategic Asset Management Plan development process.

The strategic 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 condition 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 other assets emerge with higher priority needs.

2.3.2 STRATEGIC TARGET GUIDES ASSET RENEWAL INVESTMENT LEVELS

In order to ensure the outcomes from its asset renewal planning are realistic and measureable, Endeavour Energy has sought to identify a simple indicator that could focus replacement planning activity and ensure that expenditure was appropriately targeted. However, it is recognised that it is difficult to establish a single indicator of overall network condition (or network health index) that would appropriately drive investment due to the breadth of technologies and asset types that make up the network.

Notwithstanding this, with asset age adjusted for condition recognised as a reasonable surrogate for asset remaining life, Endeavour Energy settled on Weighted Average Remaining Life (WARL) as a high level indicator of overall asset health. The WARL of the asset base measures the remaining life of the network assets, taking into account both age and condition factors, assuming that variations in individual asset condition within a class of assets balance out over time. WARL is a readily obtainable output from the VDA's Replacement Model.

This indicator has the advantage of weighting an asset's contribution to the overall outcome 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.

The VDA 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. This has provided the opportunity to determine a strategic trajectory for the overall condition of the asset base as represented by WARL, and in particular the identification and arrest of an historic long-term expected decline. It also enables calibration of the model to actual asset condition and network risk outcomes through the empirical alignment of current observed risks and outcomes to the present WARL position of the asset base.

In other words, developing expenditure projections that maintain the current WARL are expected to result in the maintenance of the current range of network outcomes actually observed. This enables the establishment of a long-term sustainable asset renewal driven expenditure trajectory consistent with the strategic goals established for the network.

This approach, the associated long-term expenditure projections thus developed, and the detailed condition-based asset renewal programs proposed, have formed the basis of Endeavour Energy's expenditure projections for asset replacement for 15 years and for the current regulatory control period. The validity of this approach is evidenced by acceptance of VDA projections during previous determinations by the AER and the broader industry.

2.3.3 EXPENDITURE PROJECTION DEVELOPMENT

As noted above, multiple approaches are utilised in developing the short and long-term renewal program expenditure estimates. A combination of "top-down" and "bottom-up" forecasting approaches are used to determine asset renewal expenditure required for each asset class or asset replacement program. Asset specific condition assessments and known "fit-for-purpose" asset renewal drivers are used to establish the scope of assets that will be potential candidates for renewal. High-level modelling informs the size of programs and enables the creation of a long-term view about the appropriateness of the proposed spend.

In particular, 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 contained in the various asset maintenance and performance standards and through individual asset condition and performance assessment regimes. The forecast of replacement costs for these assets is developed using a bottom-up approach based on historical unit rates and current equipment costs and labour rates. Model based assessments (from the VDA) are used to ensure the proposed expenditure is appropriate and consistent with long-term needs.

The calibration of needs-based investment programs with modelling projections ensures that proposed expenditure is consistent with the risk-profile necessary to achieve Endeavour Energy's strategic network outcomes. Further, modelling outcomes from the VDA take into account the degree of asset replacement effected through other network investment programs such as growth. This "growth-to-renewal" bleed analysis is used to discount the renewal modelling outcomes to ensure that the model projections are reflective only of the renewal investment required in addition to that which occurs as a by-product of other investment strategies.

Replacement programs for low-value, high-volume assets (typically distribution network equipment such distribution poles and associated hardware), are forecast using a "top-down" or model-based approach. These forecasts are then optimised by actual asset need through condition assessment programs), the size of the asset base and extraneous drivers such as changes in regulatory requirements (such as that required for bushfire prevention management). The expenditure forecasts are based on actual average replacement costs, discounted for network/asset growth as appropriate.

This approach however, only establishes an appropriate expenditure level for asset class programs. Actual candidates for replacement are identified through condition assessment prior to the implementation of each stage of the program and are controlled through Endeavour Energy's investment governance and portfolio management processes.

2.4 PROGRAM OPTIMISATION AND INTEGRATION

The Capital Allocation Selection Hierarchy (CASH) tool is used to assist in selecting the projects for inclusion into the capital expenditure planning process each year which best meet the Company's business objectives based on addressing risk, generating benefits and achieving strategic business outcomes. CASH does not assess absolute network risk but comparative risk between both renewal and augmentation projects and programs to enable the development of a prioritised and holistic investment program.

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 a short-term requirement whose risk is able to be managed allowing its replacement to be deferred) 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 reduced investment in asset renewal due is transparent, observable and manageable.

The use of the CASH prioritisation methodology assists Endeavour Energy to understand where it should spend its available funding in order to most efficiently and effectively manage network risk and hence maximise benefits for its stakeholders. The application across different drivers for investment also ensures that an appropriate priority is assigned to renewal expenditure versus growth-related investment in an objective manner.

Endeavour Energy's risk-based investment planning and optimisation processes ensure that the current Portfolio Investment Plan is at a level that appropriately manages network risk and minimises investment requirements in a long-term sustainable manner that meets stakeholder's expectations.

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03

THE ‘TOP-DOWN’ AND ‘BOTTOM-UP’ APPROACH

Endeavour Energy uses a combination of top-down and bottom-up processes to forecast asset renewal expenditure requirements. The different expenditure forecasting methods and their intended use are summarised in Table 3 below.

TABLE 3 - COMPARISON TOP-DOWN AND BOTTOM-UP REPLACEMENT NEEDS

Forecasting method	Intended use	Comments
Top-down replacement analysis (VDA and REPEX)	Guide for renewal expenditure at a high level for the development of expenditure projections by asset category. Provide a renewal expenditure forecast for the next regulatory period based on VDA and Australian Energy Regulator (AER)’s predictive model (REPEX).	Complex analysis based on age profile, standard life, replacement cost, asset condition and condition adjustment. Further, it takes into account the risk limits, deferred asset spread, start of replacement year etc. with risk positions calibrated to current outcomes using WARL. The AER REPEX analysis includes a calibration process which takes into account the historical levels of expenditure and volumes to project the future expenditure and volumes. **Provides valuable insight into longer term renewal needs and trends**
Bottom-up replacement needs	SARP program development.	Actual short term replacement needs are based on field assessments (condition, reliability), operational requirements, industry experience, safety, environmental and regulatory requirements, maintenance issues, spares availability and age. Medium to long-term projections are based on the renewal plans developed for substations and specific asset categories. When such plans are not available, the medium to long term estimates are based on current replacement needs and anticipated replacement needs projected forward. **Identifies specific short to medium-term renewal requirements based on actual identified needs.**

3.1 THE "TOP-DOWN" APPROACH

Endeavour Energy employs the Value Development Algorithm (VDA) modelling tool to forecast direct network capital expenditure requirements and resulting network performance outcomes. The asset replacement capital forecast model is a part of the VDA and has the capability of projecting potential renewal capital expenditure requirements and the corresponding average remaining life of the assets, network health and reliability outcomes.

High-level renewal expenditure modelling was first carried out in 2002 as part of Endeavour Energy's preparation for the 2004 Network Revenue Determination (as well as for the release of the inaugural edition of the SARP in 2003). In conjunction with this, a Network Strategy was developed that articulated the various issues affecting the performance of the network and the desired outcomes for the network over the following five to ten years and into the longer term. The articulation of the need to arrest the declining condition of the network asset base through long-term asset renewal investment, which commenced in the previous regulatory period, was underpinned by the high level modelling undertaken using the VDA.

In particular the adoption of Weighted Average Remaining Life as a leading indicator of asset decline gave insight and guidance to the appropriate level of asset reinvestment required for the long-term. One of the key network strategies Endeavour Energy has adopted is to arrest the decline in the Weighted Average Remaining Life of our existing asset base and to maintain it at a sustainable level in order to maintain acceptable network outcomes into the long-term.

The VDA is particularly useful for informing the development of strategic views of long-term asset renewal expenditure needs. This is undertaken in order to minimise future expenditure peaks that may arise should asset renewal investment be reduced in line with other corporate imperatives without changes in asset management and risk mitigation approaches being adopted. These views allow potential future investment shocks due to the effects of lower levels of expenditure to be identified and effectively mitigated to assure sustainable long-term performance of the network assets.

The VDA model outputs are used as a guide and form the basis each year for a landscape against which the bottom-up expenditure projections are developed. Further, the outputs from the VDA are tested for practicality, realism and impact against strategic targets for asset renewal, at an asset category and whole-of-network level.

3.2 ASSET RENEWAL EXPENDITURE MODELLING DATA SOURCES

The VDA Replacement model is populated with specific data for each asset class in order to produce the replacement capital forecast, as follows:

- Data for each asset type is allocated into Asset Categories, which represent major components that make up the network such as poles, transformers, conductor, cable, switchgear etc;
- Each asset type is assigned an average "standard life" and a replacement cost based recent actual costs; and
- The quantity of new assets installed in the network and the quantity retired each financial year are recorded to build on the age profile of the network assets.

The current model uses the data from the 2017 Asset Valuation carried out by the consultancy firm KPMG. The average asset replacement costs used in the model have been updated from a combination of project historical expenditures, the KPMG valuation report, the previous SARP and previous VDA models as appropriate to each asset category.

3.3 THE IMPACT OF GROWTH ON RENEWAL

The impact that growth-related capital investment has on replacing assets at or near their end-of-life is recognised in the high-level renewal expenditure modelling process. Various assessments have been made of this impact, noting that it will vary over time and by asset class in accordance with the actual works program being implemented.

Endeavour Energy's approach to the development of major renewal projects relies upon the clear identification of all drivers for investment and where these may coalesce, the development of a single major re-investment project if this is the most efficient way to address the needs. This strategic approach to asset management investment planning ensures that any proposed works are undertaken in an efficient and optimal manner, addressing all of the needs identified through the planning aspects of Endeavour Energy's asset management framework. In turn, identifying the impacts that growth-based development was having on renewal need enabled the size of the renewal-driven investment program to be reduced. These impacts are assessed at the asset renewal program planning level, i.e. all proposed candidates for renewal are reviewed for the likelihood of renewal due to future augmentation works. An assessment is then made as to whether their replacement can be postponed to align their renewal with the need to augment the assets for supply security, capacity or growth reasons.

Modelling outcomes from the VDA take into account the degree of asset replacement achieved through the growth-driven network investment programs. This "growth-to-renewal" bleed analysis is used to discount the renewal modelling outcomes to ensure that the model projections are reflective only of the renewal investment required in addition to that which occurs as a by-product of other investment strategies.

3.4 "BOTTOM-UP" ASSET CLASS EXPENDITURE FORECASTS

The detailed asset renewal items outlined in the SARP have been identified by the respective asset engineers and managers from various groups across the Company. A combination of renewal planning approaches have been used which are consistent with Endeavour Energy's Network Supply Strategy, Network Asset Renewal and Network Asset Maintenance policies.

In this respect, the mix of issues considered in the development of individual asset renewal programs and/or projects include:

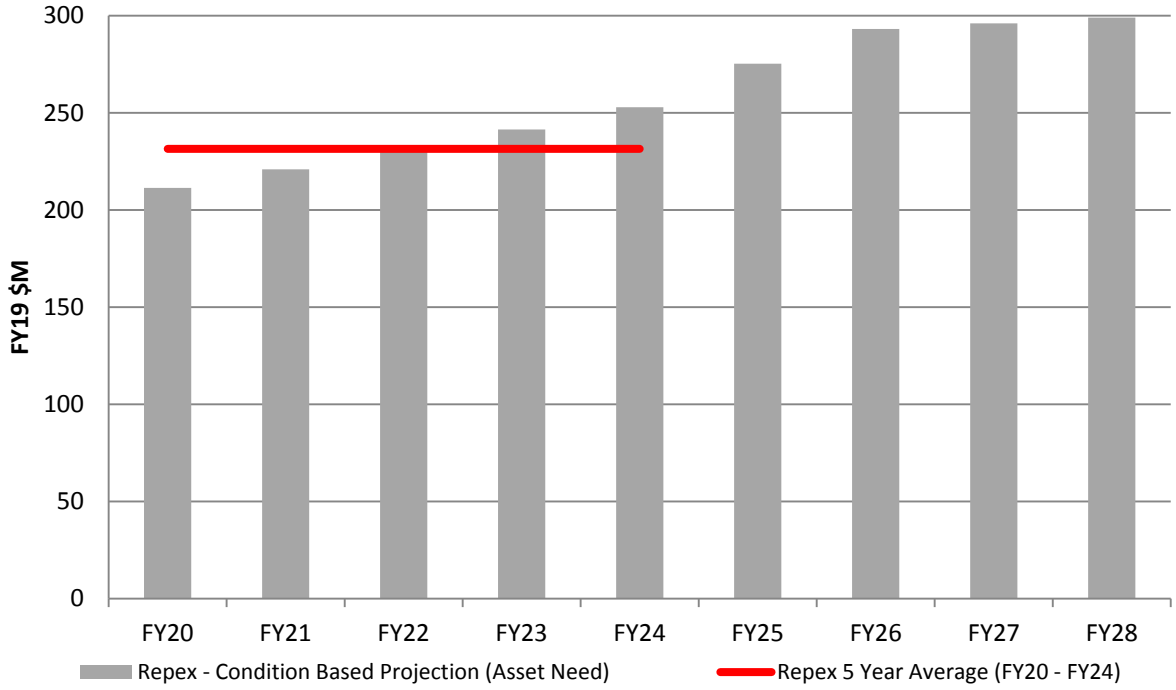
- Safety, environment and regulatory requirements;
- Condition of the asset;
- Suitability of the assets for their function;
- Present and forecast demand on the asset;
- Historical demand placed on the asset over its service life;
- Maintenance and service history;
- Knowledge of equipment type faults;
- The unique risk relating to those assets;
- Pre-defined criteria that form the basis of the asset health index and trigger a flag for asset refurbishment or replacement (for major equipment groups); and
- The age of the assets.

The "bottom-up" projection has been developed through the original asset need for the 2019 planning cycle.

3.5 SARP EXPENDITURE FORECASTS AND VDA PROJECTIONS

Figure 1 below shows the FY20 – FY28 SARP renewal expenditure estimates developed by a bottom-up aggregation of renewal projects and programs.

FIGURE 1 – SARP BOTTOM-UP PROJECTIONS



Note that the short-term SARP expenditure levels are based on an aggregation of individual "bottom-up" replacement needs whereas the medium to long term SARP expenditure projections are based on asset specific strategic replacement plans and estimates developed using VDA as a guide.

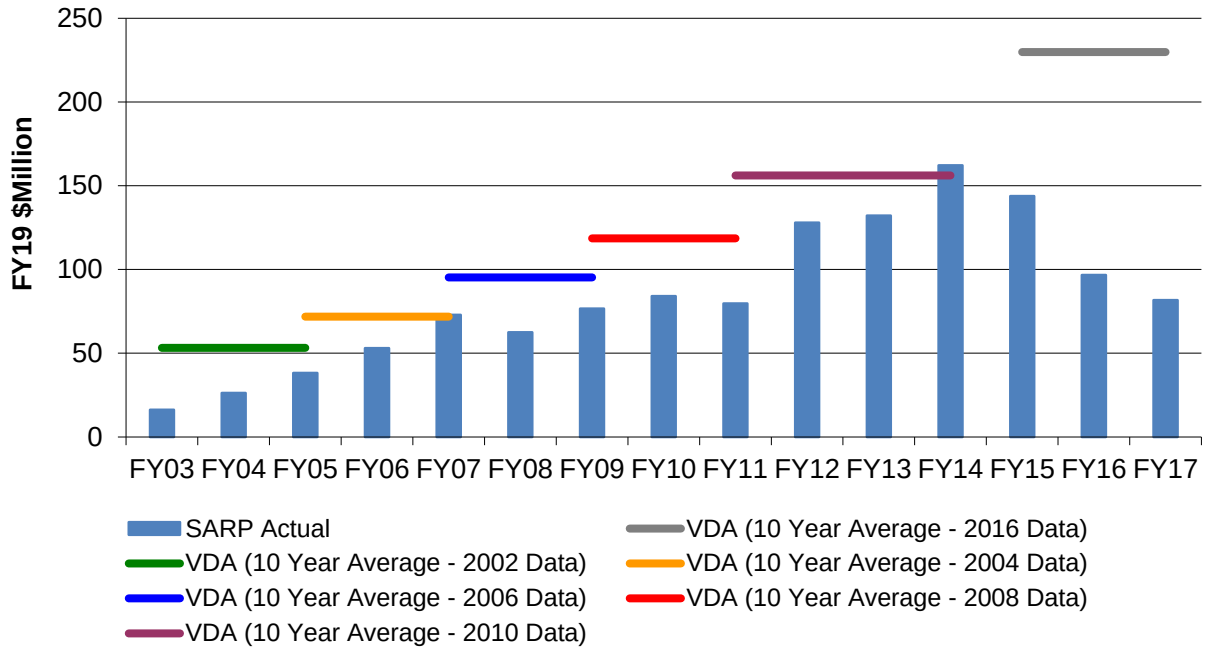
Figure 2 below compares the historical SARP expenditure compared to VDA projections for asset renewal. In the past, the actual SARP expenditure has been consistently lower than the recommended VDA expenditure levels. This is partly due to the availability of asset condition data currently (being addressed through improved asset management practices and IT systems refresh programs), and partly due to limitations in delivery capability.

As a consequence, there appears to be a two to three year lag between actual renewal investment and projected need. As shown in Figure 2, it is evident that the VDA projected investment requirement can be seen as a leading indicator of actual SARP expenditure.

Digression from the investment trend and the observed "VDA - Actuals" relationship is evident during the current FY15 - FY19 regulatory period. This is due to the temporary impacts of the lease transaction in the earlier years of this period and resulted in a deferral of a number of planned capital investments. This approach was undertaken in order to provide the new majority shareholder flexibility to review and undertake investments that aligned to their preferred asset management practices. Following the completion of the transaction project the investment increased over the remaining years of FY15 - FY19 regulatory period to the extent possible without incurring a penalty under the Capital Expenditure Sharing Scheme (CESS).

Experience over the last 20 years has shown that the impacts of this investment shortfall are likely to become evident in the medium term in terms of asset deterioration, network risk profile, and performance outcomes unless corrected. This will require a return to higher than recent average investment levels, similar to what occurred during the FY09 - FY14 period in order to address the accumulating volume of assets in need of replacement.

FIGURE 2 – HISTORICAL SARP EXPENDITURE VS VDA COMPARISON (FY19$M)



It should be noted that the average expenditure projected by the VDA shown in Figure 2 above is based on replacement occurring at 100% of standard asset life. Recent experience indicates that due to asset life extension and end-of-life management approaches, replacement is typically occurring at 110% of standard asset life, which is also consistent with the several year lag between projected need and actual investment noted above.

In response to these observations, the VDA is used to inform the "right size" of the projected investment requirements in asset renewal. This is achieved through using the projected trend in WARL as the mechanism to calibrate the VDA to actual investment levels and network outcomes, as noted above. This is discussed further below.

3.6 VDA MODELLING SCENARIOS

Several integrated modelling scenarios have been used to test the sustainability of future investment levels. The modelling reflects the empirical evidence of replacement typically occurring when assets are beyond their current standard lives for the asset class.

On this basis, and in order to determine an appropriate range of expenditure projections that reflect alternate risk positions and network outcomes, three scenarios have been modelled. These scenarios have been classified as 'Constant $WARL_N$', 'Condition Based' and 'Proposed 2018 Regulatory Capex', mainly as a means to readily identify them in the various model outcomes.

Note that there are two elements to the WARL. The WARL for the entire asset base including new assets projected to be added in the future is known as $WARL_N$. In practice, these new assets are added to the network through brownfield redevelopment, greenfield growth and network connection related augmentations and gifting. As they are at the other end of the risk spectrum to those assets requiring replacement, their inclusion in the models tends to obscure the network risk created by the ageing assets (represented by $WARL_E$).

Consequently, $WARL_N$ is seen to be representative of overall future network performance rather than as a network health indicator, per se.

The scenario descriptions and their respective interpretation are as follows:

- ***Constant $WARL_N$ scenario***:
  This is the "Status quo" risk position, reflected in achieving a Constant WARL profile into the future. The investment profile associated with this scenario maintains the future risk position at the same level as that which currently is observed, with the maintenance of current observable network outcomes across the short and long-term future. It is however based on replacement occurring in line with the currently observed practice of extending asset lives beyond standard lives.
- ***Condition based scenario:***
  This represents an investment profile that provides for a slow decline in network outcomes over the longer-term on the basis of current approaches to managing risk being maintained into the future, with little noticeable impact within the forthcoming regulatory period.
- ***Proposed 2018 regulatory capex scenario***:
  With a strong focus on minimising network investment in order to contain network prices, in line with customer expectations, this scenario sees a short-term decline in expected network outcomes. The risks introduced under this scenario are required to be managed and mitigated through greater sophistication in our asset management approaches and through the adoption of new network technologies where appropriate.

Each of these scenarios correlates to respective asset replacement expenditure profiles which have been developed in order to establish a range of expenditure projections for consideration as input into the forthcoming regulatory determination. The key modelling parameters of the scenarios are shown in Table 4 below, with asset replacement modelled as occurring at 110%, 115%, and 120% of standard lives for each respective scenario. It should be noted that there is also a corresponding change in the growth investment triggers for each scenario consistent with the overall risk position being established.

Further, these scenarios correlate to stages in the socialisation process for the development of the investment projections to be promulgated in Endeavour Energy's forthcoming regulatory revenue proposal. As such they have been referenced to key milestones in this process, viz:

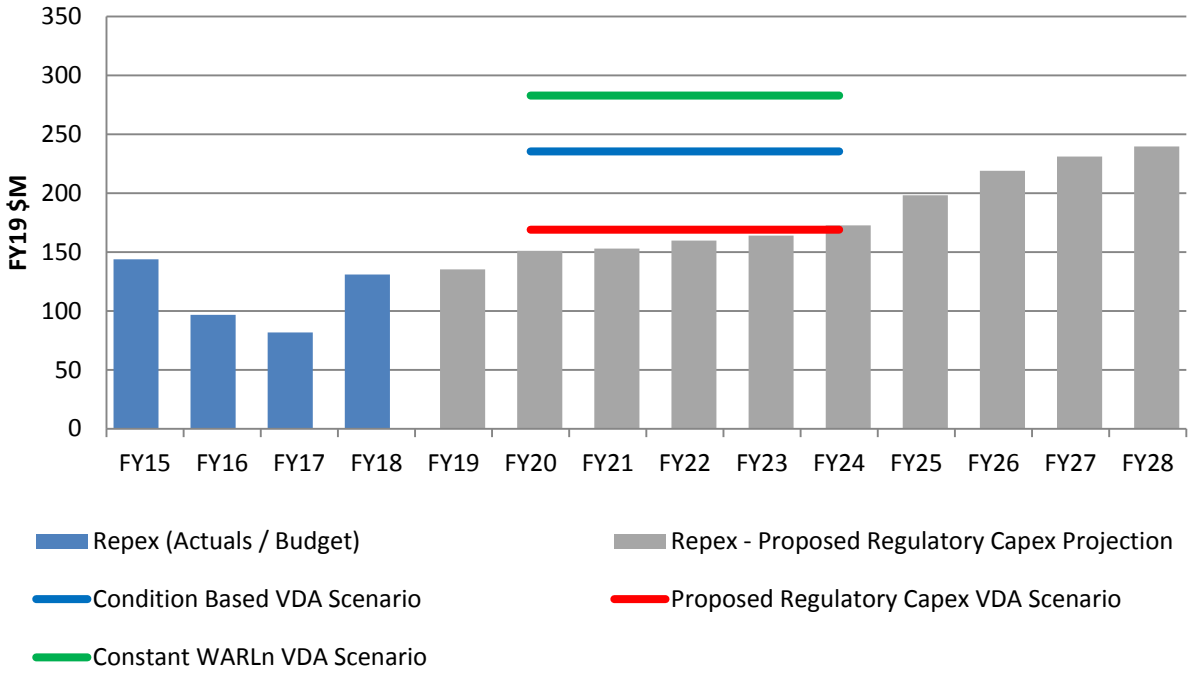
- Constant $WARL_N$ scenario – achieving a constant $WARL_N$ outcome, or the "Status quo" risk position, and corresponding to an asset replacement investment level of $1,410 million;
- Condition based scenario – corresponds to Board-considered condition based asset replacement expenditure investment of $1,143 million for the period FY20 - FY24. This scenario closely represents the bottom-up asset replacement forecasts for the forthcoming regulatory period; and
- Proposed 2018 regulatory capex scenario – with lower priority projects and programs removed or reduced to achieve a renewal expenditure of $800M in the next regulatory period.

TABLE 4 - ASSET REPLACEMENT MODELLING SCENARIOS KEY PARAMETERS

Scenario	Renewal asset life	Start of enhance replacements	Growth planning parameters	Annual average ($M)	5 year reg period total ($M)
Constant $WARL_N$	110%	Immediate	100%	282	1,410
Condition Based	115%	Immediate	110%	229	1,143
Proposed 2018 Regulatory Capex	120%	Immediate	115%	160	800

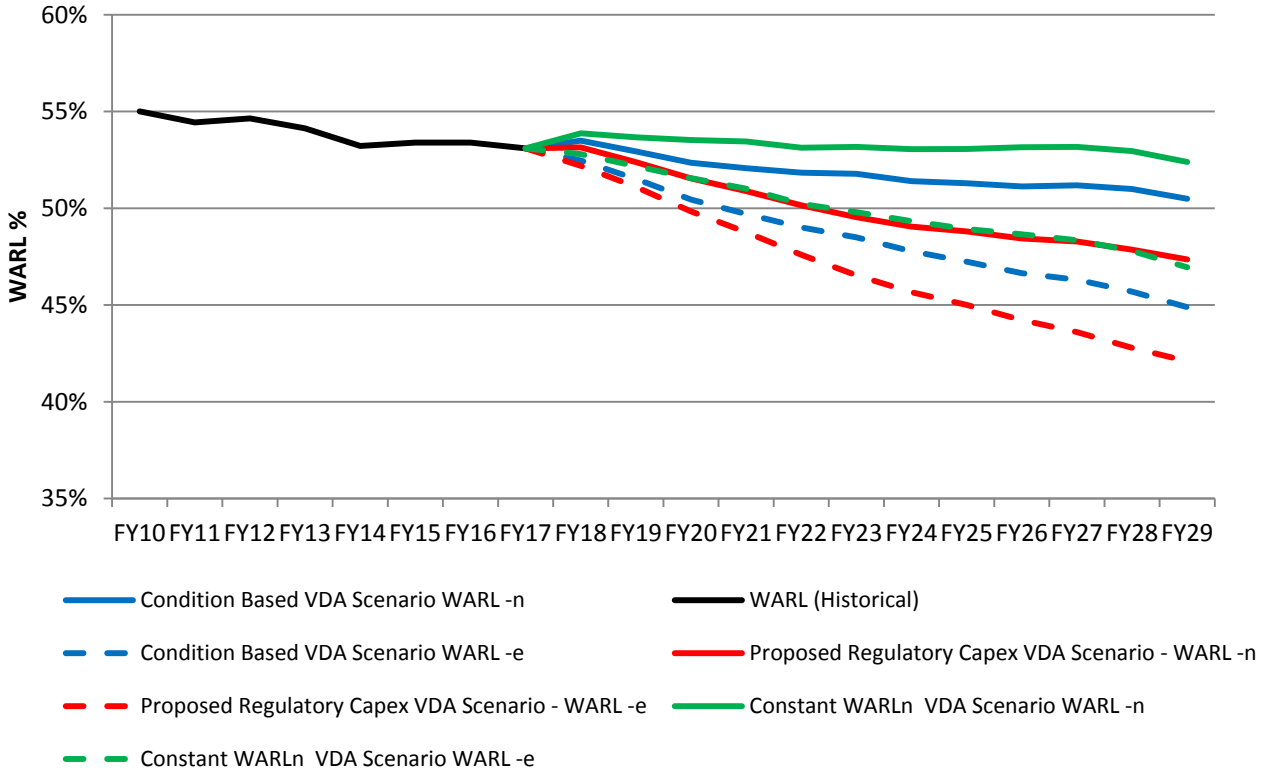
The modelling results under each scenario are given in Figures 3 and 4 below. In each of the figures the green (Constant $WARL_N$), blue (Condition Based) and red (Proposed 2018 Regulatory Capex) lines correspond to the relevant five year scenario projections produced by the VDA model.

FIGURE 3 – REPLACEMENT EXPENDITURE (FY19$M)



[MA1]

FIGURE 4 – NETWORK HEALTH (WEIGHTED AVERAGE REMAINING LIFE)



The weighted average remaining life projections for the existing asset base ($WARL_E$ - dotted lines) represents the network health or network risk profile, with a lower WARL meaning a higher network

risk whereas $WARL_N$ (solid line) is representative of overall future network performance rather than just network health.

3.7 EXPENDITURE PROJECTIONS USING THE AER REPEX MODEL

Endeavour Energy conducted a review into the application of the AER's repex model to assess our replacement expenditure forecast for the next regulatory period. This review compared the replacement expenditure proposed by Endeavour Energy against the Repex model projections under four different calibration scenarios as follows:

- Projection 1 – Based on Endeavour Energy's Value derived algorithm (VDA) which represents a constant WARL in the short to medium term but declines over the long term;
- Projection 2 – Based on Endeavour Energy's asset need;
- Projection 3 – Based on Endeavour Energy's historical calibrated asses lives (HCL); and
- Projection 4 – Based on the AERs industry benchmarked average asset lives (BMAL)

The HCL methodology had been applied by the AER in previous regulatory assessments. As part of the Endeavour Energy's consultative review with the AER, it is noted that the AER's is proposing a repex assessment based on the AER's industry benchmark asset lives (BMAL). The AER have provided the preliminary modelling forecast expenditure for the industry benchmark asset lives output for the FY20 – FY24 regulatory period. However, data quality issues and previous historical asset decisions throughout the industry across various distributors over a long period can adversely affect the outcome of the BMAL methodology.

The results of these modelling exercises are summarised in TABLE 5 below. Projections are provided based on asset categories for the FY20 - FY24 regulatory period, as well as totals. However, as is the case for the VDA model, asset category based comparisons within the short term of the next regulatory period are not strongly correlated to actual requirements. This is because the models are unable to capture and reflect the actual replacement requirements based on asset condition and risk. These discrepancies, however, even out at the high-level, either by comparing total expenditure projections in any regulatory period, or by viewing asset category comparison over longer time periods (ten years or more).

Also, it should be noted that the asset categories used in the AER models are those aligned to the RIN templates, whereas those used in the VDA are more granular and more closely aligned to actual asset class parent-child relationships and associated asset management activities. As a consequence, category based comparisons between Endeavour Energy's models and the AER's models may not always be well aligned due to different asset class allocations. Also, limitations in the AER's approach and the models themselves mean that the AER does not "assess" projections for some categories due to the ambiguity in the RIN data. Whilst modelled, these are noted as "AER unmodelled" in the table.

Notwithstanding this, the projections provided in TABLE 5 provide a useful frame within which Endeavour Energy's VDA model projections and actual "bottom-up" forecasts for asset replacement expenditure can be compared.

TABLE 5 - RENEWAL EXPENDITURE MODEL PROJECTIONS AND FORECASTS FY20 - FY24

Asset group	Actual Repex (FY13-FY17)	Forecast Repex (FY20 - FY24) - $ millions, real FY19				
		VDA model Constant $WARL_N$ (P1)	Asset need (P2)	**FY20 – FY24 proposal**	Repex model (P3 - HCL)	Repex model (P4 - BMAL)
Poles	*79*	*99*	*163*	***159***	*140*	*37*
Overhead conductors	*127*	*198*	*127*	***89***	*205*	*62*
Underground cables	*44*	*21*	*120*	***66***	*60*	*9*
Service lines	*60*	*75*	*77*	***47***	*84*	*16*
Transformers	*64*	*158*	*109*	***107***	*113*	*79*
Switchgear	*82*	*175*	*205*	***114***	*49*	*20*
Total AER Modelled	***456***	***726***	***801***	***582***	***651***	***223***
Total AER Unmodelled	***301***	***452***	**342**	***218***	***218***[1]	**218**[1]
Total	***757***	**1,178**	**1,143**	***800***	***869***	**441**

[1] *The unmodelled component has not currently been assessed as part of the AER review process. The FY20 FY24 Proposal unmodelled component has been applied*.

Notwithstanding the differences in modelling approaches, there is a sound correlation between the AER's Repex model using historical scenarios as adopted in previous determinations and Endeavour Energy's VDA model projections, especially at the total level and over the long-term.

However, the AER's future direction scenario using benchmark unit lives proposes levels of expenditure significantly below that proposed by Endeavour Energy. Accordingly, a total renewal expenditure of $1,160 million (approximately the VDA Condition Based and asset need based requirements) over the next regulatory period is considered to be the level of expenditure required to maintain the current network risk profile.

Notwithstanding this, a continuation of the current level of replacement expenditure investment is proposed for the forthcoming regulatory period. This strategy has been adopted in response to ongoing expectations from regulators and customers regarding the need to contain costs and network prices.

Further, the network is undergoing a period of transformation with regards to its role in the energy supply chain. The current network is based on the traditional bulk supply model, but its function is changing to be more of a means to move energy between a combination of bulk supply sources, distributed energy resources and customers, and to facilitate the uptake of small and large scale embedded generation. Consequently, Endeavour Energy has observed that the demand on some of its older assets is diminishing to the extent where the risks posed by deteriorating asset condition are not as significant as they might have otherwise been.

In this context, the Company has proposed a renewal expenditure total of $800 million over the forthcoming FY20 - FY24 regulatory period which is about 30% below the level modelled by both our "bottom-up" condition base asset plans and "top-down" predictive modelling. This expenditure is similar to that incurred during the FY09 - FY14 regulatory period.

3.8 PROJECT AND PROGRAM PRIORITISATION

Given the deferral of expenditure in the current period combined with the replacement expenditure allowance proposal being significantly lower than projected expenditure requirements as noted in Section 3.7 above, the exposure to escalating network risks associated with assets nearing the end of their lives will need to be identified and managed accordingly to maintain existing levels of network outcomes.

The Capital Allocation Selection Hierarchy (CASH) prioritisation process is used for prioritisation of projects and programs within the SARP (previously discussed in Section 2.4). The CASH ranking

methodology used during the initial years emphasised business plan fit, network and delivery risks and project/program benefits. Currently, the emphasis has been refocussed onto network risk in the prioritisation process in order to contain risk

The network risk topics considered in the planning cycle and prioritisation process include:

- Network asset condition;
- Public safety, environmental and regulatory impact;
- Network initiated fire;
- Network reliability;
- Community impact (reputation);
- WH&S for Endeavour Energy workers; and
- Network capacity.

The full scope of projects and programs proposed for inclusion into the FY20 - FY24 delivery period has been assessed though the CASH algorithm which has calculated individual project/program priority scores. The greater the individual score the higher is the project/program's priority.

Proposed works are then ordered according to their risk from the highest scored priority to the lowest. This provides the focus for a risk-based impact assessment when reviewing various levels of renewal expenditure.

Following this process, three key strategies have been applied to identify areas where expenditure reduction can be made across FY20 - FY24 without incurring an excessive increase in risk. These strategies include:

1. Improved productivity (efficiencies through work force planning);
2. Mitigation of risk through schemes such as demand management; and
3. More effectively addressing risk with improved targeted asset condition information.

Smart systems implemented recently are providing precise asset condition data which is allowing Endeavour Energy to more effectively target renewal expenditure and therefore more effectively manage network risks. In addition, improvements to Endeavour Energy's IT systems currently being implemented are expected to support more efficient asset management processes and practises in the Company.

Further efficiencies are expected to be gained through the newly established delivery alliance partnership and major projects unit.

In addition, there has also been an extension of the weighted average asset base life of greater than 10% when compared to the Company's Repex submission for FY15, as shown in Table 6 below.

TABLE 6 - ASSET BASE LIFE VARIATION FY15 VERSUS FY20

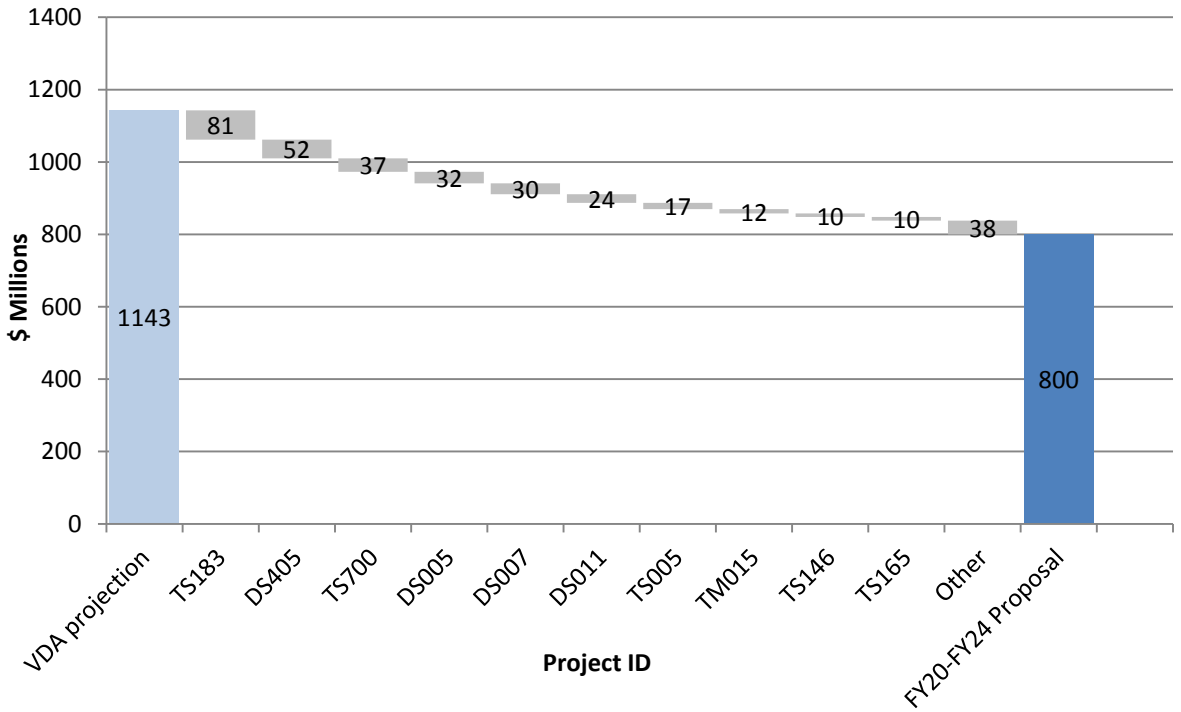
Asset category	Revised regulatory proposal FY15 (Years)	REPEX proposal FY20 (Years)	Variance (%)
Transformers	58	57	-3
Underground cables	63	71	+13
Poles	64	67	+4
Service lines	53	63	+20
Overhead conductors	59	62	+5
Switchgear	50	51	+1
Repex – unmodelled	52	59	+13
Total (weighted average)			+11

These three strategies support the adoption of the revised Repex proposal of $800 million in the FY20 - FY24 period and will allow the risk inherent in this proposal to be effectively managed.

An example of where these strategies have been applied include Carlingford Sub-transmission Substation and the associated Dundas Zone Substation where the assessment of risk and cost confirmed that piecemeal like-for-like refurbishment of the two substations provided an approach with a lower overall cost to the community than wholesale redevelopment and therefore represented the most appropriate solution. The increase in risk due to this approach is not significant. This approach has also been extended to other ageing assets in the network where appropriate.

Other significant program reductions are shown in Figure 5 below. The Renewal Project ID descriptions can be found in Table 7.

FIGURE 5 – FY20 - FY24 RENEWAL PROGRAM REDUCTIONS



Further examples of project reductions and risk impacts are provided in Table 7 below.

TABLE 7 - TOP 10 RENEWAL PROGRAM REDUCTIONS FROM CONDITION BASED

Project ID	Description	Reduction ($ million)	Impact
TS183	Carlingford transmission substation redevelopment	81	Assessment of risk and cost confirmed that piecemeal like-for-like refurbishment provided a lower cost to the community than wholesale redevelopment and therefore represented the most appropriate solution. The increase in risk due to this approach is not significant. The revised solution includes a separate project TS167 to replace the Carlingford TS control building and protection and control equipment.
DS405	Air break switch replacement	52	Revision of the standard resulted in a reduction in the number of switches required on the network. Over time this revised strategy is expected to result in the removal of 20-30% of the total number of switches currently in operation which otherwise would require replacement. In addition, a revision of the works program to replace existing switches at the end of their life with predominantly a manual air-break switch or a manual load-break switch rather than a SCADA operated switch will also result in reduced investment.
TS700	11kV zone substation switchboard replacement	37	Assessment of risk and cost confirmed that for most zone substations, replacement of the oil circuit breaker trucks with vacuum trucks allows the life of the switchboards to be extended while reducing the safety risks presented by the existing oil switchgear at a lower cost than wholesale replacement of the switchboard.
DS005	Distribution pole replacement	32	The preliminary results of an ongoing audit of the oldest reinstated poles in the network indicate that the effective life of reinstatement nails is generally in excess of the 15 years previously estimated. On this basis nailed poles are to be replaced on a planned-reactive basis when demanded by their condition rather than on pro-active age basis.
DS007	Service wire replacement program	30	The revised strategy includes reactive capital replacements being absorbed into the planned annual replacement quantity rather than in addition to annual quantity replaced. In addition, further cost efficiencies are being realised with the implementation of the new alliance partner delivery model.
DS011	HV distribution steel mains replacement	24	The risk assessment of steel mains has been enhanced by the revision of supporting standards, replacement cost modelling and high definition aerial images of the pole tops now provided with the most recent aerial surveys. These learning's have been applied to the remaining steel mains and small ACSR conductors and have allowed for more precise targeting of at-risk assets for renewal and deferral of other scope.
TS005	33kV circuit breaker replacement	17	The reduction was achieved by reverting from a strategic replacement program of aged and worn 33kV bulk-oil CBs to a program of life extension by replacement of component parts such as bushings, contacts and contactors. There is a modest increase in risk of circuit breaker bushing failure or failure to clear faults as a result. However, impact on reliability and safety are expected to be minimal.
TM015	Subtransmission tower replacement	12	There is some leeway in the timing of the replacement of steel towers and works undertaken to extend their life which allowed the replacement program to be deferred.
TS146	Marayong zone substation renewal	10	This project commenced in FY18 and its construction has been accelerated with the expectation that work will be largely complete in FY19 with a reduced expenditure in the next regulatory control period with no change to the risk profile.
TS165	Greystanes zone substation renewal	10	This project has been deferred substantially until the beyond FY24. There is also a high probability that a lower cost like-for-like replacement strategy will be followed rather than wholesale redevelopment. Therefore the increase in risk is likely to be minimal.
Total		305	

In summary, the asset management requirements based on our current understanding of asset risk and network outcomes requires that a prioritised renewal program be developed totalling $1,143 million over the next regulatory period. Notwithstanding this, Endeavour Energy's renewal priorities will be adjusted and programs implemented to spend up to a total of $800 million whilst still achieving the desired network outcomes in that period.

The programs detailed in the SARP have been revised and reprioritised from the original condition based asset need and included in the FY20 - FY24 renewal proposal.

04

DEVELOPMENT OF THE STRATEGIC ASSET RENEWAL PLAN

The Strategic Asset Renewal Plan is developed on an annual cycle and includes the following key stages:

- The identification of specific short-term (1 - 2 year) renewal needs through asset condition and performance analysis (the 'bottom-up' approach);
- Formulation of a long-term position on renewal needs using asset renewal expenditure modelling (the 'top-down' approach);
- The collation and integration of short-term and long-term needs into the SARP;
- The prioritisation of renewal expenditure; and
- The integration with and prioritisation against, other expenditure in the Strategic Asset Management Plan (SAMP).

In order to comply with the Company's requirements for budgeting, the "bottom-up" based projections (for a 10 year period) are developed between June and September each year, with the first year of the ensuing program forming the asset renewal budget for the following financial year. This budget is submitted for approval in the following November/December period for implementation with other programs commencing the following financial year.

In the period prior to the development of the "bottom-up" projections, high-level projections are developed. These are disseminated to inform the stakeholders in the Company of emerging trends and long-term proposals for asset re-investment, against a backdrop of strategic corporate intent. Long-term, high-level assessments of expenditure requirements in particular, are intended to quantify the effects of previous deferrals of expenditure and the need to arrest long-term consumption of the asset base.

4.1 SARP DEVELOPMENT PROCESS

The renewal program development process is coordinated and sponsored by the Asset Strategy and Planning Branch. The principal inputs are provided by:

- Asset Standards and Design Branch (substations, mains, earthing, distribution; protection, communications and SCADA);
- Major Contracts Branch (substation civil works, access tracks);
- Portfolio Management and Governance Branch (portfolio management); and
- Network Investment Planning Section (asset renewal strategy and sub-transmission substation, mains and distribution programs and projects).

The above branches and sections work together with the regions to identify asset renewal needs. In addition, the Asset Strategy and Planning Branch develops top-down high-level renewal expenditure projections based on asset age profiles and expected lives, combined with condition and risk-based modelling. Further, the Asset Strategy and Planning Branch develops specific

major asset renewal projects and programs based on applicable policies and standards, stakeholder inputs and network load forecasts and plans.

Once the SARP is completed each year it becomes a subset of the Strategic Asset Management Plan (SAMP), identifying the renewal capital expenditure proposed for the network for the forthcoming ten-year period.

4.1.1 INCLUSIONS

The renewal needs of the following network asset categories are included in this plan:

- Sub-transmission substations, zone substations and switching stations;
- Sub-transmission civil works;
- Sub-transmission mains;
- The distribution system;
- SCADA & communication systems;
- Protection systems; and
- Access tracks.

The asset renewal expenditure which is driven by safety issues and environmental and regulatory requirements is also collected under the broad category of renewal expenditure and is therefore included in the SARP. The inclusion of the expenditure initiated by these drivers simplifies the capital budget submission process for asset related expenditure.

4.1.2 EXCLUSIONS

The renewal needs of the following assets are not covered in the SARP, but are included directly into the SAMP:

- Metering; and
- Street lighting.

4.2 FY19 – FY28 REPEX SUMMARY

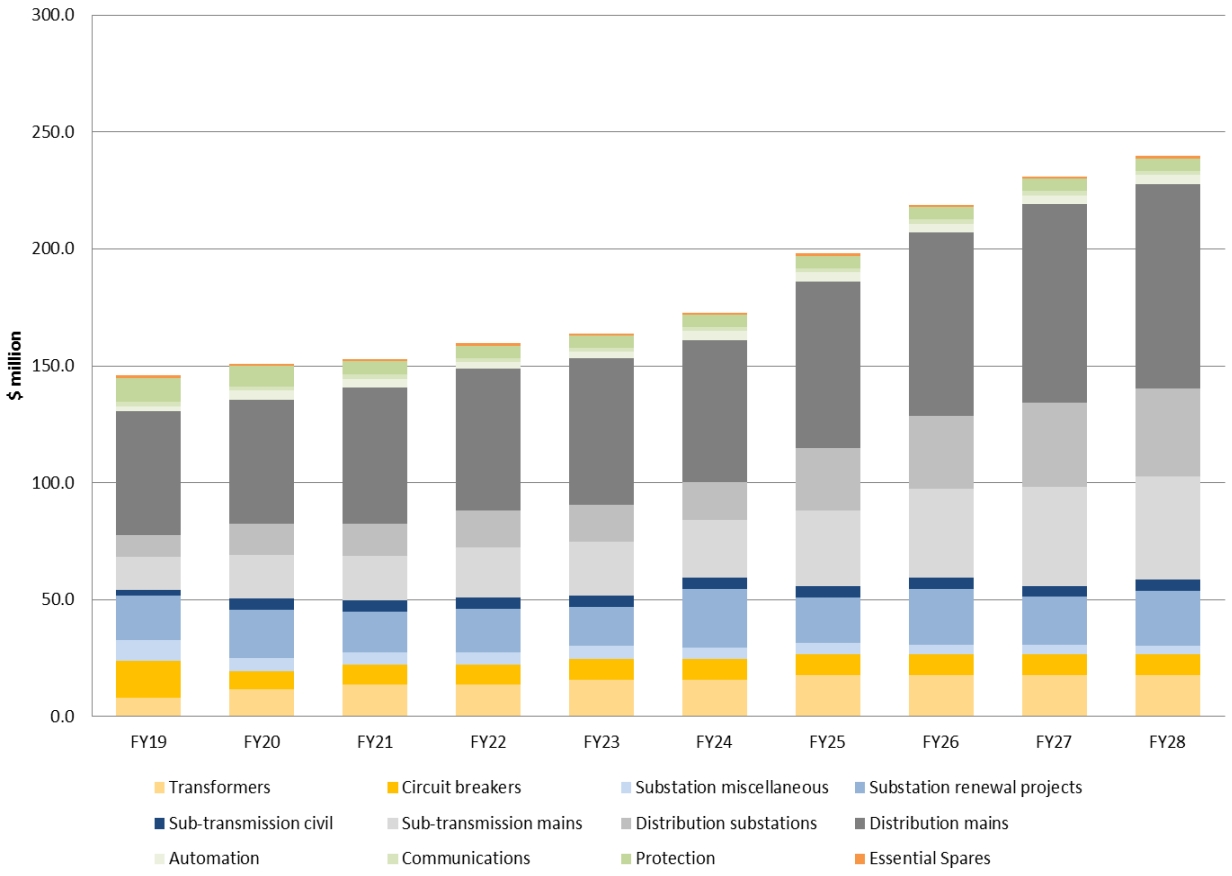
A summary of the FY19 – FY28 REPEX is shown in Table 8 and Figure 6 below. The table has been divided into logical asset groupings for ease of reference. The total needs-based asset renewal expenditure proposed for the 10 year period is $1,834.4 million in real FY19 terms.

Note that short-term expenditure estimates are based on "bottom-up" replacement needs whereas the medium to long-term expenditure projections are based on asset specific strategic replacement plans and estimates developed using the VDA model output as a guide.

TABLE 8 – FY19 – FY28 REPEX SUMMARY ($M, $FY19)

Category	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	Total
Transformers	8.1	11.6	13.6	13.6	15.6	15.6	17.6	17.6	17.6	17.6	**148.5**
Circuit breakers	15.8	7.7	8.7	8.7	9.0	9.0	9.0	9.0	9.0	9.0	**94.7**
Substation miscellaneous	8.7	5.6	5.1	5.2	5.8	5.1	4.9	4.1	4.1	3.7	**52.4**
Substation renewal projects	19.0	20.9	17.3	18.5	16.5	25.0	19.5	24.0	20.5	23.5	**204.5**
Sub-transmission civil	2.7	4.9	4.9	4.9	4.7	4.7	4.7	4.7	4.7	4.7	**45.8**
Sub-transmission mains	13.9	18.3	19.2	21.5	23.1	24.8	32.6	38.0	42.5	44.3	**278.2**
Distribution substations	9.3	13.3	13.7	15.6	16.0	16.2	26.5	31.0	35.7	37.5	**214.9**
Distribution mains	53.1	53.4	58.2	61.0	62.6	60.7	71.5	78.5	85.0	87.4	**671.4**
Automation	2.0	3.8	3.8	2.8	2.8	3.8	3.8	3.8	3.8	3.8	**34.6**
Communications	2.2	1.6	1.6	1.6	1.6	1.6	1.8	1.8	1.8	1.8	**17.8**
Protection	9.9	8.9	5.8	5.2	5.2	5.2	5.2	5.2	5.2	5.2	**61.4**
Essential spares	1.2	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	**10.2**
Total	**146.0**	**151.0**	**153.0**	**159.7**	**164.0**	**172.7**	**198.1**	**218.9**	**231.1**	**239.7**	**1834.4**

FIGURE 6 - REPEX EXPENDITURE LEVELS ($FY19)

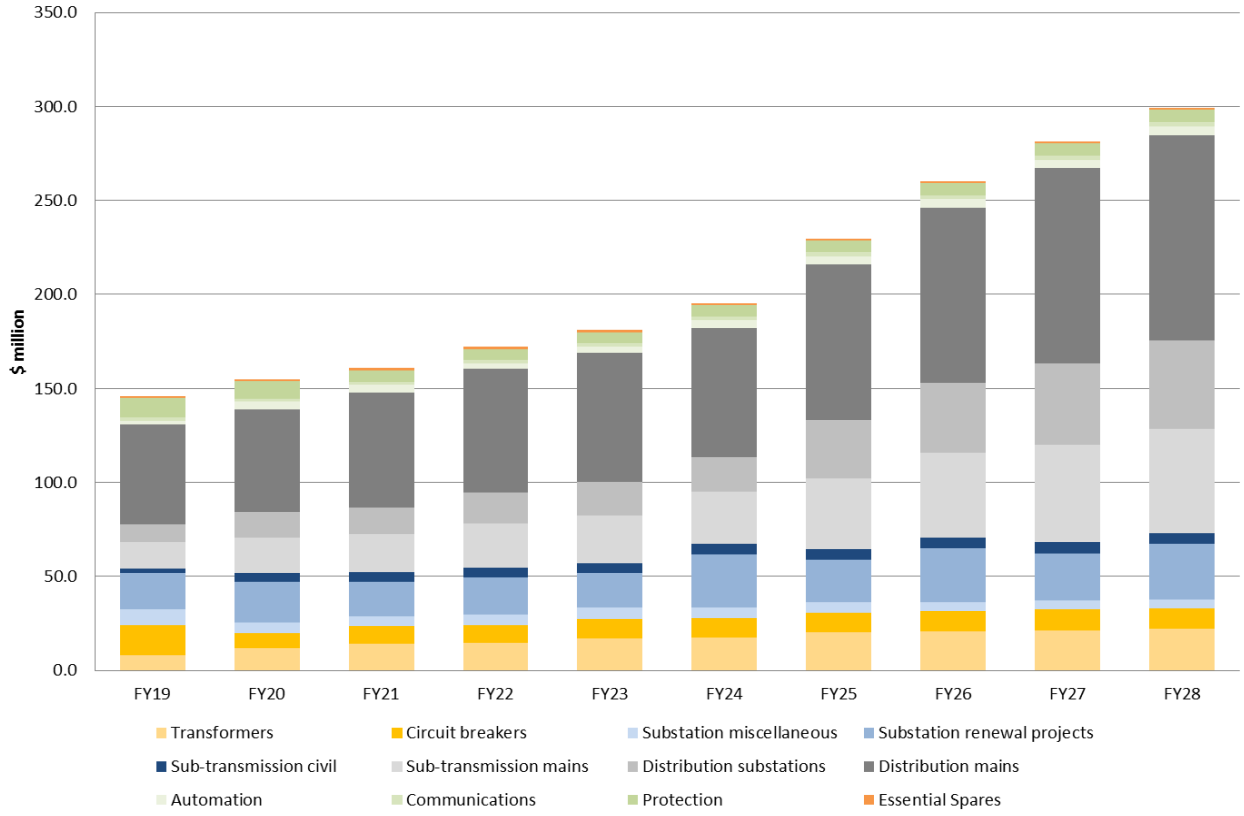


The above information is shown in nominal terms in Table 9 and Figure 7 below.

TABLE 9 - FY19 – FY28 REPEX SUMMARY ($M, $NOMINAL)

Category	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	Total
Transformers	8.1	11.9	14.3	14.6	17.2	17.6	20.4	20.9	21.4	22.0	**168.6**
Circuit breakers	15.8	7.9	9.1	9.4	9.9	10.2	10.4	10.7	10.9	11.2	**105.5**
Substation miscellaneous	8.7	5.8	5.4	5.6	6.4	5.8	5.6	4.9	5.0	4.6	**57.8**
Substation renewal projects	19.0	21.4	18.1	19.9	18.2	28.3	22.6	28.5	25.0	29.3	**230.3**
Sub-transmission civil	2.7	5.0	5.1	5.3	5.2	5.4	5.5	5.6	5.8	5.9	**51.5**
Sub-transmission mains	13.9	18.7	20.2	23.1	25.5	28.0	37.8	45.2	51.8	55.3	**319.6**
Distribution substations	9.3	13.7	14.4	16.8	17.6	18.3	30.7	36.9	43.5	46.9	**248.1**
Distribution mains	53.1	54.7	61.2	65.7	69.1	68.6	82.9	93.4	103.6	109.2	**761.4**
Automation	2.0	3.9	4.0	3.1	3.1	4.3	4.5	4.6	4.7	4.8	**39.0**
Communications	2.2	1.7	1.7	1.8	1.8	1.9	2.1	2.2	2.2	2.3	**19.9**
Protection	9.9	9.1	6.1	5.7	5.8	5.9	6.1	6.2	6.4	6.6	**67.8**
Essential spares	1.2	1.0	1.1	1.1	1.1	1.1	1.2	1.2	1.2	1.2	**11.4**
Total	**146.0**	**154.8**	**160.8**	**172.0**	**181.0**	**195.4**	**229.8**	**260.3**	**281.6**	**299.4**	**2081.0**

FIGURE 7 - REPEX EXPENDITURE LEVELS ($NOMINAL)



4.3 TEN-YEAR STRATEGIC ASSET RENEWAL PLAN

The FY19 – FY28 REPEX is shown in Table 10. It outlines the proposed expenditure for each REPEX program and project as identified to date, for the next 10 years. Expenditure is shown in real FY19 terms.

TABLE 10 - FY19 – FY28 REPEX PROPOSAL ($M, $FY19)

Project/program		FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	Total
Transformer renewals												
TS017	Power transformer refurbishment	0.600	0.600	0.600	0.600	0.600	0.600	0.600	0.600	0.600	0.600	6.000
TS026	Noise attenuation in ZS and TS	0.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	9.000
TS600	Power transformer replacement	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	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.007
TS616	Camellia Transmission Substation transformer replacement and 33kV busbar rearrangement	2.609	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.609
TS617	Prospect Zone Substation transformer replacement	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 Zone Substation transformer replacement	2.458	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.458
Subtotal		**8.123**	**11.600**	**13.600**	**13.600**	**15.600**	**15.600**	**17.600**	**17.600**	**17.600**	**17.600**	**148.523**
Circuit breakers renewal programs												
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	0.000	0.000	0.350	0.350	0.000	0.000	0.000	0.000	0.000	0.000	0.700
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
TS173	11kV switchboard truck replacement program	2.894	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.894
TS700	11kV zone substation switchboard replacement	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	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	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	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	1.740	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.740
Subtotal		**15.805**	**7.722**	**8.697**	**8.697**	**8.972**	**8.972**	**8.972**	**8.972**	**8.972**	**8.972**	**94.749**
Substations miscellaneous renewal programs												
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	0.000	0.000	0.000	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
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

Project/program		FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	Total
TS049	Tunnelboard refurbishment	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	0.000	0.000	0.000	0.000	0.600	0.000	0.000	0.000	0.000	0.000	0.600
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
TS128	Capacitor bank replacement	1.270	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.270
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	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.888
Subtotal		**8.749**	**5.620**	**5.120**	**5.180**	**5.780**	**5.114**	**4.864**	**4.114**	**4.114**	**3.714**	**52.364**
Substation asset renewal projects												
TS122	Leabons Lane Zone Substation renewal	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	0.163	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.163
TS146	Marayong Zone Substation renewal	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	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	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	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	0.000	4.500	4.500	4.500	0.000	0.000	0.000	0.000	0.000	0.000	13.500
TS174	West Wollongong Zone Substation 11kV renewal	0.000	0.000	3.000	4.000	5.500	0.000	0.000	0.000	0.000	0.000	12.500
TS184	Blaxland Zone Substation Reinstatement	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	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 transformer trailer refurbishment	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	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	0.000	4.000	6.000	6.000	6.000	12.000	12.500	17.000	20.500	23.500	107.500
Subtotal		**18.953**	**20.861**	**17.271**	**18.500**	**16.500**	**24.970**	**19.470**	**24.000**	**20.500**	**23.500**	**204.525**
Transmission civil												
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

Project/program		FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	Total
TS027	Substation switchyard lighting improvement	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	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	0.000	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	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
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
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
Subtotal		**2.718**	**4.886**	**4.886**	**4.886**	**4.736**	**4.736**	**4.736**	**4.736**	**4.736**	**4.736**	**45.792**
Transmission mains												
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	0.000	0.000	0.000	0.000	0.000	0.720	0.765	1.530	1.485	1.485	5.985
TM015	Subtransmission tower replacement	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	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.013
TM030	Feeder 7028 replacement	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	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	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	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	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	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	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	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	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	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 feeder oil testing and flushing	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	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	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	0.000	0.000	0.000	0.000	0.000	0.000	0.800	0.800	0.800	0.800	3.200

Project/program		FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	Total
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 on Blue Mountains	0.178	0.280	0.280	0.280	0.280	0.020	0.020	0.020	0.020	0.020	1.398
TM809	Steel tower earthing refurbishment works	0.000	0.000	0.600	0.600	0.600	0.600	0.600	0.600	0.600	0.600	4.800
Subtotal		**13.860**	**18.265**	**19.237**	**21.495**	**23.095**	**24.755**	**32.600**	**38.027**	**42.520**	**44.320**	**278.174**
Distribution substation renewal programs												
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**
DS301	Ground substation refurbishment program	**0.510**	**0.510**	**0.510**	**0.850**	**0.**	**1.020**	**1.275**	**1.275**	**1.275**	**1.275**	**9.350**
DS302	Distribution transformer replacement programs	**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**
DS308	HV oil and RGB12 switchgear replacement	**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	**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**
DS316	HV oil switchgear replacement program	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**9.200**	**13.700**	**18.400**	**20.200**	**61.500**
DS317	Future distribution substation renewals	**0.676**	**0.270**	**0.270**	**0.270**	**0.270**	**0.270**	**0.270**	**0.270**	**0.270**	**0.270**	**3.106**
DS318	Distribution earthing refurbishment	**0.735**	**0.735**	**0.735**	**0.735**	**0.788**	**0.840**	**0.893**	**0.945**	**0.945**	**0.945**	**8.295**
Subtotal		**9.337**	**13.343**	**13.693**	**15.608**	**15.953**	**16.176**	**26.476**	**31.028**	**35.728**	**37.528**	**214.869**
Distribution mains renewal programs												
DS005	Pole replacement capital	**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	**0.000**	**0.650**	**1.950**	**2.340**	**2.340**	**1.300**	**1.300**	**1.300**	**1.300**	**1.300**	**13.780**
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**

Project/program		FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	Total
DS416	Asbestos service fuse replacement program	**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	**0.500**	**0.440**	**1.408**	**1.892**	**1.892**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**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	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**9.200**	**13.700**	**18.400**	**20.200**	**61.500**
Subtotal		**53.075**	**53.366**	**58.223**	**61.027**	**62.597**	**60.675**	**71.495**	**78.535**	**85.005**	**87.405**	**671.403**
SCADA												
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
Subtotal		**2.044**	**3.840**	**3.840**	**2.840**	**2.840**	**3.840**	**3.840**	**3.840**	**3.840**	**3.840**	**34.604**
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
Subtotal		**2.170**	**1.646**	**1.646**	**1.646**	**1.646**	**1.646**	**1.846**	**1.846**	**1.846**	**1.846**	**17.784**
Protection												
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
PS010	Protection refurbishment (interfacing feeders)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
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 protection modernisation	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	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	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.600
Subtotal		**9.941**	**8.898**	**5.798**	**5.248**	**5.248**	**5.248**	**5.248**	**5.248**	**5.248**	**5.248**	**61.373**
Essential Spares												
SP	Essential spares	1.239	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.239
Subtotal		**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**

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GLOSSARY

Term	Description
$M	AU Dollars Million
AER	Australian Energy Regulator
ALARP	As Low As Reasonably Practicable
augex	Augmentation expenditure
BMUC	Bench Mark Unit Costs
CESS	Capital Expenditure Sharing Scheme
capex	Capital Expenditure
CASH	The Capital Allocation Selection Hierarchy
CT	Current Transformer
FUC	Future Unit Costs
FY	Financial Year
HUC	Historical Unit Costs
HV	High Voltage
ID	Identification
IT	Information technology
KPMG	Klynveld Peat Marwick Goerdeler
kV	Kilovolt
LV	Low Voltage
OH	Overhead
repex	Renewal Expenditure
RIN	Regulatory Information Notice
RIT D	Regulatory Investment Test Distribution
SAIDI	System Average Interruption Duration Index
SAMP	Strategic Asset Management Plan
SARP	Strategic Asset Renewal Plan
SCADA	Supervisory Control And Data Acquisition
TS	Sub-Transmission Substation
UG	Underground
VDA	Value Development Algorithm
VT	Voltage Transformer
WARL	Weighted Average Remaining Life
WH&S	Work Health and Safety
ZS	Zone Substation

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