UNITED ENERGY

April 2015

Replacement Capital Expenditure

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Approval and Document Control

VERSION	DATE	AUTHOR
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Glossary

Abbreviations	
ABC	Aerial Bundled Cable
ACR	Automatic Circuit Re-Closer
The Act	Electricity Safety Act 1998
ALARP	As Low As Reasonably Practicable
AMI	Advanced Metering Infrastructure
AOC	Actual Outturn Costs
CAIDI	Customer Average Interruption Duration Index
CBRM	Condition Based Risk Management
CCTV	Closed Circuit Television
CESS	Capital Expenditure Sharing Scheme
Code	Victorian Electricity Distribution Code
DFADCAA	Distribution Fault Application Data Collection and Analytics
DPRP	Doncaster Pillar Replacement Program
DRMCC	Dynamic Rating Monitoring and Control Communications
EPA	Environment Protection Authority
ES&L	Environmental, Safety & Legal
ESMS	Electricity Safety Management Scheme
ESV	Energy Safe Victoria
HVABC	High Voltage Aerial Bundled Cable
IT	Information Technology
LCS	Asset Class Life Cycle Strategy
LiDAR	Light Detection And Ranging
LVABC	Low Voltage Aerial Bundled Cable
MAIFIe	Momentary Average Interruption Frequency Index
OMSA	Operational and Management Services Agreement
OT	Operational Technology
RCGS	Remote Control Gas Switch
REFCL	Rapid Earth Fault Current Limiter
RQM	Reliability and Quality Maintained
SAIDI	System Average Interruption Duration Index

Abbreviations	
SAIFI	System Average Interruption Frequency Index
STPIS	Service Target Performance Incentive Scheme
SWER	Single Wire Earth Return
TOC	Target Outturn Costs
VCR	Value of Customer Reliability
ZS	Zone Substation

1. Overview and background

1.1. Key Messages

The purpose of this document is to describe and explain our forecast Replacement capex for the forthcoming regulatory period. The other categories of capital expenditure (namely, Augmentation, IT and Communications, Connections and Non-network General) are explained in separate overview documents. Together, these 'sub-category' overview documents and the supporting papers that underpin them, demonstrate that our total capital expenditure forecast complies with the Rules requirements and should be approved by the AER.

The key drivers for Replacement capex are:

- to maintain network performance; and
- to satisfy our safety, environmental and compliance obligations.

Customers have said that they want us to maintain reliability performance, consistent with our regulatory obligations. In contrast to this goal, however, our reliability performance is following a deteriorating trend. This trend is driven by the growing percentage of our assets that are '85% life-expired'. As assets enter this age group, the risk of failure increases significantly, as explained in the Appendix to this document. Our analysis shows that the percentage of assets that are '85% life-expired' will continue to increase in the forthcoming regulatory period. This necessitates focused action on our part to arrest the deteriorating trend in reliability, so that network performance can be maintained.

We have adopted a prudent, holistic approach to bridging the performance gap in our network reliability, which is detailed in our Network Performance Strategy document (UE PL 2300). Our objective is to strategically combine Replacement, Augmentation and ICT capex to deliver our SAIDI targets at lowest cost. We therefore look beyond Replacement capex and the current regulatory control period to identify the lowest cost solutions by:

- Replacing assets at end of life with the objective of minimising total life cycle costs;
- Deferring capex through targeted refurbishment, condition monitoring and risk management initiatives;
- Improving reliability outcomes for those customers in our worst served areas; and
- Pursuing alternatives to traditional investment in network capacity to meet growth in peak demand where it is economic to do so.

While this document is focused specifically on Replacement capex, it must be viewed and assessed in this broader context. Within the Replacement capex category, our prudent holistic approach is also highly relevant. The approach recognises that the required improvement in SAIDI performance cannot be achieved efficiently by focusing solely on the traditional asset-specific replacement programs, driven by asset condition and performance. Instead, our plans must address the underlying drivers of deteriorating reliability performance by:

- Replacing assets near end of life, thereby managing the increased risk and incidence of equipment failure;
- Improving network performance through targeted programs to:
  - address existing poor performance (through our rogue feeder program);
  - reduce outages or outage risk (by installing fuse saver equipment, preventing conductor clashing, and installing animal proofing); and
  - facilitate more rapid supply restoration (through installation of new automatic circuit re-closers and remote control gas switches);
- Investing in Operational Technology, which will enable us to anticipate asset failures and respond to major outage events more effectively.

Collectively, these non-asset specific programs of expenditure provide smarter, lower cost ways of delivering the required SAIDI performance. Without this targeted expenditure, Replacement capex focused purely on asset groups would need to be substantially higher in order to achieve the same SAIDI outcome.

In addition to delivering our reliability targets, a significant amount of Replacement capex is driven by compliance obligations, in relation to safety and environmental protection. In relation to safety, our Replacement capex includes the following programs:

- SWER replacement, which minimises bushfire risk, and which is undertaken in accordance with the recommendations of the Victorian Bushfires Royal Commission;
- Replacement of Doncaster Pillars in order to safeguard the public from the risk of electrocution;
- Installation of REFCLs at zone substations, which will reduce the risk of fire starts;
- Installation of video surveillance (CCTV) at critical zone substations to address heightened security risks and to enable remote monitoring for safety purposes.

We also expect Replacement capex to increase in response to technology improvements. In particular, our Replacement capex proposal includes allowances for various Operational Technology projects that deliver safety improvements as part of their core benefits. These include:

- Securing the Operational Technology Network against cyber security risks.
- Enhancing In-Meter Capabilities of AMI meters to enable testing services for neutral integrity, detection of fuse blown causing brown outs, detection of fuse candling, and meter overload detection.
- Increasing the AMI network communication bandwidth to facilitate the In-Meter (AMI) Capabilities project.
- A program to install disturbance recording at zone substations to capture information about network faults.
- Development of other new technologies through pilot projects that involve installation of solid state circuit breakers (which will greatly reduce fire risk) and development of new condition monitoring technologies.
- Development of smart analytics on AMI meter data to detect neutral integrity issues as they occur. This will avoid site visits other than those where detected issues need investigation and rectification.
- Smart detection of other safety hazards such as “live wire down”.

A significant proportion of our Replacement capex is driven by non-asset specific programs and safety programs. This has implications for the coverage of the AER’s Repex model, which is one of a number of validation tools employed by the AER to test the efficiency of our forecast capex.

We engaged Nuttall Consulting to apply the AER’s Repex model to our asset data to produce alternative estimates of our Replacement capex requirements, applying various modelling scenarios. As shown in the table below, the AER’s model could only be applied to approximately 64% ($366 million) of our total unescalated Replacement Capex.

Table 1-1: Forecast replacement capex 2016 – 2020 ($M, Real 2015)

	2016	2017	2018	2019	2020	Total
Replacement - Modelled and within scope of repex model	66.7	76.7	78.8	76.8	66.9	**366.0**
Replacement - Modelled (PL, SCADA & ZSS other) outside scope of repex model	9.3	8.6	6.9	5.6	6.6	**37.0**
Replacement – Un-modelled	9.6	11.9	13.4	10.5	8.1	**53.5**
Replacement - Other	32.0	24.9	20.6	17.4	17.4	**112.3**
Replacement -Total (pre-escalation)	**117.6**	**122.2**	**119.7**	**110.3**	**99.0**	**568.9**
Weighted average escalator	1.3	3.5	5.1	3.5	2.9	**16.2**
Replacement -Total (escalated)	**118.9**	**125.6**	**124.8**	**113.8**	**101.9**	**585.1**

While Nuttall Consulting confirmed that the modelled portion of our Replacement capex is justifiable with reference to the AER's Repex model (depending on the scenario adopted), the model could not be applied to the remaining 36% of our Replacement capex. The majority of the remaining Replacement capex relates to safety ('Replacement – Unmodelled') and the non-asset specific programs already noted (Replacement-Other), which cannot be assessed by the Repex model. These observations emphasise the importance of taking a cautious approach in applying and drawing conclusions from the Repex model

This document and the more detailed supporting 'Capital Expenditure Explanatory Statements', explain and justify each component of our proposed Replacement capex. For the reasons set out in these documents, we are confident that the forecast complies with the requirements of the Rules.

1.2. Nature and categorisation of Replacement expenditure

In previous regulatory periods Replacement capex comprised:

- Reliability and Quality Maintained (RQM), which is the replacement and refurbishment capex required to maintain current network performance in accordance with the requirements of clause 6.5.7(a)(3) of the Rules.
- Environmental, Safety & Legal (ES&L), which relates to programs of work that are required to ensure we comply with environmental, electrical safety, and other Victorian and national legislative obligations, in accordance with the requirements of clause 6.5.7(a)(2) and (4) of the Rules.

In practice, some asset Replacement could be classified as either "RQM" or "ES&L" expenditure, as the work may be required to maintain reliability and also to comply with a specific obligation. To some extent, therefore, the previous regulatory distinction between RQM and ES&L expenditure categories is blurred. Accordingly, in this document, we have adopted the AER's current classification of "Replacement capex." The AER's other capex categories are:

- Augmentation;
- Connections;
- Non-network IT and Communications; and
- Non-network General.

The AER's RIN template 2.2 identifies 9 categories that comprise Replacement capex. As already explained, a significant proportion of our Replacement capex is not asset-specific, and therefore has been allocated to the "Other" Replacement capex category. Further information on the expenditure categories is provided in Chapter 6 of this document.

1.3. Compliance obligations

Our expenditure plans must enable us to satisfy our compliance obligations. It is useful, therefore, to set out a brief summary of the compliance obligations that are most relevant to Replacement capex. For information on the specific compliance obligations for a particular asset class, please refer to the relevant LCS.

Clause 3.1 of the Victorian Electricity Distribution Code (the Code) requires us to manage our assets in accordance with the principles of good asset management. Under this provision, we must, among other things, develop and implement plans for the acquisition, creation, maintenance, operation, refurbishment, repair and disposal of our distribution system assets:

- to comply with the laws and other performance obligations which apply to the provision of distribution services including those contained in the Distribution Code;
- to minimise the risks associated with the failure or reduced performance of assets; and
- in a way which minimises costs to customers taking into account distribution losses.

Under clause 5.2 of the Code, we are required to use best endeavours to meet customers' reasonable expectations of supply reliability.

Clause 4.2 of the Code requires voltages to be maintained within specified limits. It also sets out requirements relating to monitoring of voltages and voltage variations. Chapter 4 of the National Electricity Rules sets out requirements relating to power system security.

The Electricity Safety Act 1998 (the Act) makes provisions relating to:

- the safety of electricity supply and use;
- the reliability and security of electricity supply; and
- the efficiency of electrical equipment.

Under section 98 of the Act, United Energy (as a major electricity company) must design, construct, operate, maintain and decommission its supply network to minimise as far as practicable:

1. the hazards and risks to the safety of any person arising from the supply network; and
2. the hazards and risks of damage to the property of any person arising from the supply network; and
3. the bushfire danger arising from the supply network.

Section 99 of the Act requires United Energy to prepare and implement an electricity safety management scheme, which specifies the company's safety management system for complying with its obligations under section 98.

Under the Electricity Safety (Management) Regulations 2009, it is mandatory for network operators to implement an Electricity Safety Management Scheme (ESMS). This change in regulation represents a paradigm shift away from prescribed regulations to a system that is underpinned by identification and management of safety risks associated with the assets to a level that is "As Low As Reasonably Practicable" (ALARP).

This change in safety legislation has prompted us to accelerate the replacement of aged assets that have a direct bearing on public safety. For example, priority is given to the replacement of low voltage service wires that expose householders to the risk of electric shocks.

The ESMS must be submitted to Energy Safe Victoria (ESV) every five years for acceptance, and is audited by ESV. We have prepared an ESMS synopsis document that provides descriptions of the 4 major sections of our ESMS, being:

- Facility Description;
- Formal Safety Assessment;
- Safety Management System; and
- Emergency response.

The Safety Management System incorporates all network asset policies, procedures, systems, standards and controls in place to manage network safety.

The Environment Protection Act 1970 empowers the Environment Protection Authority (EPA) to issue regulations and other compliance instruments relating to protection of the environment. Areas covered by the legislation include:

- Part V – Clean Water
- Part VI – Clean Air
- Part VII – Control of solid wastes and pollution of land
- Part VIII – Control of noise
- Part IXA – Transport of prescribed waste
- Part IXD – Environmental audits

We have detailed plans to ensure that we comply with the EPA regulations, as set out in our Environment Strategy and Plan document UE PL 2038.

Part 6 of the Victorian Terrorism (Community Protection) 2003 Act, together with the following State and Federal Government documents set out requirements for protecting critical assets from acts of terrorism:

- Department of the Prime Minister and Cabinet, Strong and Secure: A Strategy for Australia's National Security, January 2013;
- Commonwealth of Australia National Counter-Terrorism Committee, National Guidelines for Protecting Critical Infrastructure from Terrorism, 2011.
- Department of Premier and Cabinet, A Roadmap for Victorian Critical Infrastructure Resilience, December 2012.

In summary, the compliance obligations described above are important inputs to our expenditure plans. We must aim to satisfy all of these obligations. As already noted, these obligations together with reliability considerations are the key drivers of our Replacement capex requirements.

1.4. Asset Management Framework

Our asset management framework and systems are aligned with the key elements of ISO 55001. Our asset management processes and systems therefore ensure that network risks and costs are systematically analysed and optimised. In turn, the systematic consideration of risks and costs underpins our efficient expenditure forecast.

The following key asset management objectives have been set for the business, which requires us to:

- Employ good asset management practices to prudently manage and operate the assets over their total life cycle;
- Minimise our long-term cost structure considering the potential downturn in future grid consumption;

- Build our reputation as a trusted company with customers and stakeholders by striving for active industry leadership, agility, reliability, safety and good customer service in light of changing customer and community expectations;
- Meet all legal and regulatory requirements;
- Adhere to the relevant Australian, international and industry standards and any other requirements to which United Energy subscribes;
- Prudently manage reasonably foreseeable and critical credible safety hazards and risks to as low as reasonably practicable;
- Develop high performance operations by engaging our people and having the right skills and capabilities within our business; and
- Embed continuous improvement and innovate to drive efficiency; and
- Monitor and evaluate appropriate metrics to effectively manage our network.

Our Asset Management Strategy draws on our corporate strategy and roadmap to develop specific asset management objectives and strategies. These objectives and strategies are further developed and advanced through the Asset Class Life Cycle Strategies (LCSs) and Non-asset Specific Strategies and Plans. These strategies and plans feed into the overall Asset Management Plan and capex/opex works program, which is prepared annually, and provides a rolling view of:

- Our overall asset management direction and focus; and
- Our capex forecasts (for 10 years) and operating expenditure forecast (for 5 years).

Our capex forecasts for the forthcoming regulatory period are 'business as usual' forecasts, underpinned by the asset management framework, strategies and work programs described above. As explained in section 1.1, our expenditure forecast also reflects the optimisation of our expenditure plans across the Replacement, Augmentation, and Information Technology and Communications categories to achieve the objective of maintaining reliability at minimum life cycle costs. As already noted, our forecast Replacement capex, which is the subject of this document – draws from the relevant LCSs and is further justified through Capital Expenditure Explanatory Statements.

1.5. Structure of this document

The remainder of this document is structured as follows:

- Chapter 2 provides an overview of our recent actual and forecast Replacement capex for the period from 2006 to 2020.
- Chapter 3 explains our recent reliability performance and our prudent holistic approach to maintaining reliability in the forthcoming regulatory period. It highlights that the declining performance of '85% life-expired' assets is driving deteriorating network reliability. This chapter provides a 'top down' explanation of the reasons why our Replacement capex must increase in the forthcoming regulatory period.
- Chapter 4 explains our forecasting methodology, the inputs to that methodology and the key assumptions that are reflected in our Replacement capex forecasts.
- Chapter 5 set out the results of the repex modelling undertaken by Nuttall Consulting to verify our Replacement capex forecasts.
- Chapter 6 summarises our Replacement capex requirements for each of the asset categories identified in template 2.2 of the RIN. Each summary describes:

- the expenditure category;
- the principal expenditure drivers;
- the forecasting methodology;
- the proposed capex compared to historic spend; and
- our approach to validating the efficiency and prudency of the forecast expenditure.

The information provided for the non asset-specific expenditure programs focuses on:

- the need for the expenditure;
- the benefits of the proposed programs; and
- our approach to validating the efficiency and prudency of the forecast expenditure.

The expenditure forecast for each expenditure category is supported by a Capital Expenditure Explanatory Statement, which provides more detailed information to explain the forecast expenditure and demonstrate that it is prudent and efficient.

- Chapter 7 draws on the material in the previous chapters to explain and justify our forecast Replacement capex against the objectives and criteria in the National Electricity Rules. In so doing, it explains why the AER should approve our capex forecast in its distribution determination. It also addresses other specific information requirements in the Rules.
- Chapter 8 lists the supporting documents.
- The Appendix explains the relationship between '85% life-expired' assets and increasing risk of equipment failure, with reference to the Weibull methodology, which is used to inform decisions on the timing of asset replacement decisions.

2. Historic and forecast Replacement Capex

2.1. Forecast Replacement Capex

Table 2-1 presents our forecast Replacement capex by asset class as submitted in the completed reset RIN template 4.2. It includes the effect of labour and materials escalation over the forthcoming regulatory period, which is explained in further detail in section 4.5.

Table 2-1: Replacement expenditure – Including labour and materials escalation ($M, Real 2015)

	2016	2017	2018	2019	2020	Total
Asset Class - Poles	7.4	7.7	7.9	8.1	8.3	**39.4**
Asset Class - Pole Top Structures	18.8	19.0	20.5	20.3	20.8	**99.4**
Asset Class - Connectors and Conductors	9.2	13.1	14.0	10.8	8.2	**55.3**
Asset Class - Underground Cable Systems	8.9	9.2	9.5	9.0	7.7	**44.3**
Asset Class - Services and Terminations	9.1	6.9	6.0	6.0	6.1	**34.2**
Asset Class - Zone Substation Transformers	8.9	14.3	15.2	12.1	6.1	**56.6**
Asset Class - Pole Top Transformers	1.0	1.2	1.3	1.4	1.5	**6.3**
Asset Class - Non Pole Transformers	1.4	1.5	1.7	1.8	1.9	**8.3**
Asset Class - Distribution Switchgear	9.9	11.5	9.6	9.5	8.3	**48.8**
Asset Class - Zone Substation Switchgear	1.0	5.5	9.1	10.2	7.3	**33.1**
Asset Class - SCADA and Communication	3.3	3.3	2.9	2.2	2.8	**14.4**
Asset Class - Protection and Control Relays	6.5	4.5	2.4	2.4	4.1	**20.0**
Asset Class – Zone Substation Capacitor Banks and Earth Grids	1.0	1.3	1.3	1.3	0.9	**5.9**
Asset Class - Buildings	0.0	1.0	2.0	0.9	0.0	**3.9**
Other Programs	32.4	25.6	21.4	17.9	17.9	**115.3**
Total escalated replacement expenditure	**118.9**	**125.6**	**124.8**	**113.8**	**101.9**	**585.1**

2.2. Variances in forecast and actual capital expenditure

Table 2-2 presents the following information:

- A comparison of our actual capex with the AER's allowance for the previous and current regulatory periods; and
- Our forecast Replacement capex for the 2016 to 2020 period.

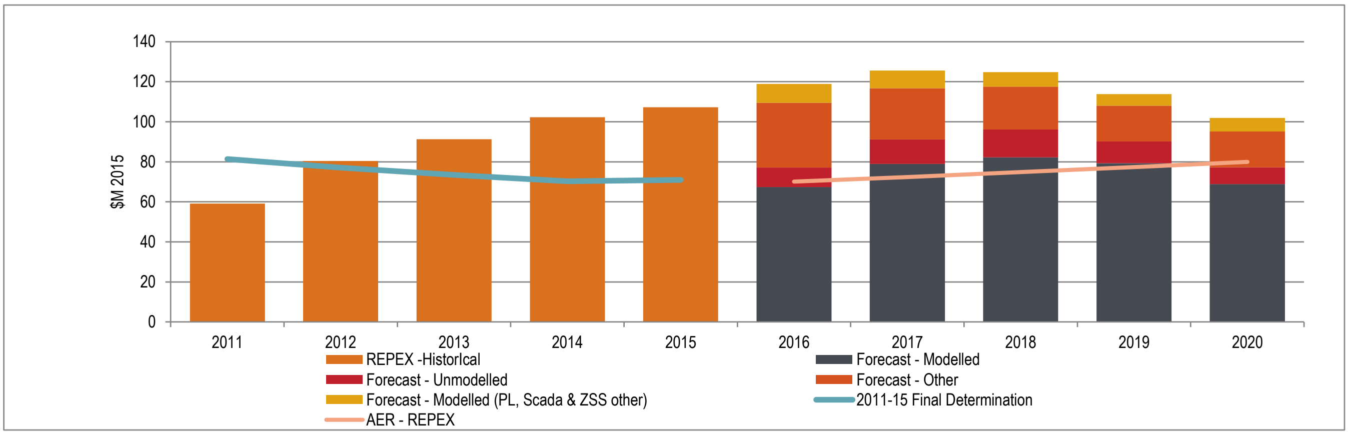
The table shows that our capex in the 2011-15 period more than doubled the amount incurred during 2006-2010, from $200.5 million to $440.6 million. A more modest increase in expenditure of 33% compared to the 2011-2015 period is forecast for the 2016-2020 period.

Table 2-2: Historic and forecast Replacement capital expenditure

	2006-10 Actual	2011-15 Actual	2016-20 forecast
Capital expenditure $M	200.5	440.6	585.1
AER Allowance $M	321.2	368.1	
Variance, Actual minus AER allowance $M [%]	-120.7 [-38%]	72.5 [20%]	

Figure 2-1 shows our annual actual Replacement capex for the current regulatory period alongside our forecast for the forthcoming period. It also shows the output from the AER's Repex model is closely aligned with the modelled component of our capex forecast. While further discussion of the AER's Repex model is provided in Chapter 5 of this submission, it is worth noting here that it validates our Replacement capex forecast for the forthcoming regulatory period.

Figure 2-1: Actual and forecast replacement capex 2011 – 2020 ($M, Real 2015)



The table below sets out actual and forecast replacement capex for each year of the period from 2006 to 2020. This information is presented in accordance with clause S6.1.1(6) of the Rules.

Table 2-3: Replacement capital expenditure 2006-2020 forecast, actuals and distribution determination ($2015M)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Regulatory Proposal	74.2	79.8	81.6	82	102.9	95.5	84.3	79.6	68.7	69.2	118.9	125.6	124.8	113.8	101.9
Actual / Estimated	41.1	38.5	37.0	42.2	41.7	59.2	80.4	91.3	102.2	107.5					
Distribution Determination	54.8	59.8	62.4	63	81.2	81.2	76.3	69.7	70.1	70.8					

3. Prudent holistic approach to maintaining reliability

3.1. Introduction

Chapter 2 highlighted that we are forecasting a 33% increase in Replacement capex in the forthcoming regulatory period compared to our actual expenditure for 2011-2015. While this is a relatively modest increase compared to the 120% increase[1] in capex in the current period, it is nevertheless significant in absolute terms.

We recognise that our stakeholders expect us to explain in straightforward terms why our Replacement capex requirements are continuing to increase in the forthcoming regulatory period, albeit at a reduced rate. The purpose of this chapter is to provide that high level explanation. A more detailed explanation of our prudent holistic approach to maintaining reliability is provided in our Network Performance Strategy document (UE PL 2300).

As a starting point, we consider the feedback from our stakeholder and consumer engagement process, and explain how this feedback is factored into our Replacement capex plans. We explain the challenges in the forthcoming regulatory period, in terms of reliability performance, the declining performance of '85% life-expired' assets and the consequential increase in the risk of equipment failure. We explain how our compliance and safety obligations are contributing to our increased Replacement capex requirements in the forthcoming regulatory period.

Customers also want assurance that our expenditure is efficient. They expect us to find better ways of delivering better outcomes, rather than simply increasing expenditure. In this Chapter, we explain our prudent holistic approach to maintaining reliability. By better targeting our expenditure, and developing new technologies, we will deliver reliability improvements at much lower cost compared to focusing our attention solely on asset-specific replacement programs.

While this Chapter is intentionally high-level, a more detailed explanation of our forecasting methodology and Replacement capex requirements for each RIN category is provided in Chapters 4 and 6 of this overview document. Chapter 5 also explains the validation conducted by Nuttall Consulting using the AER's Repex Model. As already noted, further detailed information is provided in the 'Category Expenditure Explanatory Statements' for each RIN Replacement capex category.

The remainder of this chapter is structured as follows:

- Section 3.2 reports the feedback from our stakeholder and consumer engagement.
- Section 3.3 explains the declining performance of '85% life-expired' assets, and the impact this has on network reliability.
- Section 3.4 explains the relationship between asset age and risk of equipment failure.
- Section 3.5 presents data showing the recent trend deterioration in network performance and its principal causes.
- Section 3.6 explains why compliance and safety-driven expenditure is tending to increase over time.

3.2. Stakeholder / consumer engagement

We have consulted with stakeholders in the development of our Replacement capex plans, and we have taken stakeholder feedback into account in framing our Replacement capex proposals.

[1] It should be noted that the percentage increases presented here are based on our best estimate for replacement capital expenditure in 2015, as this year is not yet complete.

Our approach is set out in our *Customer and Other Stakeholder Engagement Strategy,* which is provided as a supporting document to our regulatory proposal. The table below summarises the key issues relating to Replacement capex that were raised with stakeholders through our engagement process.

Table 3-1: Key stakeholder issues relating to Replacement capital expenditure

Issue	How and why we have engaged on these issues
Safety	Safety is our highest priority. We are committed to operating and maintaining a safe electricity network in order both to meet our safety obligations and to be an employer of choice. We have engaged with our stakeholders to improve awareness and understanding of matters such as: • Ensuring safety when we carry out works on our network, including in the event of emergencies; and • Promoting bushfire awareness and preparedness. We have consulted our stakeholders about proposed new safety programs, including the need to replace assets to minimise risks and hazards in our network.
Environment	We are committed to reducing our environmental impacts and contributing to the community's environmental targets. We have consulted our stakeholders about matters such as: • Reducing the noise of our works and assets; • Improving the amenity and aesthetics of our assets, including by undergrounding powerlines; and • Sensitively managing impacts in locations of cultural significance or outstanding natural beauty.
Power outages and restoration	We are committed to meeting our customers' needs and expectations for the reliability of our electricity supply, having regard to their willingness to pay for improvements.
Quality of supply	Electricity is not a homogenous product – its quality can vary because of changes in voltages and harmonics. We are committed to ensuring that the electricity our customers receive meets their needs. We have consulted our customers about the nature, and causes, of the power quality issues that they experience.
Affordability	We are committed to providing our customers with sustainably cost-efficient, value-for-money services. We have consulted with our stakeholders about their willingness to pay for service improvements.
Major projects and investment	We have communicated and consulted with our stakeholders on matters including our: • Plans for our networks; and • Proposed capital and operating expenditure program. Effective communication and consultation will ensure our major projects are delivered in a manner that is consistent with community and business needs and expectations, and that our investment decisions are properly explained.

A detailed discussion of our stakeholder engagement process is provided in the Stakeholder Engagement – Strategy, Focus Groups, Workshops and Willingness to Pay Survey – Outcomes Report. A key finding from that report is that business and residential participants were not prepared to accept lower reliability in exchange for lower network prices. Customers regard electricity as a basic utility, and they consider that electricity supply should be continuous and of high quality. Business participants also reported significant inconvenience and loss of revenue associated with planned and unplanned outages, noting in particular the impact of supply reliability on IT systems and infrastructure.

While customers do not want deteriorating network performance, even if it meant lower network tariffs, they also do not want to pay more for improved reliability or undergrounding of assets. We have taken this feedback on board in developing our Replacement capex plans.

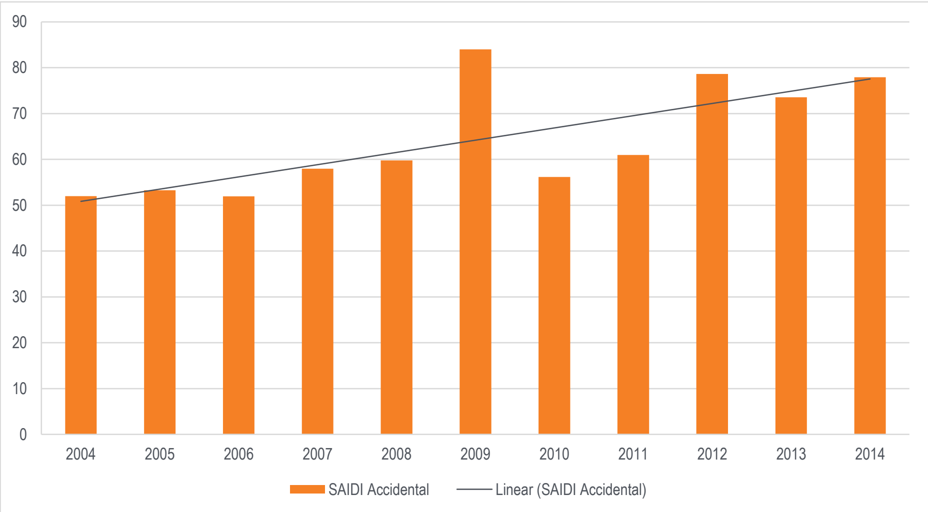
3.3. Declining performance of '85% life-expired' assets

Reliability of supply is a key aspect of network performance. It refers to the degree to which the network avoids outages (interruptions to customers' electrical connection) and provides as continuous a supply as possible. The international reliability indicators SAIDI, SAIFI, CAIDI and MAIFIe are defined as follows:

- **SAIDI** (System Average Interruption Duration Index) – the total minutes, on average, that a customer is without electricity in a year.
- **SAIFI** (System Average Interruption Frequency Index) – the number of occasions, on average, each customer would experience an outage in excess of one minute.
- **CAIDI** (Customer Average Interruption Duration Index) – the average time taken for supply to be restored when an outage greater than one minute has occurred
- **MAIFIe** (Momentary Average Interruption Frequency Index) – the total number of momentary interruption events (less than one minute) that a customer would experience in a year, on average. The small letter "e" stands for "event" where an event consists of one or more momentary interruptions occurring sequentially in response to the same cause that does not result in a sustained loss of supply.

Of these reliability indicators unplanned SAIDI is the primary measure of reliability. The figure below shows our unplanned or accidental SAIDI for the period from 2004 to 2014.

Figure 3-1: Actual and trend unplanned SAIDI



It is evident from the above figure that our network reliability performance is exhibiting a deteriorating trend. With the exception of 2009, which was an extraordinarily difficult year because of the impact of bushfires, our network has delivered significantly poorer reliability outcomes over the most recent 3 year period.

Our 2014 SAIDI performance must be considered in the context of the AER's SAIDI targets in the STPIS. In accordance with the STPIS, the AER will set an average reliability target for unplanned SAIDI minutes of 68.7 minutes for the forthcoming regulatory period, which is substantially more onerous than our actual performance of 78 minutes in 2014. This discrepancy arises because the target reflects our average actual performance over the previous 5 years, even though our performance is following a deteriorating trend.

Customer feedback is consistent with the AER's SAIDI targets, as customers do not want deteriorating reliability. It is therefore appropriate for reliability to return to the average level delivered over the previous 5 years, consistent with the STPIS targets. The challenge, however, for the forthcoming regulatory period is how we should arrest the decline in performance and deliver a 'maintain reliability' outcome for our customers as efficiently as possible.

To address this challenge, the first step is to consider the causes of SAIDI, as shown in Figure 3-2 below.

Figure 3-2: Historic causes of unplanned SAIDI 2004-2014

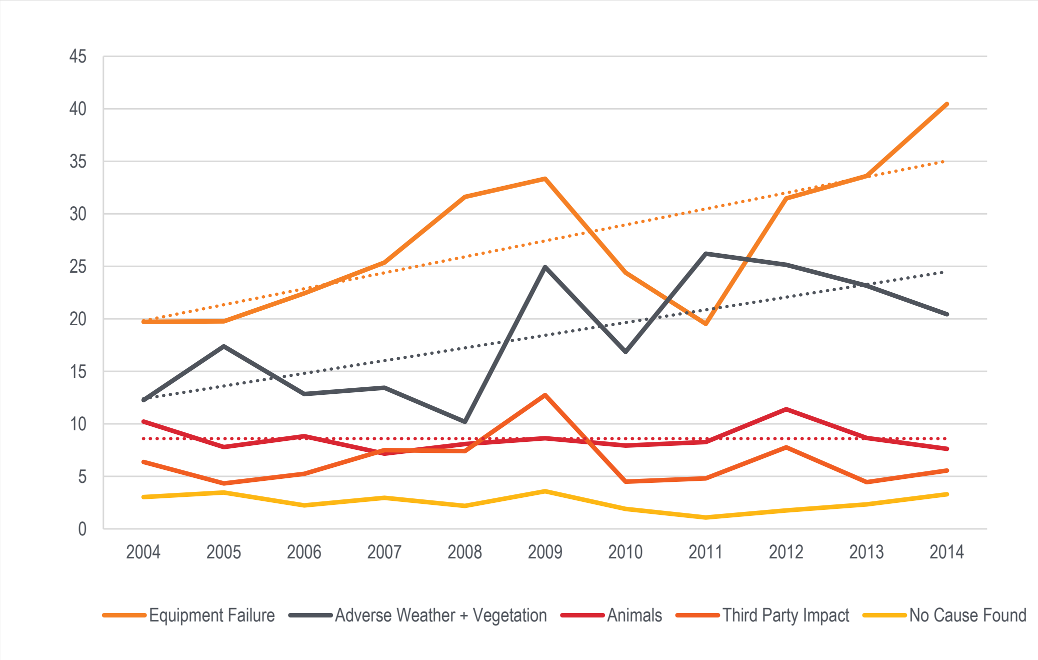
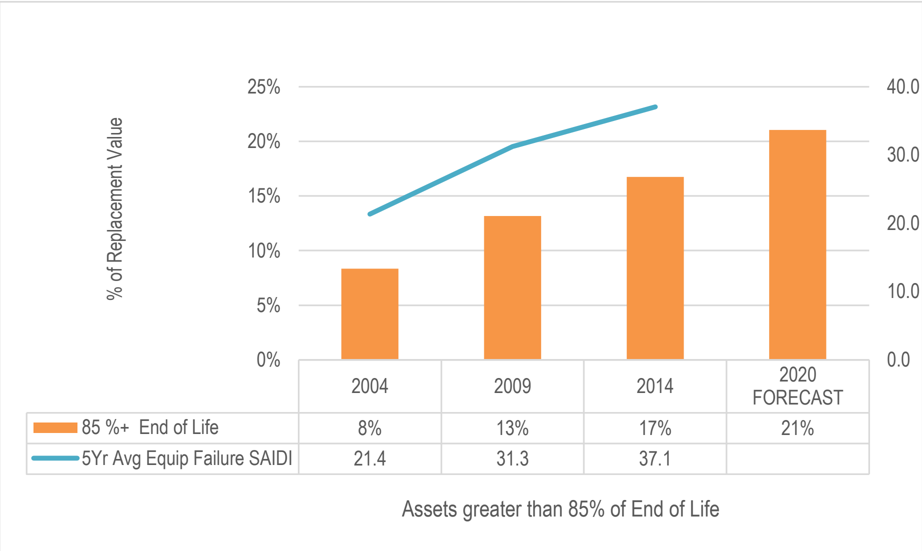


Figure 3-2 shows that equipment failure is a significant driver of the trend increase in unplanned SAIDI, and the single largest contributor. The contribution of that driver to unplanned SAIDI is subject to annual volatility, partly driven by temperature and maximum demand variations in addition to natural annual random variations. Notwithstanding these annual variations, the trend deterioration in equipment failure is clearly evident from the data.

Importantly, our network performance is consistent with the expected result that the risk of equipment failure increases as assets become '85% life expired'. Figure 3-3 shows this relationship for our network.

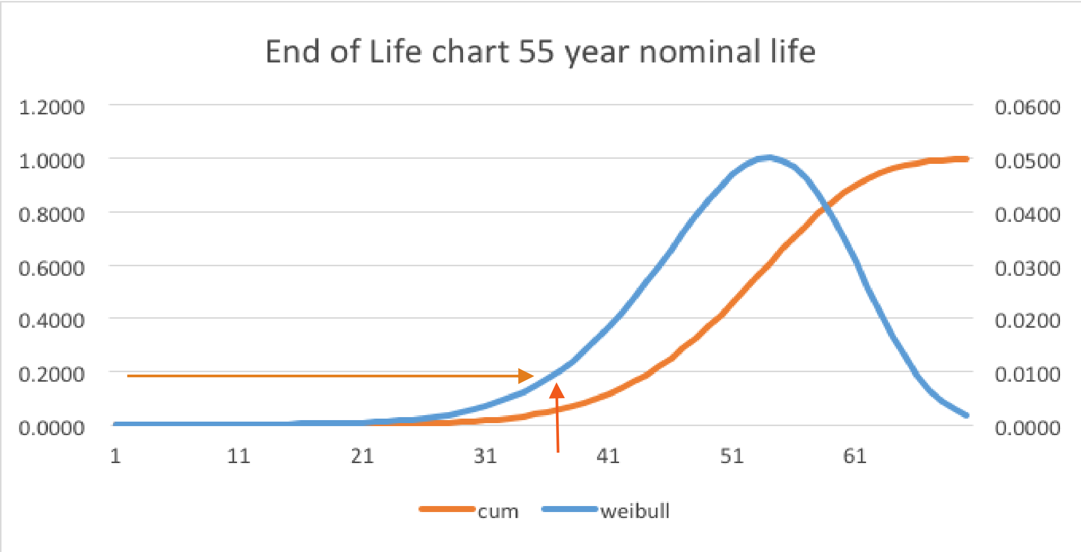
Figure 3-3: Trend of assets approaching end-of life



	2004	2009	2014	2020 FORECAST
85 %+ End of Life	8%	13%	17%	21%
5Yr Avg Equip Failure SAIDI	21.4	31.3	37.1	

In effect, the age profile of our network is largely responsible for driving the trend deterioration in network reliability. The relationship is best illustrated by the Weibull probability density function, which depicts the distribution of failure rates for a particular asset class. The figure below shows that only a small proportion of assets with an expected life of 55 years would be replaced at 35 years. However, by approximately 47 years the rate of asset failure accelerates significantly (as the slope of the blue line increases). Depending on the criticality of the asset, as assets become '85% life expired', there is a significant increase in the risk of equipment failure and worsening network reliability.

Figure 3-4: Weibull distribution for asset with 55 year nominal life



The relationship is explored in further detail in the Appendix.

3.4. Developing a prudent holistic response

The analysis provided in the previous section highlighted that the increasing percentage of 85% life expired assets is driving our worsening reliability performance. It follows that action must be taken to deliver future reliability performance that meets the AER's SAIDI targets, which require an improvement in reliability of approximately 9 unplanned SAIDI minutes compared to our 2014 performance. As explained below, we have developed a prudent holistic response to address this performance gap by combining asset-specific replacement plans with non-asset specific expenditure programs.

In relation to our asset replacement plans, we recognise that many asset classes have an increasing proportion of assets nearing the end-of-life. An increased level of Replacement capex is required to address the corresponding deterioration of network performance and to maintain network safety. An Asset Life Cycle Strategy (LCS) is prepared for each asset class, which selects a strategy for managing the assets to achieve desired outcomes at least life cycle cost. Targets for network performance are set for each asset class considering historical performance, industry benchmarks, and what may be reasonably achievable for reasonable cost considering the specific circumstance for the asset class.

Further information on our asset replacement plans is provided in our explanatory statements and Life Cycle Strategies (LCS). These plans also include operating expenditure initiatives to minimise total life cycle costs, such as improved inspection practices in order to facilitate better targeting of Replacement capex.

For several asset classes, however, we forecast a deterioration in their contribution to network performance. We recognise that it would be inefficient to maintain performance for these asset classes through additional replacement of assets. Instead, we have proposed more efficient ways of maintaining reliability, as outlined below:

- Network performance programs deliver targeted reliability improvements through the following work programs:
  - A program to install new automatic circuit re-closers (ACR's) and remote control gas switches (RCGS's). These programs will act to automatically restore the network after transient faults and to allow quicker, remote isolation of faulted sections of the network so that non-faulted sections can be returned to supply more quickly. They will act to minimise the number of customers affected by an outage, and enable us to restore supply as quickly as possible.

- A program to address "rogue feeders". This is a continuation of an existing program to find solutions to local problems on poorly performing feeders. This program manages the experience of individual customers, those who are currently experiencing poor supply reliability.
- A program to commence installing fuse saver equipment, which will prevent fuses from operating for transient faults, and thus avoiding a sustained outage.
- A program to prevent conductor clashing, which will minimise the impact on customers for particular faults.
- A program to provide animal proofing to pole top structures to prevent faults and outages from occurring.

- Operational technology, which facilitates activities such as fault location identification, asset condition monitoring, and continuous neutral integrity testing. These activities support programs for maintaining reliability, as well as enhancing safety. For instance, condition monitoring of transformers allows us to defer replacement of zone substation transformers to as close as practicable to the end of their life. Fault location identification enables us to rectify a fault and restore supply as quickly as possible.

Our expenditure in these 'Other programs' provides a smarter and lower cost solution to meeting the SAIDI target. Our forecast expenditure in Operational Technology is much broader in scope, however than delivering targeted improvements in reliability. In particular, the table below shows the drivers for each of our proposed works.

Table 3-2: Operational Technology drivers

	Maintain Reliability	Safety	Facilitate better asset management	Power Quality compliance	Customer data or services
Service Mains Deterioration (Field Work)		✓			
In Meter Capabilities		✓		✓	✓
Test Harness					✓
Light Detection And Ranging (LiDAR)	✓	✓	✓		
Dynamic Rating Monitoring and Control Communications			✓		
Operational Technology Security (Network part)		✓			
Network Optimiser	✓		✓	✓	
Analytics and Forecasting toolset			✓		
Distribution Fault Application Data Collection and Analytics	✓	✓	✓	✓	
Fault Location and application development	✓			✓	
Develop New Technologies	✓	✓	✓	✓	

3.5. Compliance and safety-driven capital expenditure

Our Replacement capex must also satisfy our compliance and safety obligations. Historically, our obligations have tended to become more onerous over time. The forthcoming regulatory period is no different, as we expect the following safety and compliance drivers to put upward pressure on our Replacement capex:

- In relation to safety, we are required to adopt a risk management approach that is "As Low As Reasonably Practicable" (ALARP). As already noted, one consequence of ALARP is that we must accelerate the replacement of aged assets that have a direct link to public safety.

- We must address the increased risk of bushfire and the findings of the Victorian Bushfires Royal Commission. The initiatives planned for the forthcoming regulatory period include:
    - Removal of SWER power lines, as recommended by the Victorian Bushfires Royal Commission.
    - Installation of REFCLs in zone substations to reduce the risk of fire starts
    - Adoption of Light Detection and Ranging Asset Management (LiDAR), which will enable us to better identify potentially unsafe assets, as required by the recommendations of the Royal Commission.
- Our capex proposal includes allowances for expenditure on a range of other safety-driven activities including:
    - Replacing Doncaster Pillars to safeguard the public from electrocution.
    - Installation of closed-circuit TV (CCTV) at critical zone substations to address heightened security risks and to enable remote monitoring for safety purposes.

In addition to compliance-driven expenditure, we also expect Replacement capex to increase in response to technology improvements. In particular, data from smart meters is being “mined” to characterise asset fault types and provide early warning of an upcoming asset failure. Specifically,

- Our Replacement capex proposal includes various Operational Technology projects, which deliver safety improvements as part of their core benefits. These include:
    - Securing the Operational Technology Network against cyber security risks.
    - Enhancing In-Meter Capabilities of AMI meters to enable testing services for neutral integrity, detection of fuse blown causing brown outs, detection of fuse candling, and meter overload detection.
    - Increasing the AMI network communication bandwidth to facilitate the In-Meter (AMI) Capabilities project.
    - A pilot program involving installation of disturbance recording at a zone substation to record information about network faults.
    - Development of other new technologies through pilot projects that involve installation of solid state circuit breakers (which will greatly reduce fire risk) and development of new condition monitoring technologies.
- In addition, the proposed Network Analytics project in the ICT capex proposal includes work that delivers predominantly safety related benefits, including:
    - An intelligent software solution utilising analytics on AMI meter data to detect neutral integrity issues as they occur. This will avoid site visits other than those where detected issues need investigation and rectification. Avoiding site visits for neutral integrity testing translates to a lower risk of electrical shocks due to associated neutral integrity issues. Our approach will ensure that neutral integrity tests are performed on a daily basis and are corrected before the customer notices any problems.
    - Smart detection of other safety hazards such as “live wire down”.

We expect some of these initiatives to lead to increased asset replacement, which will assist in reducing asset failures and improving safety.

It is difficult to provide a ‘top down’ quantification of the impact of safety and compliance obligations on our Replacement capex requirements. Instead, we provide a detailed assessment of our Replacement capex requirements in the more detailed ‘Category Expenditure Explanatory Statements’ that address each RIN Replacement capex category. In terms of a ‘top down’ perspective, however, it is evident from the above discussion that safety and compliance obligations will drive increased Replacement capex in the forthcoming regulatory period.

3.6. Outcomes for customers

As already explained, we are committed to the efficient and safe delivery of reliable services to customers. We achieve this outcome through the application of a robust asset management framework, which aims to deliver the following benefits to our customers and the community:

- ensure the safety of the public and our personnel and contractors at all times;
- ensure that all compliance obligations are met;
- manage risk efficiently; and
- ensure the prudent, efficient and reliable delivery of an essential service that meets customers' and stakeholders' needs.

We recognise that value for money is a critical consideration for our customers, particularly in an environment of increasing cost of living pressures and rising energy prices. Our Replacement capex plans are aimed at delivering all of the customer benefits noted above at minimum total life cycle cost.

In terms of outcomes for customers, our proposed Replacement capex (supported by our other expenditure plans) is seeking to return SAIDI performance from 78 minutes in 2014 to the 5 year average performance of approximately 68 minutes, which is the target for the forthcoming regulatory period. To achieve the target, therefore, we must reduce 2014 SAIDI by approximately 10 minutes. Furthermore, given the increasing risk of equipment failure as more assets approach their end-of-life, the AER's SAIDI target becomes increasingly challenging over time.

From our customers' perspective, we expect the proposed program of capital and operating expenditure to deliver the reliability targets in the STPIS. Replacement capex is the primary contributor to this outcome. As already noted, achieving the reliability targets is consistent with the feedback from our customers that they do not want reliability to deteriorate, even if it meant lower network prices. As explained in our Revenue Proposal, we plan to achieve the reliability target and lower overall network prices – despite the required increase in Replacement capex.

4. Overview of forecasting methodology, inputs and assumptions

4.1. Introduction

Chapter 3 provided a 'top down' explanation of why our Replacement capex requirements must increase in the forthcoming regulatory period. The purpose of this chapter is to explain our forecasting methodology, the inputs to that methodology and the key assumptions that are reflected in our Replacement capex forecasts. We discuss the application of these forecasting methodologies for each expenditure category in the next chapter.

4.2. Overview of forecasting methods

The table below summarises the five forecasting methodologies that we have applied to different asset groups.

Table 4-1: Summary of forecasting methodologies

Forecasting Methodology	Description
Condition based	Asset-specific condition model based on condition data and failure modes
Weibull	Weibull model using a probability distribution based on mean asset life and age profile
Trend	Historical trend based on linear extrapolation of historic data
Specific	Specific projects

These forecasting methods are explained in further detail in the supporting papers for each expenditure category. The table below shows the forecasting methodology adopted for each of the thirteen major asset groups.

Table 4-2: Summary of expenditure forecasting methodologies by asset category

Asset category	C	W	T	S
Protection and control equipment		✓	✓	
ZSS CBs		✓		
Poles replacement		✓		✓
Network switchgear		✓	✓	
Distribution Transformers		✓	✓	✓
ZSS other				✓
Services		✓	✓	✓
Overhead lines – HV		✓	✓	✓
Underground Cables – LV		✓	✓	✓
ZSS Power Transformers	✓	✓		✓
Underground Cables - HV		✓	✓	
Overhead lines – LV		✓	✓	✓
Pole tops structures		✓		✓

LEGEND: C – Condition model, W – Weibull model, T – Trending, S – Specific projects

4.3. Key assumptions

Clause S6.1.1(4) of the Rules requires us to list the key assumptions that underpin our capex forecast. The detailed assumptions for each RIN category of Replacement capex are presented in the supporting documents. In broad terms, however, the key assumptions applying across the Replacement expenditure forecasts are summarised in the following table.

Table 4-3: Summary of key assumptions

Parameter or variable	Assumption
Compliance obligations	Unless stated otherwise in the relevant Life Cycle Strategy, all compliance obligations applying under the legislative and regulatory instruments listed in section 4.1 of United Energy's Expenditure Forecasting Methodology document will remain in force for the duration of the forthcoming regulatory period.
Average asset life	Capital expenditure forecasts are based on a projected average asset life. The nominal asset life is typically estimated via Weibull analysis of failure and replacement data, and validated against the condition performance of the asset class.
Projected asset failure rates	This assumption is a key driver of the forecast capex. Please refer to the individual Life Cycle Strategy documents for full details.
Network reliability outcomes	Our capex forecast is aimed at maintaining existing average reliability standards. As explained in section 3.3, we have used a five-year average of actual performance figures from 2010 to 2014 as the basis for setting reliability targets for the next regulatory period.
Unit costs and escalators	Please refer to sections 4.4 and 4.5 below.
Economically efficient replacement	We undertake economic evaluations with the aim of minimising total life cycle costs, by optimising the maintenance and capital replacement program, and by balancing the costs of increasing expenditure against the risks and consequences of asset failure. In evaluating the expected costs of asset failure we apply the value of customer reliability (VCR).

4.4. Unit costs

As explained in our section 10.6 of the Regulatory Proposal, Replacement capex comprises:

- Unitised projects – these projects that are forecast using standardised unit rates; and
- Non-unitised projects – these are individually costed projects.

4.4.1. Unitised projects

We forecast the costs of unitised projects by multiplying work volumes by unit costs.

Our unit rates are sourced from our Operational and Management Services Agreements (OMSAs) with our service providers. These rates are the best we have available for developing our capex forecasts given that they are market tested through the establishment of the OMSAs under competitive arrangements, as explained in section 10.3 of the Regulatory Proposal. They are based on the actual outturn costs (AOC) that we incurred from 1 July 2013 to 30 June 2014.

We derive the annual OMSA rates using the prescribed OMSA budget setting process. Under the agreements, the OMSA rates are applied to the forecast volumes to determine the target outturn costs (TOC). We reimburse our service providers for their actual costs during the year, which must conform to the cost reimbursement rules under the OMSA – we refer to this as Limb 1. We also pay a contribution fee – that we refer to as Limb 2 – that is an agreed mark-up on Limb 1 costs. Together, Limb 1 and Limb 2 comprise our AOC.

The AOC are considered during the budget setting process to develop the following year's OMSA rates (and therefore the TOC, having regard to the volumes). This process is largely finalised by March and applies from 1 July the same year (i.e. on a financial year basis). The OMSAs incentivise our service providers to achieve the lowest sustainable cost of service provision and, in this way, the target (TOC) and actual (AOC) costs converge over time.

4.4.2. Non-unitised projects

Project costs are developed for work that has a higher level of complexity, which means that it cannot be costed upfront based purely on unitised rates. We forecast project costs using a combination of:

- Actual historical costs from previous completed projects;
- Expert estimation tools;
- Statements of Works from our Service Providers based on their procurement policies and processes;
- Open tender processes;
- Customised cost estimates, where there is no relevant benchmark; and
- Verification by an Independent Estimator.

In this way, our non-unitised projects require tailored cost estimates

4.5. Cost escalation

As explained in our Expenditure Forecasting Methodology, the costs we incur in delivering distribution services do not always increase in line with the basket of goods and services used by the Australian Bureau of Statistics to calculate the consumer price index.

Therefore, in order to ensure that we are compensated for appropriate real cost increases that we will incur in acquiring the inputs necessary to provide services, we have engaged an external economic consultant BIS Shrapnel to forecast real increases in the cost of labour and materials costs that we expect to incur during the 2016 to 2020 period.

These cost escalators have been applied to our capex forecasts using appropriate weightings based on an estimated use of internal and contracted labour services to deliver work programs. While our Replacement capex forecasts include the impact of cost escalation, our analysis in preparing the forecasts is conducted without the effect of cost escalation. For example, the detailed analysis in the Capital Expenditure Explanatory Statements and the supporting Life Cycle Strategies is conducted exclusive of cost escalators for the forthcoming regulatory period. To assist the AER, however, each of the Capital Expenditure Explanatory Statements includes a reconciliation table showing the escalated forecasts submitted in the Reset RIN template 4.2. The table below shows the aggregate impact of the cost escalators on our Replacement Capex forecast for the forthcoming regulatory period.

Table 4-4: Replacement expenditure – impact of labour and materials escalation ($M, Real 2015)

	2016	2017	2018	2019	2020	TOTAL
Total unescalated Replacement capex	117.6	122.2	119.7	110.3	99.0	**568.9**
Escalation for materials and labour	1.3	3.5	5.1	3.5	2.9	**16.2**
Total escalated replacement expenditure	**118.9**	**125.6**	**124.8**	**113.8**	**101.9**	**585.1**

Further details regarding our cost escalators are provided in the supporting document titled “Real Labour and Material Cost Escalation Forecasts to 2020”.

5. Repex modelling

The AER’s Repex model is one of a number of tools that is used by us and the AER to verify our Replacement capex forecasts. We engaged Nuttall Consulting to apply the AER’s Repex model to our asset data to produce an alternative estimate of our Replacement capex requirements. Nuttall Consulting’s report[2] is provided as part of our Regulatory Proposal.

As explained in section 1.1, a significant proportion of our Replacement capex is driven by non-asset specific programs and safety programs. This has implications for the coverage of the AER’s Repex model. In particular, as shown in the table below, the AER’s model could only be applied to approximately 64% ($366 million) of our total unescalated Replacement Capex.

Table 5-1 shows our forecast Replacement capex for the forthcoming regulatory period, presented in the following groups:

- *Replacement – Modelled and within scope of Repex model*. This group matches the scope of the work that is covered by the AER’s Repex model, and includes end-of-life asset replacement;
- *Replacement* – Modelled but outside scope of Repex model. This group contains capital works that are outside the scope of the AER’s Repex model. Replacement expenditure in this group includes public lighting, field network control and protection and zone substation Primary Assets capex;
- *Replacement - Unmodelled*. This group contains capex that is excluded from the AER Repex model. The expenditure in this group relates to capex that is undertaken for reasons other than end-of-life asset replacement. The principal driver of capex in this group is safety. The two largest components of this expenditure are SWER replacement for bushfire mitigation and replacement of Doncaster pillars to safeguard the public from electrocution; and
- *Replacement - Other.* This group includes network performance capex (on items such as Automatic Circuit Reclosers and Remote Control Gas Switches, animal proofing); environmental compliance capex, safety capex (on assets such as REFCLs), power quality, and operational technology investment required to ensure safety and maintenance of reliability.

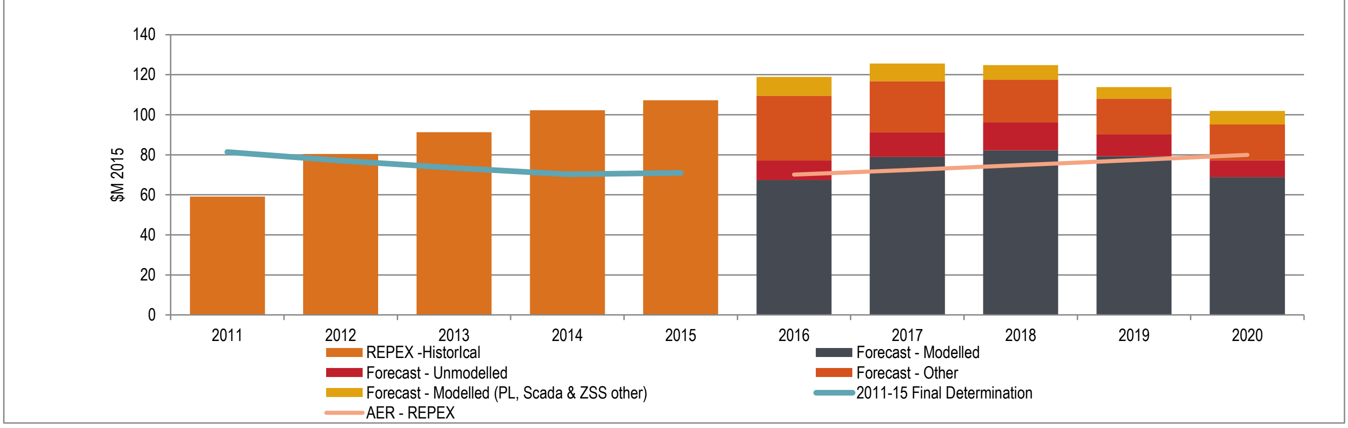
[2] Nuttall Consulting, AER repex modelling - Assessing UED’s replacement forecast: A report to UED, April 2015.

Table 5-1: Forecast replacement capex 2016 – 2020 ($M, Real 2015)

	2016	2017	2018	2019	2020	Total
Replacement - Modelled and within scope of repex model	66.7	76.7	78.8	76.8	66.9	**366.0**
Replacement - Modelled (PL, SCADA & ZSS other) outside scope of repex model	9.3	8.6	6.9	5.6	6.6	**37.0**
Replacement – Un-modelled	9.6	11.9	13.4	10.5	8.1	**53.5**
Replacement - Other	32.0	24.9	20.6	17.4	17.4	**112.3**
Replacement -Total (pre-escalation)	**117.6**	**122.2**	**119.7**	**110.3**	**99.0**	**568.9**
Weighted average escalator	1.3	3.5	5.1	3.5	2.9	**16.2**
Replacement -Total (escalated)	**118.9**	**125.6**	**124.8**	**113.8**	**101.9**	**585.1**

The figure below shows the above data in graphical form, along with actual Replacement capex for the current regulatory period.

Figure 5-1: Actual and forecast replacement capex 2011 – 2020 ($M, Real 2015)



It is important to note the following points in relation to Figure 5-1:

- As already explained, Nuttall Consulting's Repex modelling only covers the modelled component of Replacement capex. This is consistent with the AER's approach and represents about 64 per cent of our total Replacement capex.
- Nuttall Consulting's report confirms that the modelled portion of our Replacement capex ($366 million) is justifiable with reference to the Repex Model, depending on the scenario adopted. In particular, Nuttall Consulting modelled a range of different scenarios representing different combinations of asset life and unit cost parameters, to derive a range of Replacement capex predictions from the Repex Model. These predictions ranged from 16% below United Energy's Replacement capital expenditure forecast to 3% above the forecast.
- We think the best scenario is the one that uses our forecast unit rates because they are the most current, market tested rates that are available, being our 2013-14 actual unit rates. Our forecast of the Replacement capex (modelled component) falls below the most appropriate scenario in the Repex model as modelled by Nuttall Consulting, which has been calculated using our 2013-14 unit rates.

- Nuttall Consulting's assessment of the reasonable range of the Replacement capex (modelled component) shows a steadily rising replacement program over time. Our forecast, on the other hand shows a trend reduction over the period from 2017.
- Our current performance data is indicating higher asset failure rates which are not fully reflected in the Repex model across certain asset categories, namely pole top structures, transformers, switchgear and overhead conductors. This will cause the AER's Repex model to under-estimate our efficient Replacement capex requirements.
- Our forecast capex on Services replacements includes expected asset failures attributable to causes other than age. Examples of such causes include third party damage. The AER's Repex model, on the other hand, is based on relatively young average asset age with a bias towards lower replacement volumes. This will cause the AER's Repex model to under-estimate efficient Replacement capex.

The apparent efficiency of our Replacement capex (modelled component) would be further enhanced if these last two matters are taken into account in assessing the outputs of the AER's Repex model. Taking these considerations into account, we consider that Nuttall Consulting's analysis verifies that the modelled portion of our Replacement capex is efficient.

It is important to recognise that the Repex model could not be applied to the remaining 36% of our Replacement capex. As explained in section 1.1, the majority of this Replacement capex is driven by safety ('Replacement – Unmodelled') and non-asset specific programs (Replacement - Other), which cannot be assessed by the Repex model. This observation highlights the limitations of the Repex model and the importance to taking a cautious approach in drawing conclusions from its outputs.

The information presented in Chapter 6 below provides a summary of the rationale for each component of our Replacement expenditure proposal, including those programs that are outside the scope of the Repex Model. More detailed 'Capital Expenditure Explanatory Statements' explain and justify each component of our proposed Replacement capex.

UNITED ENERGY

6. Explanation of forecast expenditure

6.1. Introduction

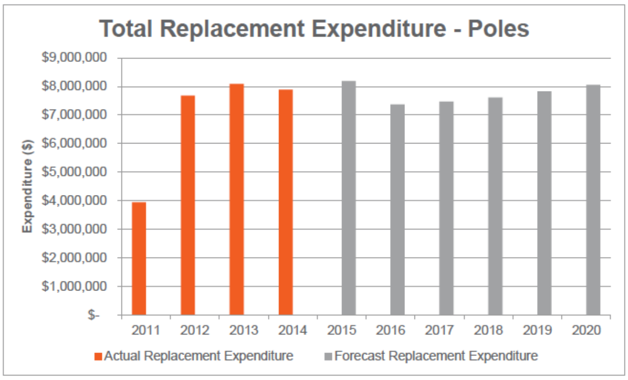
This chapter provides a high-level explanation of the forecast expenditure for each Replacement capex category specified in RIN template 2.2. A more detailed explanation is provided the accompanying Capital Expenditure Explanatory Statements, which also address the requirements of paragraph 6 of Schedule 1 of the RIN.

The table below lists each RIN category; the relevant Capital Expenditure Explanatory Statement; and the forecast capex over the forthcoming regulatory period. A summary of each Capital Expenditure Explanatory Statement is provided in the remainder of this chapter. As noted in section 4.5, the expenditure forecasts provided in the Capital Expenditure Explanatory Statements, and in the summaries in this chapter, are not escalated. The escalated totals for each RIN category are shown in the table below.

Table 6-1: Total escalated capex forecasts by RIN category

Expenditure category (as per RIN template 2.2)	Cross reference to Capital Expenditure Explanatory Statement summary		Expenditure forecast for 2016-2020 ($M in 2015)	Percentage of Replacement Capex
Poles	6.2	Poles	39.4	6.7%
Pole top structures	6.3	Pole top structures	99.4	17.0%
Overhead conductors	6.4	Overhead conductors	55.3	9.4%
Underground cables	6.5	Underground cables	44.3	7.6%
Service lines	6.6	Service lines	34.2	5.8%
Transformers	6.7.1	Zone substation transformers	56.6	9.7%
	6.7.2	Pole top transformers	6.3	1.1%
	6.7.3	Non-pole transformers	8.3	1.4%
Switchgear	6.8.1	Zone substation circuit breakers	33.1	5.7%
	6.8.2	Distribution switchgear	48.8	8.3%
SCADA, network control and protection systems	6.9.1	SCADA and Communications	14.4	2.5%
	6.9.2	Protection and control relays	20.0	3.4%
Other - Zone substation primary assets	6.10.1	Zone substation capacitor banks and earth grids	5.9	1.0%
	6.10.2	Zone Substation Buildings	3.9	0.7%
Other programs	6.11.1	Reliability Maintained	36.4	6.2%
	6.11.2	Environmental	5.3	0.9%
	6.11.3	Power Quality	8.2	1.4%
	6.11.4	Safety	27.4	4.7%
	6.11.5	Operational Technology	38.0	6.5%
TOTAL			**585.1**	**100.0%**

6.2. Poles

Asset description	United Energy has 170,000 poles on its network. Poles are critical to the network as they carry live HV and LV conductors through public space and city streets and connect power to customers. Any pole falling to the ground can cause damage to property or people as a result of the impact of the pole or electrocution from the live conductors. Pole failures also create fire risk. Poles are either staked or replaced according to individual condition assessments, location, and criticality. Staking is significantly lower cost than replacement. Approximately 55% of poles at end of life are currently staked, and is expected to increase to 60% in the forecast period.
Main drivers of expenditure	Safety is the single most important driver of pole replacement expenditure. The rate at which a pole deteriorates and reaches the end of its working life is dependent on the local environment. The main deterioration drivers for wood poles are, timber rot (internal, external and above ground), pole top water pooling, fungi, termite attack and pole top fires, among others. For steel and reinforced concrete poles, the deterioration drivers are mostly due to steel corrosion from salt in the air and soil among other corrosive elements. In the period between 1996 and 2013, there has been an average of 4 pole failures per year out of a total of 142,940 wood poles, or 0.003% of poles failing per year. Pole failures contributed 2.5 minutes of unplanned SAIDI in 2014.
Expenditure forecasting methodology	The forecasting model has been revised so it is now based on a Weibull distribution and uses actual age of historical replacement data to determine the parameters. Improvements also allow for identifying, and modelling separately, programmes of work that target specific pole types. EA Technologies CBRM model has been implemented by UE and is being used as a validation tool to test the output of United Energy's internal forecasting model.
Historic and forecast expenditure	United Energy expects to replace or stake approximately 6,514 poles in the current regulatory period compared to the AER's allowance of 4,904. Our volume forecast for the forthcoming regulatory period is 9,492. The majority of the increased volumes (both for the current and forecast period) relate to staking poles, rather than replacing poles, which is substantially cheaper. The annual forecast expenditure is in line with recent historic levels. 
Principal reasons for proposed expenditure	The age profile and risk analysis indicates that the proposed volume of replacement is appropriate in terms of maintaining performance and safety. Lower volumes would expose United Energy and its customers to unacceptable risks.
Validation	The repex model predicts lower replacement volumes and a higher staking rate. However, our detailed analysis of the repex modelling demonstrates that our forecasts are soundly based. This conclusion is confirmed by the CBRM analysis.

6.3. Pole top structures

Asset description

United Energy has approximately 254,000 pole top structures on its network. Pole top structures support overhead electrical conductors and other cross arm mounted assets, providing safe clearance and isolation from ground and between phases plus to other adjacent objects, complying with safety regulations.

Main drivers of expenditure

Condition is the principal driver of expenditure, and the majority of replacements are identified through inspection cycles. Age is an important determinant of asset condition. The age profile of the asset base indicates that 3,000-4,000 pole top structures per annum approach end of life (approximately 50 years). Pole top structures are significant contributors to unplanned SAIDI, which is showing a worsening trend.

Change to pole top camera inspections (and increased inspection) will improve condition assessment and hence effectiveness of replacement capex.

Other replacement programs target specific issues such as, replacing certain types of insulators that are prone to failure, replacement of stay wires and wooden cross arms.

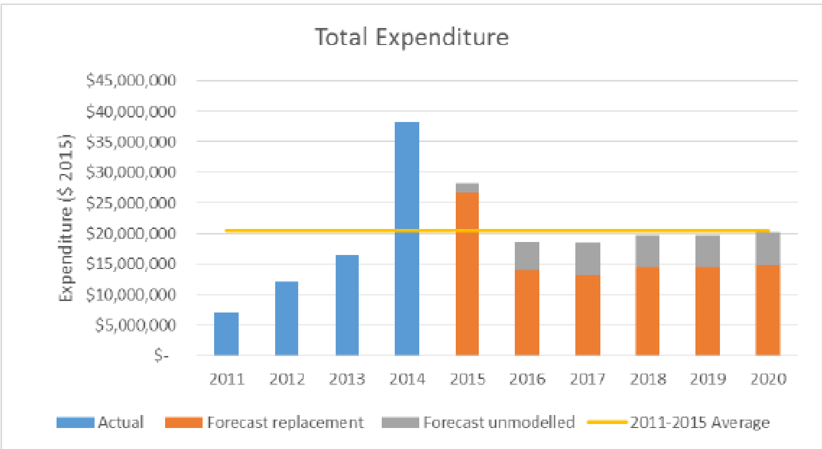
Expenditure forecasting methodology

Failure rates are estimated on a trend basis. Replacement based on condition is estimated using a Weibull model.

EA Technologies CBRM model has been implemented and is being used as a validation tool to test the output of United Energy's internal forecasting model

Historic and forecast expenditure

United Energy is forecasting lower capex on pole top structures in the forthcoming regulatory period, as illustrated below. Our replacement capex for this asset class is expected to be 5% lower than the current period, with volumes reducing by 3%.



Pole top failures increased significantly during the current regulatory period, with the number of failures involving fire increasing from 6 in 2011 to 77 in 2013. We increased replacement volumes in 2014 and 2015 in response to the poor performance. Our improvements to condition monitoring should enable us to reduce capex compared to the current period and also reduce the contribution to SAIDI minutes.

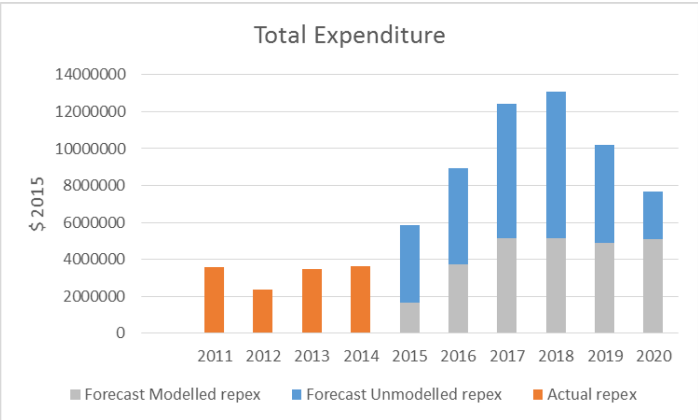
Principal reasons for proposed expenditure

The proposed expenditure reflects the estimated volume of replacements based on condition and historic failure rates. The lower total costs reflects the expected improvement in condition monitoring, which we expect to deliver savings for our customers and is reflected in our lower capex forecasts.

Validation

The repex model predicts lower replacement volumes, but does not recognise the deteriorating asset performance or revised asset lives. United Energy considers its forecast to be prudent and efficient, noting that we are forecasting 5% lower capex.

6.4. Overhead conductors

Asset description	Conductors provide the electrical conducting medium that connects various sections of the electrical network together. United Energy classifies conductors by both voltage level and conductor type as follows: • ABC – Aerial Bundled Cable (HVABC/LVABC) • Steel (SWER/Non SWER) • Bare/Open Wire (ASCR/AAC/HDBC) The connectors on United Energy's network have been installed over a broad time-span, using different materials and construction methods as technology developed.
Main drivers of expenditure	United Energy aims to replaced assets before the end of the serviceable life to reduce the risk of bush fire starts and improve network safety. Expenditure is driven by our obligations to maintain a safe and reliable network, including: ESV directives; the Electrical Safety Management Scheme; and the Victorian Bushfires Royal Commission. SAIDI performance is also an important driver, noting that unplanned SAIDI is showing a trend increase for this asset class. The installed HVABC is failing prematurely because of a fault in the cable design and has resulted in reduced network reliability and an increased bushfire safety risk.
Expenditure forecasting methodology	Three different forecasting methods are adopted, depending on the expenditure category: • The Weibull model is applied for the conductors age based replacements • Historical trend is used for the Ampact replacement, damper installations and live line clashing • Project based forecasts have been developed for SWER and non-metallic screened HV ABC replacement projects.
Historic and forecast expenditure	The figure below shows actual and forecast replacement capex for conductors and connectors, including projects that are 'unmodelled' by the AER's Repex model.  The total length of conductor replacement in the forecast period (121Km) is similar to that replaced in the current period (115Km), but the mix of conductor types differs.
Principal reasons for proposed expenditure	Major replacement projects, including SWER and HVABC replacement, are driven by our compliance obligations. The replacement program for conductors aims to return SAIDI performance to historic levels. Increased installation of dampers and armour rods are required in response to the Victorian Bushfires Royal Commission.
Validation	The AER's Repex model supports our forecast, providing that unmodelled projects, such as SWER replacement and HVABC replacements, are taken into account.

6.5. Underground cables

Asset description

Underground cables, LV underground service pits, LV underground service pillars; and lightning / surge arrestors. United Energy has approximately 853 km of HV underground cables; 1,694 km of LV underground cables; 111,871 pits, pillars and cabinets; and 13,200 surge arrestors installed in our network

Main drivers of expenditure

Cable replacements are driven by faults, which is correlated with asset age. The network is experience trend SAIDI increases as a result of cable faults.

Surge arrestor replacements are driven by asset performance, which is typically age related, and adverse weather conditions.

In Doncaster and Templestowe, United Energy initiated the Doncaster Pillar Replacement Program (DPRP) in 2013. There have been a number of faults found with this type of pillar and the root cause is the low clearance between “live” parts and the external metal case, which is a public safety issue. To date, the DPRP is approximately 50% complete, with the remaining replacements planned for the 2016-2020 period.

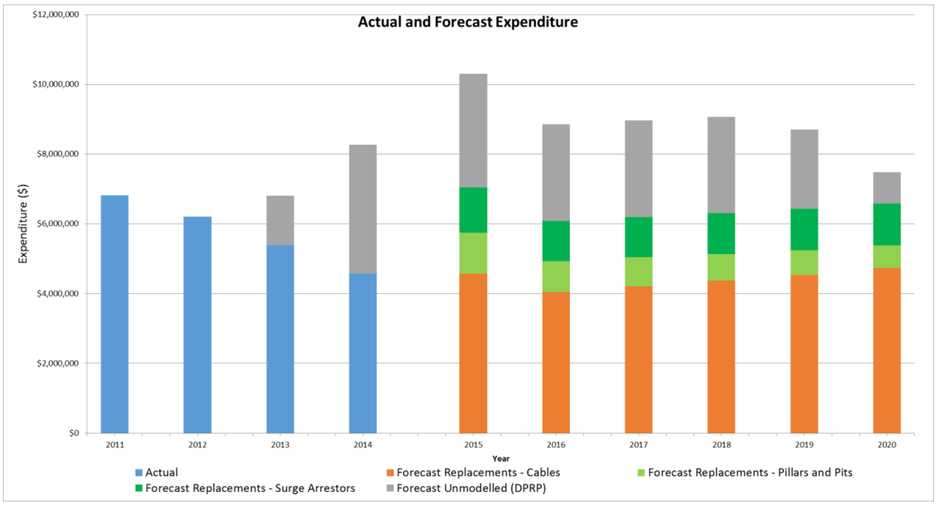
Expenditure forecasting methodology

Weibull models are used to forecast replacement volumes for surge arrestors, HV and LV underground cables. For pillars and pits, forecasts are based on historical actual replacement rates and escalated annually to account for increasing failure rates with ageing assets.

The DPRP replacement program is subject to a separate forecast, with the program planned for completed in the forthcoming regulatory period.

Historic and forecast expenditure

The figure below shows actual and forecast replacement capex, including unmodelled Repex expenditure. The forecast increase in reflects higher replacement volume as a consequence of the aging asset base.



Our actual capex in the current period exceeded the AER’s allowance, principally because the DPRP was not included in the AER’s allowance.

Principal reasons for proposed expenditure

There is an increase in the number of underground cables reaching end of life, which is driving an increase in replacement volumes. A similar driver is leading to increased volume for surge arrestors (1888 compared to 1236) and pillars and pits (2258 compared to 1990) is also forecast to increase.

Validation

United Energy’s forecast asset replacement volumes are less than the AER’s Repex model - except for Surge Arrestors, which is explained by different mean asset age assumptions. Our forecast unit rates are lower than estimated by the AER’s model. Our proposed capex for this asset class is demonstrably prudent and efficient.

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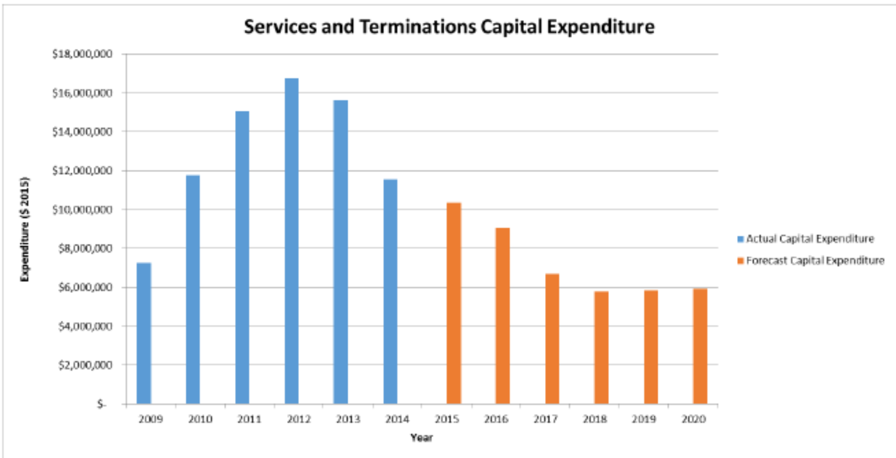
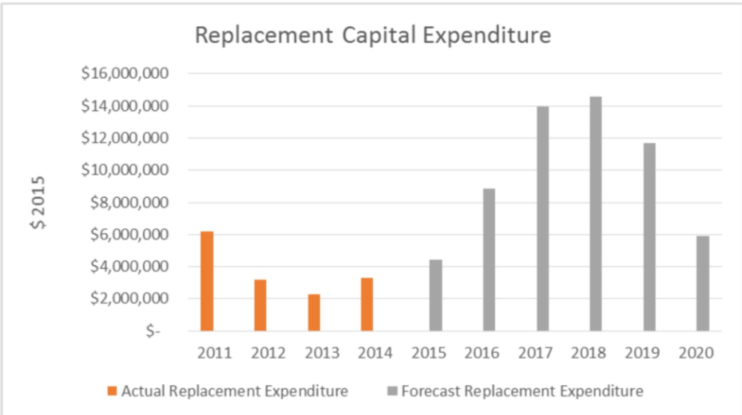
6.6. Service lines

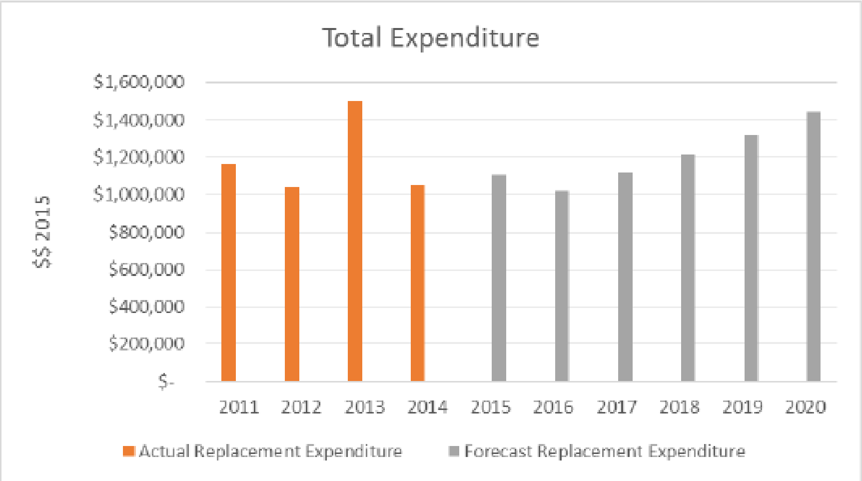
Asset description	LV Services and Terminations. United Energy has 373,000 overhead services and 99,300 underground services installed in its network.
Main drivers of expenditure	Replacement may occur as a result of testing, a service fault, or a compliance or safety issue (such as minimum clearance or service type, such as neutral screened conductors). End of life is typically at approximately 40 years of age. Faulty services are a significant source of electric shocks and fire risk. Services only contribute approximately 0.5 minutes to unplanned SAIDI and we expect this level of performance to be maintained in the forthcoming regulatory period.
Expenditure forecasting methodology	A combination of forecasting methods (principally Weibull modelling and historic trends) is used depending on the driver for replacement. The largest volume - end of life replacements – is estimated using a Weibull model. Historic data and trending are employed to address other drivers, such as non-age related faults ie. trees, disconnect device, minimum height and vegetation clearance.
Historic and forecast expenditure	The figure below provides an overview of the total actual and forecast capex for service lines.  Our capex in the current period exceeded our forecasts and the AER allowance (by 43%), principally because unit costs were substantially higher than forecast. Our principal focus was on the replacement of neutral screened services, which is a safety obligation. A number of replacements are also required in the forthcoming period. We have compared historic and forecast fault and condition based replacement volumes. The replacement volumes during 2007 to 2009 and the forecast volumes from 2017 to 2020 differ by less than 1% per year, which demonstrates that our forecast is reasonable and in line with historical trends.
Principal reasons for proposed expenditure	The proposed volume of replacements is consistent with levels observed prior to the neutral screen replacement program, taking into account the ageing asset base. The forecast expenditure reflects the updated unit rates, which are competitively tendered and provide a much better source of data than the unit cost forecasts in the current EDPR.
Validation	The AER's Repex model is not a valid forecasting method for this asset class because of the impact of recent safety programs and historic unit costs. Our detailed analysis shows that the proposed volumes are closely aligned to underlying historic volumes. Our unit costs are market tested and have been obtained from our two service providers. This provides a degree of benchmarking and competitive tension in our estimation process. We validate our costs annually, ensuring they are a realistic representation of current market conditions.

6.7. Transformers

6.7.1. Zone substation transformers

Asset description	The zone substation transformer asset class relates to power transformers located in zone substations. United Energy has 112 zone substation transformers. The majority of the replacement capex (approximately 80%) relates to transformer replacement, which is the focus of this summary. The remaining expenditure relates to specific replacement programs such as bushings replacement, tap changer replacement and oil replacement.
Main drivers of expenditure	A transformer is considered to have reached its end of life when its paper insulation has lost the majority of its mechanical strength (measured by DP values). The objective is to replace transformers before failure occurs. While zone substation transformers have not contributed to unplanned SAIDI, it is important that investment occurs to maintain this performance in the forthcoming regulatory period. By 2016, one-third of all transformers will be more than 50 years of age. This is significant because transformers of this age are reaching the end of their lives.
Expenditure forecasting methodology	United Energy has reviewed its current forecasting method (based on DP values) and found it be accurate. In particular, the estimated DP values for replaced transformers have proved to be accurate. It should be noted that the decision to replace the transformer considers cost, risk and benefits to ensure that any replacement decision is economic. United Energy bases its cost estimates on detailed scopes of works for individual projects. For bushings replacement (Weibull), tap changes (manufacturers' guideline) and oil replacement (age-based), the selection of forecasting method is appropriate for each type of work. We are confident that these forecasting methods are robust. EA Technologies CBRM model has been implemented and is being used as a validation tool to test the output of United Energy's internal forecasting model.
Historic and forecast expenditure	The figure below indicates that we are forecasting a substantial increase in forecast capex for zone substation transformers in the current regulatory period compared to the current period. Fourteen 66kV transformers and 3 22kV transformers are forecast for replacement compared with six that have been replaced in the current period. 
Principal reasons for proposed expenditure	United Energy approach to assessing transformer condition is 'best practice'. The DP values estimated for zone substation transformers drive the proposed replacement volume. The condition-based risk management model for our transformer asset class also confirms the proposed volume of transformer replacements.
Validation	The volume of transformer replacements – the primary cost for this asset class – is validated by the AER's repex model. It is also supported by the age profile of transformers and recent increases in failure numbers and days out of service.

6.7.2. Pole top transformers

Asset description	Pole type transformers are outdoor transformers mounted on timber and concrete poles. Their purpose is to convert electrical power voltages.
Main drivers of expenditure	Detailed condition monitoring of these assets is not possible, but visual inspection is undertaken to assess external condition. Assets are replaced once they have failed, or are identified as being in poor condition (e.g. leaking oil). The main expenditure drivers are projected failure rates and asset condition, which are broadly correlated with age. The asset's performance as measured by actual failure rates has deteriorated since 2011.
Expenditure forecasting methodology	Replacement volumes are forecast using a trend of historical data. The Weibull model could not be used due to skewed historical asset failure data over the period from 2009 to 2011. The method used is an improvement compared to the PB model adopted in the last EDPR. Unit rates have also been amended to reflect current competitively tendered market rates, which are informed by actual costs.
Historic and forecast expenditure	The figure below provides an overview of the total actual and forecast capex for pole top transformers.  Our capex in the current period exceeded our forecasts and the AER allowance, principally because unit costs were substantially higher than forecast, even though the volume of assets replaced was below forecast. Replacement volumes for the current period were less than forecast because a large number of transformers were replaced under the augmentation budget following high loading in the years 2009 to 2011.
Principal reasons for proposed expenditure	Overall, the asset's performance as measured by actual failure rates has deteriorated since 2011, indicating that the level of replacements in the forthcoming regulatory period needs to be increased compared to the current period. The forecast level of expenditure is consistent with maintaining the current level of reliability of pole top transformers. The forecast for the next five years predicts a slow but steady increase of replacements to maintain UE's reliability to customers, public safety and prudent and efficient expenditure. This increase is not unexpected, given an increasing number of older assets in this asset class. Without adequate replacement expenditure being allocated to this asset class, our ability to deliver reliability, safety and security outcomes that accord with the capital expenditure objectives in the Rules will be compromised.
Validation	United Energy's forecast volume is 4% more than that predicted by the AER's repex model and very similar replacement expenditure. This outcome provides additional assurance that the expenditure forecast is efficient and prudent in accordance with the Rules requirements.

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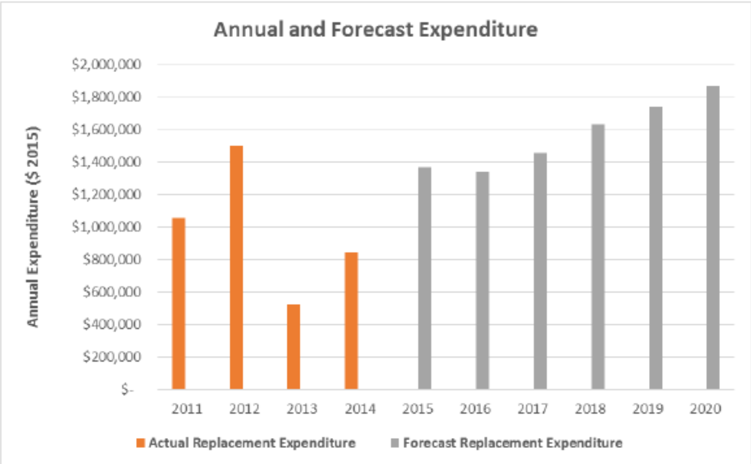
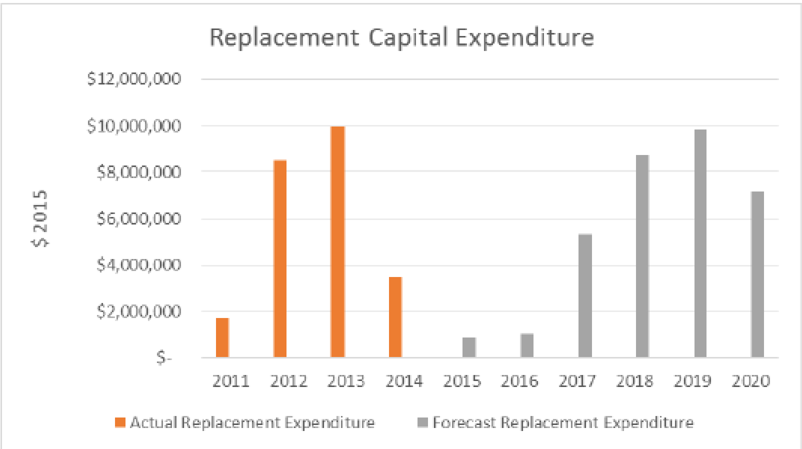
6.7.3. Non-pole distribution transformers

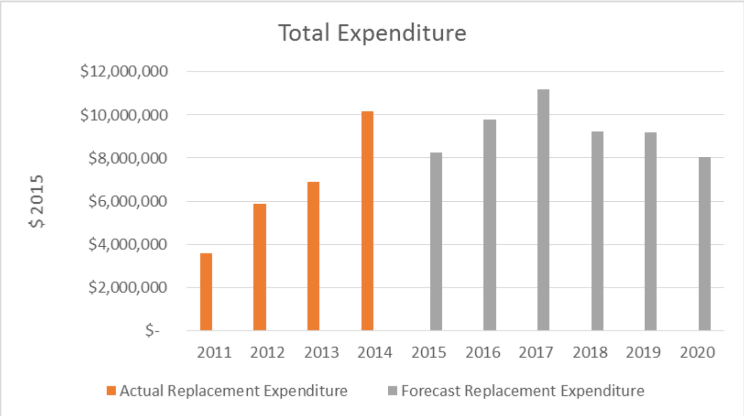
Asset description	United Energy has approximately 4,090 non-pole distribution transformer substations installed in its network, including Ground; Indoor; Kiosk; Switch Cubicles; Metal/fibreglass shells. The assets in a substation include high voltage switchgear transformers and low voltage switchgear. The expenditure discussed here only relates to transformers.
Main drivers of expenditure	United Energy's strategy for non-pole transformers is to allow non-critical transformers (typically those < 1500KVA) to run to failure and to proactively manage larger, more critical transformers to prevent failure by undertaking condition monitoring through DGA testing.
Expenditure forecasting methodology	Individual Weibull models have been created for kiosk type, indoor/underground, ground and large indoor transformers in order to accurately model the asset class. The Weibull characteristics have been developed based on the actual age of assets replaced during the past five years. For larger transformers, oil samples are used to assess asset condition and further improve the forecast expected life and replacement expenditure.
Historic and forecast expenditure	The figure below provides an overview of the total actual and forecast capex for non-pole transformers. The forecast increase in expenditure comprises a mix of additional volume (230 forecast compared to 211 in the current period) and increased unit rates. As already noted, unit rates are competitively tendered.  Our replacement capex in the current period ($5.29m) was closely aligned with the AER's allowance ($4.74m), excluding replacements through augmentation. However, replacement volumes were lower than forecast (23% lower), principally because cooler summers (and reduced peak demand) led to fewer failures than expected.
Principal reasons for proposed expenditure	Although asset performance has shown a modest trend improvement, the number of transformer faults found during inspection is increasing. In addition, there is an increasing trend rate in failures since 2013. The age profile of the asset base indicates that increased replacement volume will be required in the forthcoming regulatory period. The unit rates reflect competitively tendered market prices.
Validation	The repex model supports a higher volume of replacements (308) than United Energy's forecast (230) for the forthcoming regulatory period. We recognise that the repex model analysis reflects the higher volume of failures over the modelled period 2009-2013. Our forecasts use more relevant actual data, which showed lower numbers of replacements. Importantly, however, a return to the hot summers in 2009 and 2010 would lead to a return to the higher failure rates. Overall, we are confident that the forecast volume of replacement is appropriate, and reflects the best available information.

6.8. Switchgear

6.8.1. Zone substation circuit breakers

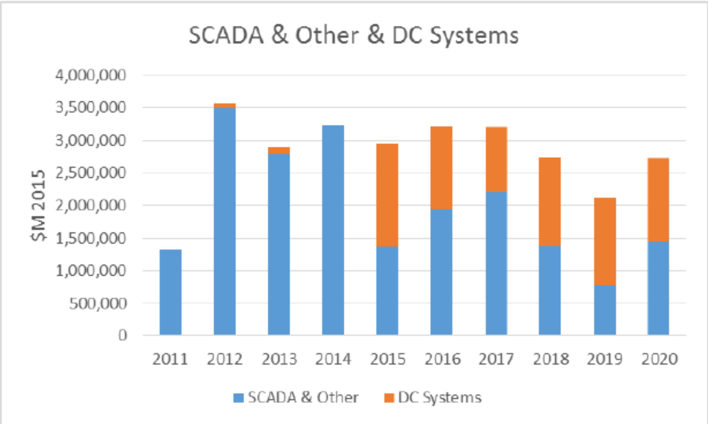
Asset description	Zone substation circuit breakers, both indoor and outdoor.
Main drivers of expenditure	A circuit breaker is replaced when it is in poor condition mechanically and cannot be repaired or when its insulation reaches end of life and it poses a high risk of failure. A total of 296 circuit breakers are more than 45 years of age. Over the next fifteen years most of these circuit breakers will need to be replaced.
Expenditure forecasting methodology	A Weibull model has been adopted to determine replacement volumes. This model produces the best estimate of the asset age at end of life, based on actual data. It is superior to historical trends and the PB age-based model that was used in the previous period. The identification of specific circuit breakers to be replaced is based on a multi-criteria assessment process, which considers a range of factors that include DLA tests, defect history and the availability of spare parts to effect repairs. The decision also considers age, consequence of failure, deterioration rates and fault interruption capability. The methodology is an improved approach compared to the PB model adopted in the previous EDPR. The unit rates have also been amended to reflect current competitively tendered market rates, which are informed by actual costs. EA Technologies CBRM model has been implemented and is being used as a validation tool to test the output of United Energy's internal forecasting model
Historic and forecast expenditure	The figure below provides an overview of the total actual and forecast capex for zone substation circuit breakers.  The volume of circuit breakers to be replaced in the forthcoming regulatory period (110) is closely aligned to the volume in the current period (107).
Principal reasons for proposed expenditure	The forecast expenditure is in line with historic replacement volumes and reflects the age profile of the assets. At the end of the forecast period, the number of assets exceeding 50 years of age will be 202 compared to 157 currently. A lower level of replacement would expose our customers to unacceptable risks.
Validation	The repex model forecast replacement volume of 114 for the forthcoming regulatory period compared to our forecast of 113. The replacement costs for this asset have been obtained through scoping and estimating each project. The costs are all-inclusive project costs and may be higher than historical costs because they will include replacements of other assets such as control and protection relays or modifications to buildings.

6.8.2. Distribution switchgear

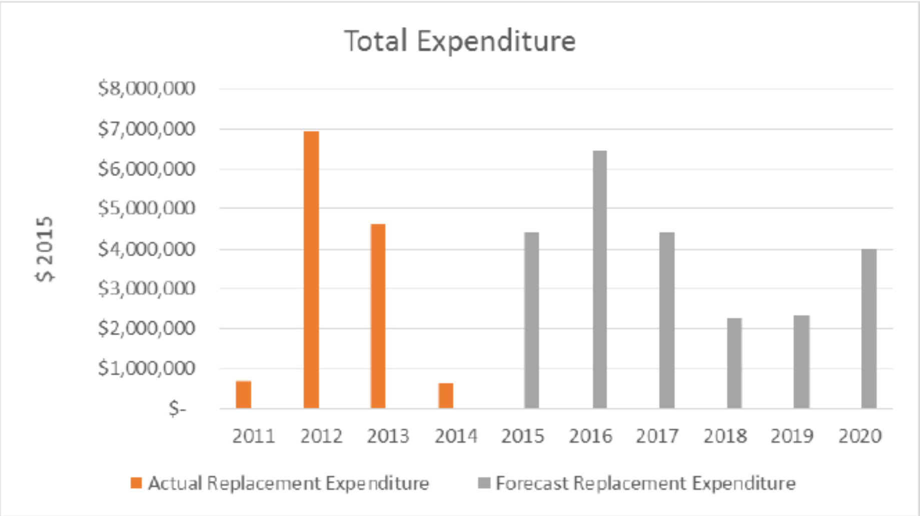
Asset description	This asset class includes: HV Switches – ABS; HV Switches – RMU; HV Switch – Isolators; Automatic circuit re-closers (ACRs); fuses; LV switches; fuse boxes; and capacitor banks.
Main drivers of expenditure	Our replacement capex is focused on maintaining network reliability, security and safety. The forecast volume of switchgear to be replaced is driven primarily by assets reaching end of life and the replacement of poorly performing assets. For example, 131 HV switches are within five years (15%) of their expected serviceable life or have already exceeded it. The percentage of the asset fleet that is inoperable or poses a safety hazard is also increasing. The contribution of distribution switchgear to unplanned SAIDI has shown a trend deterioration since 2004. This is an important driver for increased capex.
Expenditure forecasting methodology	For HV switchgear, United Energy uses a Weibull model, which employs actual historical replacement data to forecast replacement volume. For other asset classes, our forecasts are based on historic trends.
Historic and forecast expenditure	The figure below shows our actual and forecast capex for distribution switchgear. United Energy forecasts an increase in replacement capex in the forthcoming regulatory period.  It should be noted that our actual expenditure during the current period exceeded the AER's allowance by 40%, as a result of reliability issues. We forecast a modest increase in replacement volume in the forthcoming regulatory period, with the remaining increase explained by higher unit rates.
Principal reasons for proposed expenditure	Our forecast increase in replacement capex is driven by: • HV switches. We are proposing an increased replacement volume for HV switches. This increase is principally to address safety issues associated with ABS by gradually replacing them over time. The switches are a relatively high cost item and accounts for approximately 50% of the proposed increase in replacement capex for this asset class. • LV switches. The LV pole replacement program commenced in 2014. The program will continue in the forthcoming regulatory period and the costs will be similar to the actual expenditure incurred in 2014 and 2015. • LV fuses. Until recently, fuse replacements at the same time as distribution transformer replacements have not been captured as expenditure against this asset. This reporting change leads to an apparent increase in capex.
Validation	We have conducted a detailed validation against the AER's repex model, which produces a forecast that exceeds our proposed expenditure by 21%. The proposed modest increase in replacement volumes is warranted given the deterioration in asset performance.

6.9. SCADA, network control and protection systems

6.9.1. SCADA and Communications

Asset description	PQ Meter, RTUs, DWDM devices, communication systems, DC batteries, DC battery chargers. The protection and control relay replacement expenditure is discussed separately.
Main drivers of expenditure	The failure of SCADA and communication assets would have a significant impact on network reliability and safety. We cannot meet our regulatory obligations if these assets were to fail. Given the critical importance of these assets, replacement typically occurs before their serviceable life has been reached. Replacement is driven by age, asset condition, performance, absence of vendor support and obsolescence. Replacements are aligned with other zone substation projects to minimise the total costs. In the forthcoming regulatory period, we plan to duplicate DC batteries to protection and control systems and SCADA. The dependence on DC batteries – and the consequences of failure - makes it economic to commence duplication of these systems.
Expenditure forecasting methodology	Our forecasting methodology for the forthcoming regulatory period is unchanged from the current period. In general, it is based on the performance, condition and age of each asset to identify which assets are to be replaced. A Weibull forecasting approach is employed for some, but not all assets. The limited availability of historic failure data means that Weibull modelling is not always appropriate. The timing of replacement expenditure may be influenced by other related projects, which allow works to be combined and costs minimised. The availability of vendor support and spares may also influence timing.
Historic and forecast expenditure	The figure below provides an overview of the total actual and forecast replacement capex for SCADA and communications.  Although the forecast and actual expenditure is similar in aggregate, there are significant differences at the asset category level. The most material difference is the new program to establish duplicate DC systems at four zone substations.
Principal reasons for proposed expenditure	The forecast expenditure is in line with the expenditure in the current period. However, the forecast includes a new project to establish redundant battery supplies at four zone substations per annum to address risk of battery failure.
Validation	The AER has indicated that it will not be using its Repex model analyse the forecast for this asset class. Our validation is based on historical expenditure, which supports our proposed expenditure.

6.9.2. Protection and control relays

Asset description	UE has 2531 protection relays installed in our zone substations; 783 electro-mechanical; 259 analogue; and 1489 digital/numerical.
Main drivers of expenditure	The purpose of protection and control relays is to monitor operating conditions on an electrical circuit and to trip circuit breakers when a fault is detected. The devices are an essential part of providing a safe network, as they are the key element in detecting and clearing faults, thus protecting personnel and assets. The primary driver is to replace aging electromechanical and analogue relays, which are at the end of their lives. We replace electromechanical and analogue relays at nominal Weibull mean life or earlier with digital relays, as the other technologies are becoming obsolete. We also replace targeted protection and control relays that exhibit signs of failure.
Expenditure forecasting methodology	Our forecasting methodology uses a Weibull distribution and actual historical failure data to determine the parameters. Relay replacements are generally planned with other major replacement works and/or target all relays of a similar type at a substation to take advantage of synergies and efficiencies in design and construction.
Historic and forecast expenditure	The figure below shows our actual and forecast replacement capex.  The forecast volume of relays replacements varies considerably from year to year. The reason for the variation is that we replace all the relays at a substation or on a switchboard at the same time to achieve synergies in design and installation. We also align major capital projects where possible to improve efficiency and utilise resources better.
Principal reasons for proposed expenditure	The number of electromechanical and analogue relays reaching the end of their life is increasing. Given the critical nature of this asset group and that there are increasing numbers of relays reaching nominal end of life age in the forecast, United Energy is forecasting a modest increase in the number of assets to be replaced.
Validation	Our forecast volume recognises that we replace all relays at a substation or switchboard to achieve synergies in design and installation. In aggregate, our forecast volume is closely aligned with historic volumes. Our forecasts employ unit rates derived from our contractual arrangements with our competitively sourced service providers.

6.10. Zone substation primary assets

6.10.1. Zone substation capacitor banks and earth grids

Asset description	United Energy has a total fleet of 53 capacitor banks installed in its zone substations. Capacitor banks are generally expected to have a long lifespan. Zone substation earth grids are installed at the time of construction of the zone substation and generally match the installation age.
Main drivers of expenditure	Capacitor banks are non-critical network components. The consequence of failure, however, may be significant – including a reduction in transformation capacity during times of peak load, potential release of PCB-contaminated oil, and plant fire. United Energy initiated a program to replace capacitor banks aged 50 years or greater and prioritised by condition. The replacement strategy is based on the average life span of 60 years for large Ducon capacitors and 40 years for small capacitors. A large number of these Ducon capacitors are showing age related degradation problems and need to be replaced before failure. The earth grids in zone substations are considered to be in good condition/performance. Failures are primarily due to third party damage from excavations or vehicles, and changes in ground conditions.
Expenditure forecasting methodology	For capacitor banks, our forecast capex reflects historical data on failures/defect and estimates for specific projects justified by the condition of the assets. Our cost forecasts are bottom up assessments based on statements of work. For earth grids, our capex forecast reflects the cost of replacement / augmentation works for the first 10 year inspection program of all its zone substation earth grids – this program was undertaken in 2005 as part of our ESMS obligations.
Historic and forecast expenditure	The table below shows our (unescalated) forecast capital expenditure for capacitor banks and earth grids.

	2016 ($,000)	2017 ($,000)	2018 ($,000)	2019 ($,000)	2020 ($,000)	Total ($,000)
ZSS Capacitor Banks	722	1,084	1,086	1,089	731	4,711
ZSS Earth Grids	193	180	207	208	168	956
ZSS Neutral Earthing Resistor	95					95

For capacitor banks, our forecast capex of $4.71m compares to actual expenditure of $0.8m for the current period. The increase is due to the capacitor replacement program, noted above. For earth grids, we expect the second 10 year inspection program to identify fewer replacement / augmentation works compared to the first inspection program, which commenced in 2005. Consequently, our forecast capex of $0.96m is lower than the capex incurred during the first inspection program, being $4.5m.

Principal reasons for proposed expenditure	Each of United Energy's 17 Ducon Capacitor Banks showing signs of oil leaks. Due to their construction, it is not possible to determine oil levels and the units are not refurbishable. If oil levels fall below the manufacturer's prescribed operational levels, the internal insulation could breakdown resulting in a catastrophic failure of the entire capacitor bank. The oil reservoir could also explode and spill PCB-contaminated oil. Consequently, these Ducon units need to be replaced in a timely manner before failure. The proposed replacement program is reflected in the higher forecast expenditure in the forthcoming regulatory period. As noted above, the Earth Grids capex is lower than historic levels.
Validation	The nature of replacement work for capacitor banks and earth grids is needs / project based and their respective project Statement of Works vary significantly from project to project. As such the AER Repex model is not applicable as a validation tool for forecast expenditure. Our forecast expenditure for this asset class is soundly based, efficient and prudent.

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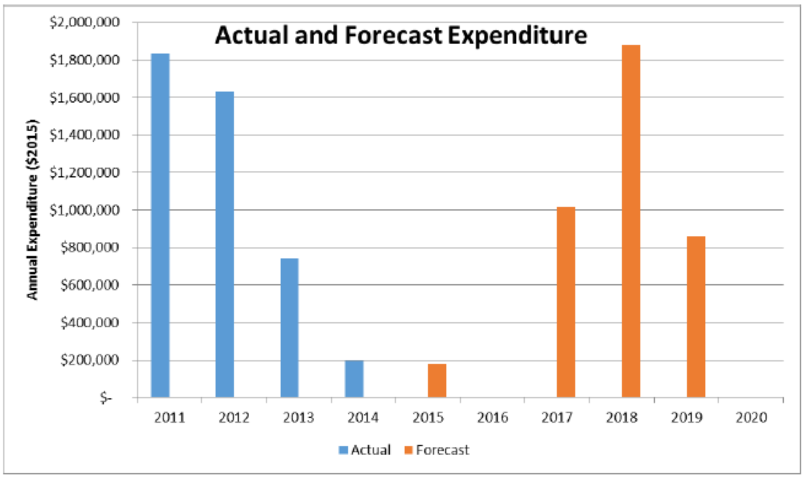
6.10.2. Zone Substation Buildings

Asset description	The expenditure for this asset class relates to zone substation (ZS) buildings, which provide United Energy's personnel with ready operational access to substation assets. The buildings also protect substation assets from environmental elements; provide security for substation assets, and provide a safe environment for the general public and our workforce**.**
Main drivers of expenditure	Brick and portable buildings generally do not need replacing; rather minor refurbishment works are required for upkeep. Timber buildings, however, constitute combinations of weatherboard and asbestos sheeting and are prone to deterioration. Failure to maintain ZSS buildings and grounds will lead to security infringements, threats to public safety, asset damage leading to mal-operation of equipment, and supply reliability issues. Civil engineering reports are obtained for each of the ZSS buildings. For those buildings found to be in an unsatisfactory condition, United Energy determines if works should be undertaken as a standalone project or aligned with other related capex replacement programs/projects.
Expenditure forecasting methodology	Our cost estimates reflect a bottom-up estimate by identifying projects, developing statements of works and obtaining cost estimates. The scope of work reflects the engineering report findings and the extent to which building works can be aligned with other projects.
Historic and forecast expenditure	The figure below provides an overview of the total actual and forecast capex for ZS buildings. Our forecast expenditure is 18% lower than the current period.  The above figure shows that ZS buildings replacement expenditure varies significantly from year to year. This variability reflects the cyclical nature of expenditure drivers – building deterioration, faults, defects and scheduling of building works with related projects.
Principal reasons for proposed expenditure	As a result of unsatisfactory civil engineering report findings for ZSS buildings at Springvale and Dandenong, United Energy will replace two aged buildings between 2017 and 2019.
Validation	United Energy manages this asset class in a cost effective, prudent and efficient manner, and minimising cost duplication over multiple projects. Our forecast expenditure is 18% less than spent in the current period. This reduction is significant considering that United Energy will replace two standalone buildings (2017 to 2019) as compared with no standalone replacements in the current period.

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6.11. Other Programs

6.11.1. Reliability Maintained

Identified need for expenditure

As explained in Chapter 3 of this overview document, we expect the AER to set an unplanned SAIDI target for the next regulatory period of approximately 69 minutes compared to our unplanned SAIDI of 78 minutes in 2014. There is a strong relationship between the percentage of assets at or older than 85 per cent of their asset life and their contribution to SAIDI from equipment failure. By 2020, 21 per cent of our assets will fall within this age category, with the consequence that SAIDI will increase significantly as a result of equipment failure. Additional reliability measures are required to meet the AER's SAIDI target.

Proposed projects and expected benefits

We propose a number of reliability projects to address the identified need:

Project	Benefit
Install new automatic circuit re-closers (ACR's) and remote control gas switches (RCGS's).	Restore supply automatically after transient faults. Minimise the number of customers affected by an outage and restore supply as quickly as possible.
Continuation of the existing program to address "rogue feeders".	Address localised problems that are causing poor supply reliability outcomes for worst served customers.
Install fuse saver equipment.	Prevent fuses from operating for transient faults, reducing the impact for these faults.
Prevent conductor clashing.	Minimise the impact for some outages.
Animal proofing to pole top structures.	Prevent some outages from occurring.
Upgrade communications to existing RCGS switches.	Enables remote isolation of faulted sections of the network, and facilitates supply restoration as quickly as possible.

Forecast expenditure

The table below shows our (unescalated) forecast capex for each program.

	2016	2017	2018	2019	2020	Total
ACR/RCGS	$4,035,681	$1,438,530	$1,327,468	$1,331,334	$1,343,662	$9,476,675
Rogue	$1,104,411	$1,106,455	$1,106,223	$1,109,445	$1,119,718	$5,546,252
Fuse saver	$331,323	$331,937	$331,867	$332,833	$335,915	$1,663,876
Clashing	$1,326,515	$663,873	$663,734	$665,667	$671,831	$3,991,620
Animal	$2,744,892	$1,680,328	$1,921,772	$1,969,513	$2,028,146	$10,344,650
Communications	$634,476	$940,487	$940,290	$943,028	$951,760	$4,410,041
Total	$10,177,298	$6,161,610	$6,291,353	$6,351,820	$6,451,033	$35,433,114

Validation

The efficiency of the proposed expenditure has been verified by reviewing the proposed cost against the corresponding SAIDI benefit. The analysis shows that the proposed capex is lower than the cost of achieving reduction via alternative methods. This analysis demonstrates that the proposed reliability programs are efficient and well targeted. Note our prudent and holistic approach to maintaining reliability recognises the contributions made by each capex category and our opex plans.

6.11.2. Environmental

Identified need for expenditure

United Energy's Environmental Management Plan is focused on meeting our legislative obligations; managing and preventing environmental risks; and providing a safe workplace for our staff and contractors. Our environmental strategies and Environmental Management Systems (EMS) are aligned with the international standard for Environmental Management Systems (ISO 14001).

Environmental programs are required in order to meet our environmental objectives in relation to containment of oil spills, noise control and asbestos. In relation to asbestos, the works will be carried out on a needs basis, as asbestos is discovered or where work is required on assets containing asbestos.

These programs are in addition to the numerous control measures already in place to manage water, land and soil impacts.

Proposed projects and expected benefits

We propose a number of projects to address the identified need:

Project	Benefit
Bunding at 5 zone substations	Satisfy EPA requirements to prevent contamination caused by oil spills from transformers.
Noise reduction at 9 zone substations	Comply with State Environment Protection Policy Control of Noise from Commerce Industry and Trade.
Asbestos management and removal	To prevent asbestos containing material becoming disturbed or damaged, posing risks to the environment and the community.

Forecast expenditure

The table below shows our (unescalated) forecast environmental-driven capex for the forthcoming regulatory period.

Environmental	2016	2017	2018	2019	2020	Total
Bunding/Noise	$1,103,600	$1,440,387	$760,381	$762,646	$542,962	$4,609,976
Asbestos	$110,441	$110,646	$110,622	$110,944	$111,972	$554,625
Total	**$1,214,041**	**$1,551,033**	**$871,004**	**$873,590**	**$654,934**	**$5,164,601**

Validation

For our noise and bunding projects, specific scopes of work have been identified for each site and cost estimates prepared. The proposed expenditure is consistent with the historic cost of similar projects, and therefore is regarded as a reasonable estimate of the efficient cost. Similarly, our estimated cost of asbestos management is based on our historic expenditure, with the expectation of one or two removals required each year.

The overall spend in this area is modest but crucial for addressing our compliance obligations and for appropriately managing risks associated with noise, asbestos and oil containment.

6.11.3. Power Quality

Identified need for expenditure

United Energy has obligations under the Victorian Electricity Distribution Code and National Electricity Rules for quality of supply, including requirements to monitor network power quality and correct power quality where it is outside the codified limits. United Energy is also required to provide information about quality of supply to customers on request.

The introduction of AMI meters (which are essentially fully deployed across the UE network) provides us with a greater capacity to identify and address power quality compliance issues. In addition, emerging disturbances such as harmonics and voltage fluctuations are forecast to become more prevalent over the next ten years with increasing penetrations of power-electronic appliances and intermittent distributed generation.

The projects and initiatives for the forthcoming regulatory period are required to address United Energy's power quality compliance obligations.

Proposed projects and expected benefits

We propose a number of power quality projects to address our compliance obligations:

Project	Benefit
Power quality metering at the end of feeders	Improved monitoring at critical HV feeders and between the transmission and distribution networks. For network fault investigations, will allow United Energy to make better decisions about corrective actions and investment options.
Voltage regulators on our low voltage system	Addresses Code requirements. Installing self-automated LV regulation units will solve the common utility problems of flicker and voltage excursions.
Harmonic filters at five zone substations	Required to address voltage and current harmonic levels outside code limits.
Bus-tie open schemes at five sites	Isolates healthy parts of the network from faulted parts by switching circuit breakers. It will reduce the number of customers affected by severe voltage sag during a fault, without compromising overall system reliability and plant utilisation.

Forecast expenditure

The table below shows our (unescalated) forecast capex for each program.

	2016	2017	2018	2019	2020	Total
PQ Meter other	$201,122	$352,573	$176,821	$51,363	$51,839	$833,718
LV Regulator	$511,301	$512,248	$512,140	$513,632	$518,388	$2,567,709
Harmonic Filter	$766,952	$768,372	$768,210	$770,448	$777,582	$3,851,564
Prot - BTOS	$76,554	$153,674	$153,642	$154,090	$155,516	$693,476
Total	$1,555,930	$1,786,866	$1,610,814	$1,489,532	$1,503,325	$7,946,467

Validation

Our forecast capex is based on a detailed bottom up assessment of project that reflect a prudent approach to maintaining power quality on our network by identifying and prioritising power quality projects where they are most needed.

6.11.4. Safety

Identified need for expenditure	There are two primary safety drivers that are addressed in the 'Other programs' Replacement capex category: • Preventing fire and bushfire starts. Minimising the risk of bushfire is an important objective, especially in light of the Black Saturday bushfire and the findings of the Victorian Bushfires Royal Commission. • Providing better public safety by improving security at our zone substations. As the sophistication of criminal and terrorist activity increases, cyber and physical attacks are increasingly seen as one of key threats to critical national infrastructure security. The increased level of cyber security threats, require greater investment in security systems and processes to ensure operational systems and associated information are protected in the event of a cyber-attack. As already noted in this document, • The replacement of the SWER system is included in the Overhead Conductor category of Replacement capex, and addresses the recommendations of the 2009 Victorian Bushfires Royal Commission. • The program to replace LV service pillars in the Doncaster area is included in the Underground Cables category of Replacement capex. These pillars pose a risk of electrocution to the public and are thus being replaced for safety reasons.
Proposed projects and expected benefits	The two safety programs in the 'Other programs' category are set out below:

Project	Benefit
Installation of Rapid Earth Fault Current Limiters (REFCL) at 4 zone substations.	Reduces the risk of fire starts by significantly reducing the energy into a single phase to ground fault, which inherently reduces the risk of fire starts. The program is included in our safety commitment to Energy Safe Victoria.
Installation of CCTV at 4 zone substations per annum	This project will provide safety benefits through deterring and detection unauthorised entry into our zone substation sites and reflects increasing risk in this area. The remote monitoring capability also provides safety benefits.

Forecast expenditure

The table below shows our (unescalated) forecast capex for each safety program.

	2016	2017	2018	2019	2020	Total
CCTV	$993,359	$1,327,746	$1,327,468	$1,331,334	$1,343,662	$6,323,568
REFCL/GFN	$6,322,437	$7,229,472	$3,912,474	$685,654	$2,240,596	20,390,634
Total	$7,315,796	$8,557,219	$5,239,942	$2,016,988	$3,584,258	$26,714,202

Validation

Cost for each REFCL installation is based on scope of work, costs and experience in installing the pilot scheme. Our approach is to install REFCL progressively, commencing with the highest risk zone substations. The cost of the CCTV role out has also been based on a pilot scheme, and forecast using a generic scope of work for each substation. Given the consistent nature of the work across sites, this is an appropriate approach.

6.11.5. Operational Technology

Identified need for expenditure

Operational Technology projects provide customer value through the application of new technology. Our replacement capex plans depend on the support from new technology to deliver the required reliability outcomes. In the absence of this support, substantially more replacement capital expenditure would be required to deliver the same outcome.

Proposed projects and expected benefits

The principal Operational Technology projects are set out below:

Project	Benefit
Service Mains Deterioration	Upgrade AMI bandwidth to maintain reliability and improve safety, power quality and resilience.
In Meter Capabilities	Captures real time information from AMI meters to deliver better customer service and outcomes.
Light Detection and Ranging	Improved record of assets to produce better strategies to rectify problems and manage risks.
Develop new technologies	9 pilot projects have been identified focused on improving asset performance or monitoring.
Dynamic Rating Monitoring and Control Communications (DRMCC)	Real time monitoring and control of transformers to maximise capacity at peak times.
OT Security	Enhances physical and electronic security.
Distribution Fault Application Data Collection and Analytics (DFADCAA)	Quick and accurate analysis of system events to facilitate identification of best solutions.
Fault location and application development	Better quality of supply, improved network utilisation and shorter outages following faults.

Forecast expenditure

The table below shows our (unescalated) forecast capex for each program (in $M).

	2016	2017	2018	2019	2020	Total
Service Mains Deterioration (Field Work)	$1,618,730	$946,400	$575,840	$615,030	$391,880	$4,147,880
In Meter Capabilities	$ 1,321,210	$249,050	$258,830	$355,910	$166,460	$2,351,460
Test Harness	$559,790	$403,560	$0	$0	$0	$963,350
Light Detection And Ranging (LiDAR)	$1,827,420	$1,317,430	$1,125,630	$1,306,690	$1,123,620	$6,700,790
(DRMCC)	$645,800	$467,610	$400,400	$464,800	$215,010	$2,193,620
OT Security (Network part)	$ 2,397,080	$ 528,600	$1,389,670	$570,670	$1,127,080	$6,013,100
Network Optimiser	$365,480	$59,280	$50,650	$58,800	$24,350	$558,570
Analytics and Forecasting toolset	$406,600	$58,190	$0	$0	$0	$464,790
(DFADCAA)	$535,820	$579,430	$825,120	$1,038,490	$914,670	$3,893,530
Fault Location and application development	$0	$756,300	$646,200	$750,140	$644,170	$2,796,810
Develop New Technologies	$2,067,690	$1,499,800	$1,283,190	$1,491,600	$587,300	$6,929,580
Total	**$11,745,641**	**$6,865,645**	**$6,555,519**	**$6,652,134**	**$5,194,542**	**$37,013,480**

Validation

As explained in chapter 3, operational technology is an important component of our prudent, holistic approach to asset management and maintaining reliability. It enables us to find smarter ways of delivering the required outcomes with fewer inputs. Detailed project justification statements have been developed which outline the scope of work, cost estimates and benefits. For new technologies, pilots will test whether a broader program will provide benefits that outweigh the costs. This is a prudent and efficient approach to assessing new technology.

7. Meeting Rules' requirements

7.1. Capital expenditure objectives and criteria

This document has explained that the main underlying drivers of our Replacement capex are:

- Our obligations to comply with statutory and regulatory requirements relating to safety, health, environmental protection, technical performance and asset management.
- The age profile of our assets, which is an unavoidable consequence of the substantial growth in network investment during the 1960s and 1970s.
- The exposure of our customers to reliability risks associated with an aging asset base, given that asset condition and performance are prone to increased deterioration as assets age.

We manage our assets in accordance with Life Cycle Strategies (LCS) for each major asset class. Each LCS defines our approach to, and principles for, the management of that asset class. The overarching objective of each LCS is to minimise the total life cycle costs by optimising the maintenance, refurbishment and capital replacement program. To achieve this objective, each LCS considers alternative inspection and maintenance cycles, refurbishment and replacement policies to avoid deterioration in overall asset condition and performance.

Our expenditure plans must also enable us to satisfy our compliance obligations. This document has highlighted the key obligations that are driving increased Replacement capex in the forthcoming regulatory period. A particular issue to note is that changes in safety regulations now represents a paradigm shift away from prescribed regulations to a system that is underpinned by identification and management of risks associated with the assets to a level that is "As Low As Reasonably Practicable" (ALARP).

In accordance with the requirements of clause 6.5.7(a) of the Rules, our proposed Replacement capex program for the forthcoming regulatory period ensures we achieve the following objectives:

- meet or manage the expected demand for standard control services over that period;
- comply with all applicable regulatory obligations or requirements associated with the provision of standard control services; and
- maintain the quality, reliability, security and safety of standard control services and our distribution network.

A key challenge in the forthcoming regulatory period is to arrest the trend decline in reliability performance. Our 2014 SAIDI was 78 minutes compared to an average target for the forthcoming regulatory period of 68.7 minutes. Our customers expect us to maintain performance, which means returning future SAIDI performance to the target level, which reflects the historic average over the previous 5 years. We have explained that our capex plans are focused on delivering this outcome and managing the emerging network risk associated with an ageing asset base, which unavoidably leads to increased risk of asset failure. Customer feedback is one of the factors the AER must consider in assessing our forecast expenditure (Rules clause 6.5.7(e)(5A)).

We are also looking for smarter ways of delivering the required outcomes with fewer inputs. For example, we are investing in technology that allows us to anticipate asset failures and response to major outage events more effectively. Our Replacement capex plans depend on the support from new technology to deliver the required reliability outcomes. In the absence of this support, substantially more Replacement capex would be required to deliver the same outcome.

This document has explained why our replacement capex requirements are increasing over the forthcoming regulatory period. For each asset class, we have validated our forecasts using the AER's Repex model, where it is appropriate to do so. This is essentially a benchmarking model, which should be considered by the AER in accordance with Rules clause 6.5.7(e)(4). In addition, we have also explained how our forecasts compare with the current regulatory period (Rules clause 6.5.7(e)(5)). For each asset category, we conclude that our forecast expenditure is consistent with the Rules requirements.

In addition to the material presented in this submission, we also provide further detailed justification of the Replacement capex in accordance with the AER's asset categories in the RIN. This further detailed information is underpinned by asset strategies detailed in the LCSs and network strategies.

The information presented in this document and the relevant supporting documents demonstrate that our forecast Replacement capex satisfies the capex objectives and criteria specified in the National Electricity Rules. We also demonstrate compliance with these provisions for each of the remaining capex categories, as explained in the relevant sub-category documents. The AER must therefore accept our total capex forecast in accordance with clause 6.5.7(c) of the Rules.

7.2. Opex-capex substitution

Clause 6.5.7(e)(7) of the Rules requires the AER to assess our capex forecasts having regard to various factors, including the substitution possibilities between operating and capital expenditure.

Our objective is to minimise total life cycle costs of service provision by optimising the maintenance and capital replacement program. This objective is achieved by balancing the costs of increasing expenditure against the risks and consequences of asset failure. Each LCS therefore considers a number of options for managing each asset class, including alternative capex and maintenance programs, before selecting the preferred approach. The preferred approach identified in each LCS is determined by co-optimising costs (both capital and operating) and outcomes, so as to identify the approach that:

- maximises overall net benefit to customers; or
- minimises the total life cycle costs of achieving specific target outcomes (such as reliability) or compliance obligations.

Through this process, a number of opex-capex substitution possibilities are considered across asset classes, and the optimal mix of capital and operating expenditure is identified.

In addition, in order to maintain reliability we have investigated potential operating expenditure initiatives that have the potential to improve restoration times for all types of faults. In general, these initiatives involve additional field resources, particularly staff. Our analysis has found that capex solutions are generally more cost effective than the operating expenditure alternatives.

We are, however, employing specific operating expenditure initiatives that will assist us in maximising the value and effectiveness of our Replacement capex. For instance, camera inspections (an opex activity) of pole top structures have been trialled and will be introduced, to improve identification of deteriorated pole top structures, so that Replacement expenditure can be better targeted. In addition, our plan for the forthcoming regulatory period is to increase preventative maintenance whilst reducing corrective maintenance, as this is expected to enable us to maintain current levels of network performance at a lower whole-of-life cost.

Given the approach described above, we are confident that our expenditure plans identify the optimal mix of capital and operating activities in order to maintain reliability and meet our compliance obligations. Our rationale for maintaining reliability – and the implications in terms of SAIDI targets – is discussed in Chapter 3.

7.3. Incentive schemes

The Rules require us to explain how our forecast capex relates to incentive schemes. It is helpful to comment briefly on this issue, which is discussed in further detail in the Regulatory Proposal.

We are subject to a Service Target Performance Incentive Scheme (STPIS), which establishes reliability and customer service targets consistent with 'maintaining historic performance'. As explained in Chapter 3 of this document, our network reliability has been subject to a trend decline in recent years. In the context of the STPIS, which sets targets based on historic average performance, our future expenditure plans must arrest the trend of deteriorating reliability.

In addition to the targets set by the STPIS, Chapter 3 notes that our customers do not want service performance to deteriorate, even if it means lower network charges. Implicitly, therefore, customers support the design of the STPIS in setting performance targets based on recent historic performance outcomes. While the STPIS provides us with an incentive to improve reliability, our expenditure plans presented in this document are consistent with meeting the target.

From the commencement of the next regulatory period, United Energy will also be subject to a capital expenditure sharing scheme (CESS). That scheme will provide financial rewards if we deliver capex savings, and will impose financial penalties if our capex exceeds the AER's allowance. Our customers will benefit from the CESS because it strengthens incentives for us to minimise capex while maintaining service performance. In effect, the scheme encourages us to find smarter ways of delivering the outputs that customers want.

In accordance with clause 6.5.7(e)(8) of the Rules, the capex forecasts set out in this document are consistent with the design of the STPIS and the CESS.

8. Supporting documentation

Table 8-1: Mapping of supporting documents for each Capital Expenditure Explanatory Statement

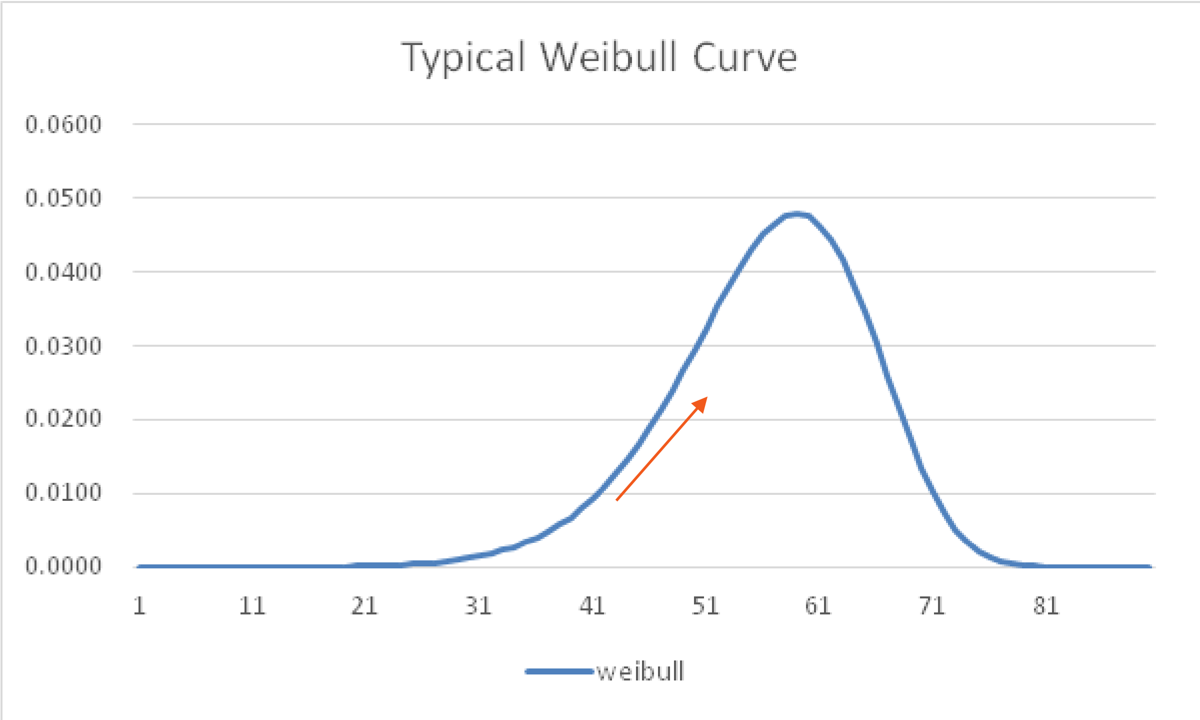
Capital Expenditure Explanatory Statement	Life Cycle Strategy (and UE document number)
Asset Class - Poles	2005 Poles 2039 Bush Fire Prevention
Asset Class - Pole Top Structures	2006 Pole tops
Asset Class - Connectors and Conductors	2007 Connectors and Conductors
Asset Class - Underground Cable Systems	2017 U/G cables 2013 Surge Arrestors
Asset Class - Services and Terminations	2018 Services
Asset Class - Zone Substation Transformers Asset Class - Pole Top Transformers Asset Class - Non Pole Transformers	2028 ZS transformers 2014 Pole top Transformers 2015 Non-Pole transformers MC development 2019 Buildings and grounds
Asset Class - Zone Substation Switchgear Asset Class - Distribution Switchgear	2012 Outdoor Fuses 2008 Overhead Line Switchgear 2023 ZS CB's 2015 Non-pole distribution Subs (part) 2009 Overhead Line Capacitors 2010 Automatic Circuit Reclosers MC development
Asset Class - Public Lighting	2011 Public Lighting
Asset Class - Protection and Control Relays Asset Class - SCADA and Communication	2027 Protection and control relays 2035 Remote Terminal Units 2025 DC systems 2051 DC strategic Plan 2003 Network Communication Equipment 2036 Supervisory Cables
Asset Class – Zone Substation Capacitor Banks and Earth Grids Asset Class - Buildings	2022 Capacitor banks 2024 Instrument transformers NER's 2019 Control buildings 2019 Fences 2016 Earth grids

Capital Expenditure Explanatory Statement	Life Cycle Strategy (and UE document number)
• Other Programs	2300 ACR/RCGS 2300 Rogue Feeders 2300 Fuse Saver 2300 Clashing 2300 Animal 2038 Bunding & Noise 2038 Asbestos 2203 PQ meter other 2203 LV regulators 2203 Harmonic filters 2203 Bus-tie Open schemes 2401 CCTV 2050 REFCL/GFN Op Technology • PJ1407 Develop New tech • PJ1500 OT security • PJ1599 Distribution Fault data • PJ1400 LIDAR • PJ1600 Fault location • PJ1385 Service mains • PJ1413 DRMCC • PJ1386 In meter capabilities • PJ1398 Test harness • PJ1597 Network Optimiser • PJ1598 Analytics and Forecasting tool

Appendix - When do assets start to become unreliable?

A Weibull distribution curve is commonly used to model the end of life of assets. It represents a long period of serviceable life followed by a period of deterioration leading to increasing failure risk with the failure curve looking similar to a normal distribution curve centred around a nominal asset life. For electricity assets, the asset life is typically 40-70 years depending on the asset class.

The chart below shows a Weibull model of end-of-life with a nominal life of 60 years (Beta).



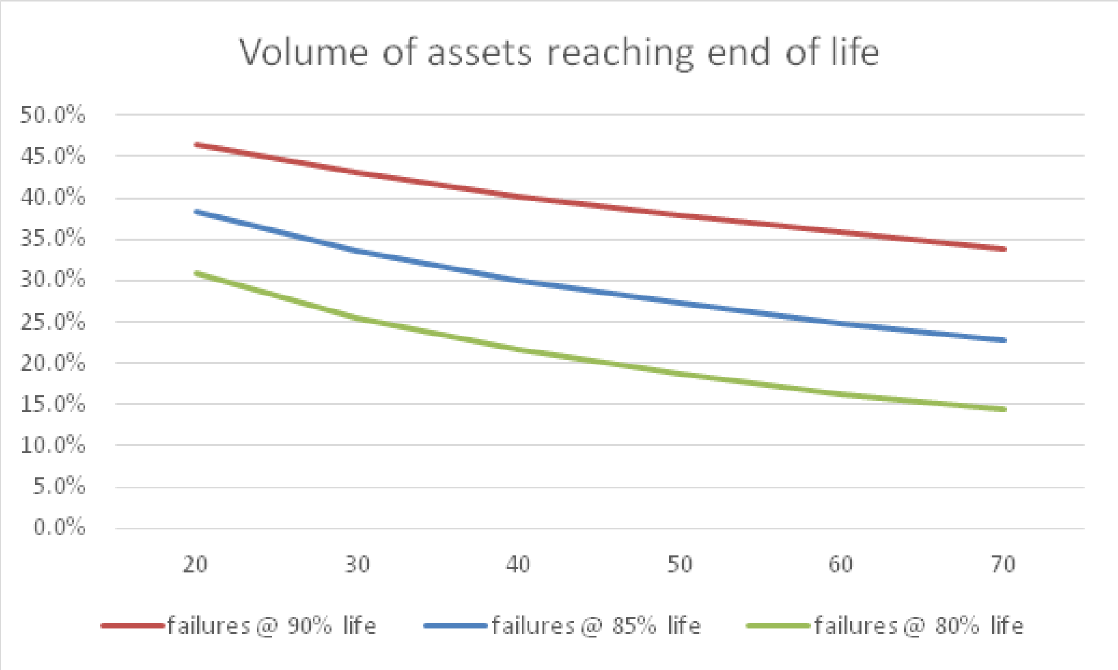
So the question is, when does the risk of failure start to accelerate?

Looking at a typical Weibull chart of end-of-life, the maximum acceleration of the blue line is:

Nominal life	Maximum Acceleration	% of nominal life
45 years	37 years	82%
50 years	42 years	84%
55 years	47 years	85%
60 years	51 years	85%

The average of the last column is 84%, so it seems that the degradation of the asset accelerates at a time when there is around 15% of nominal life remaining.

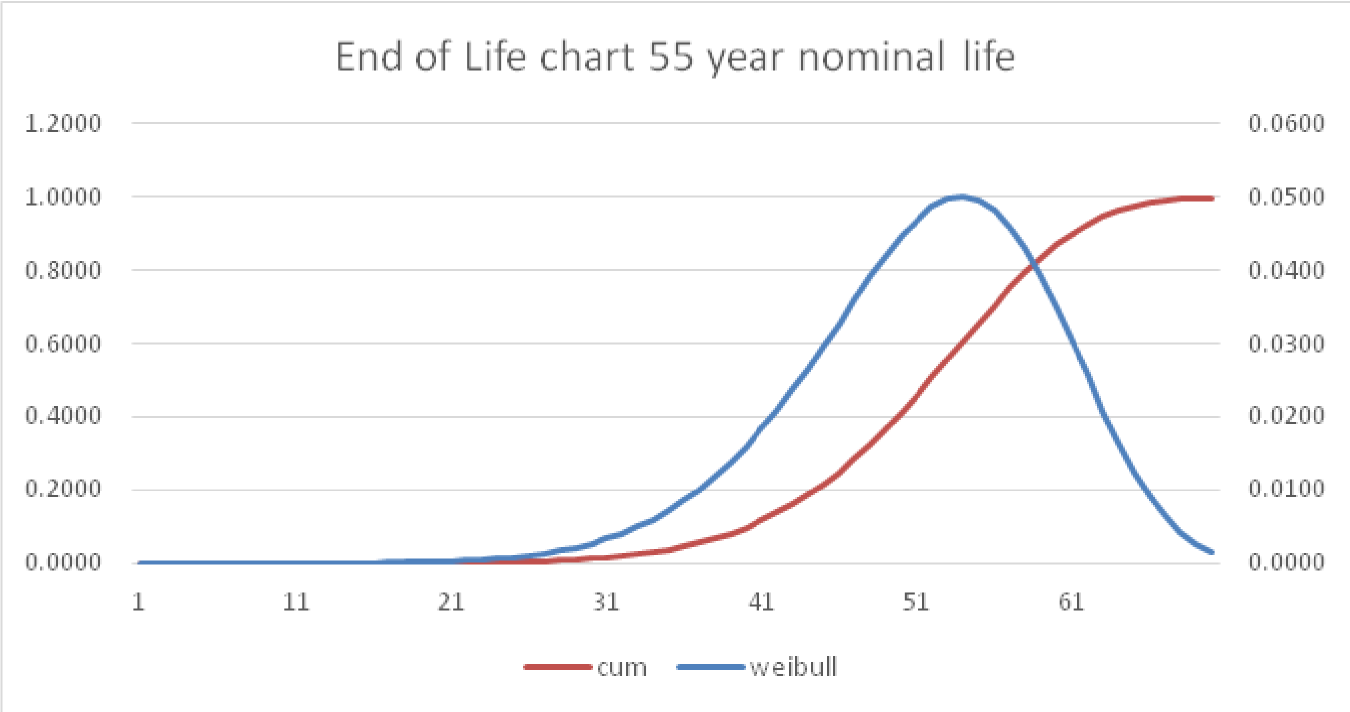
To check the sensitivity of this figure, for assets that typically have a nominal life of between 50 and 70 years, we plot the chart below of percentage of assets reaching end of life prior to the asset reaching 80%, 85% and 90% of their nominal life.



It can be seen that somewhere between 15% (for 70 year assets @ 80% of life used) and 38% (for 50 year assets @ 90% of life used) of assets will be need to be replaced in the ranges shown above with the middle ground being 24% of assets replaced for an asset of nominal 60 years (in orange).

So what is right for assessing when the asset becomes problematic?

The assets on the UE network have an average life of just less than 55 years. This is based on a cost-weighted average assessment of some assets that last up to 75 years or as short as 20 years.



According to the chart above, for a 55 year typical asset, the 85%ile point is at year 47, where 25% lost, but still 75% to go (with 65% retirements in the next 15 years).