

Asset Management Plan

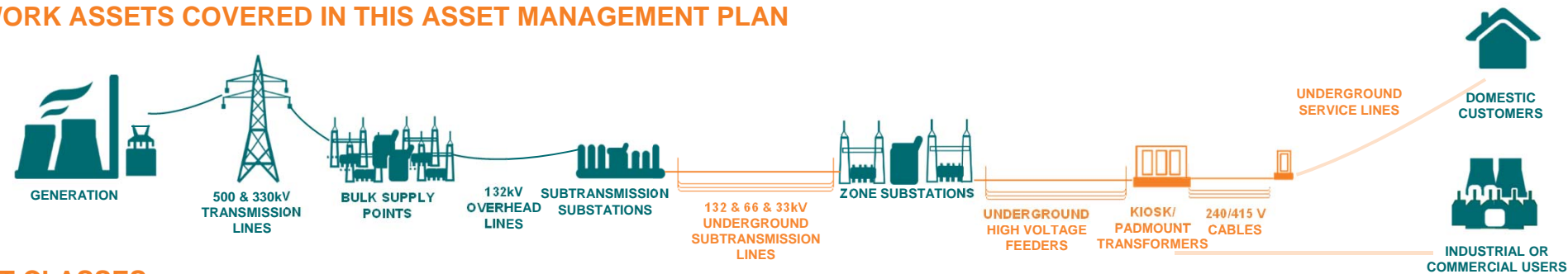
Underground Network Assets

April 2018

Supporting Document 12.1.11

Executive Summary

NETWORK ASSETS COVERED IN THIS ASSET MANAGEMENT PLAN



ASSET CLASSES:

CABLES | SERVICES | SWITCHGEAR | TRANSFORMERS

THIS ASSET MANAGEMENT PLAN REPRESENTS:

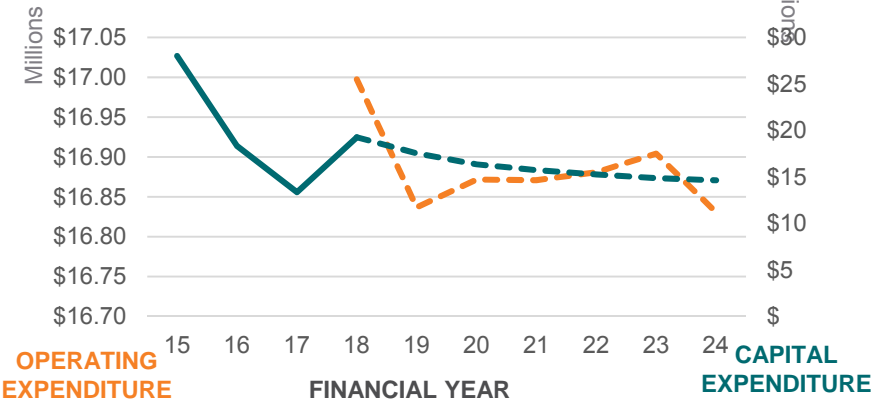
\$3.5b

OF TOTAL ASSET SYSTEM REPLACEMENT COSTS¹

12.9%

OF TOTAL NETWORK REPLACEMENT COSTS¹

ACTUAL (—) AND FORECAST (---) EXPENDITURE (FY19)



PROPOSED ANNUAL CAPITAL EXPENDITURE (CAPEX)

0.4%

OF TOTAL ASSET SYSTEM REPLACEMENT COSTS¹

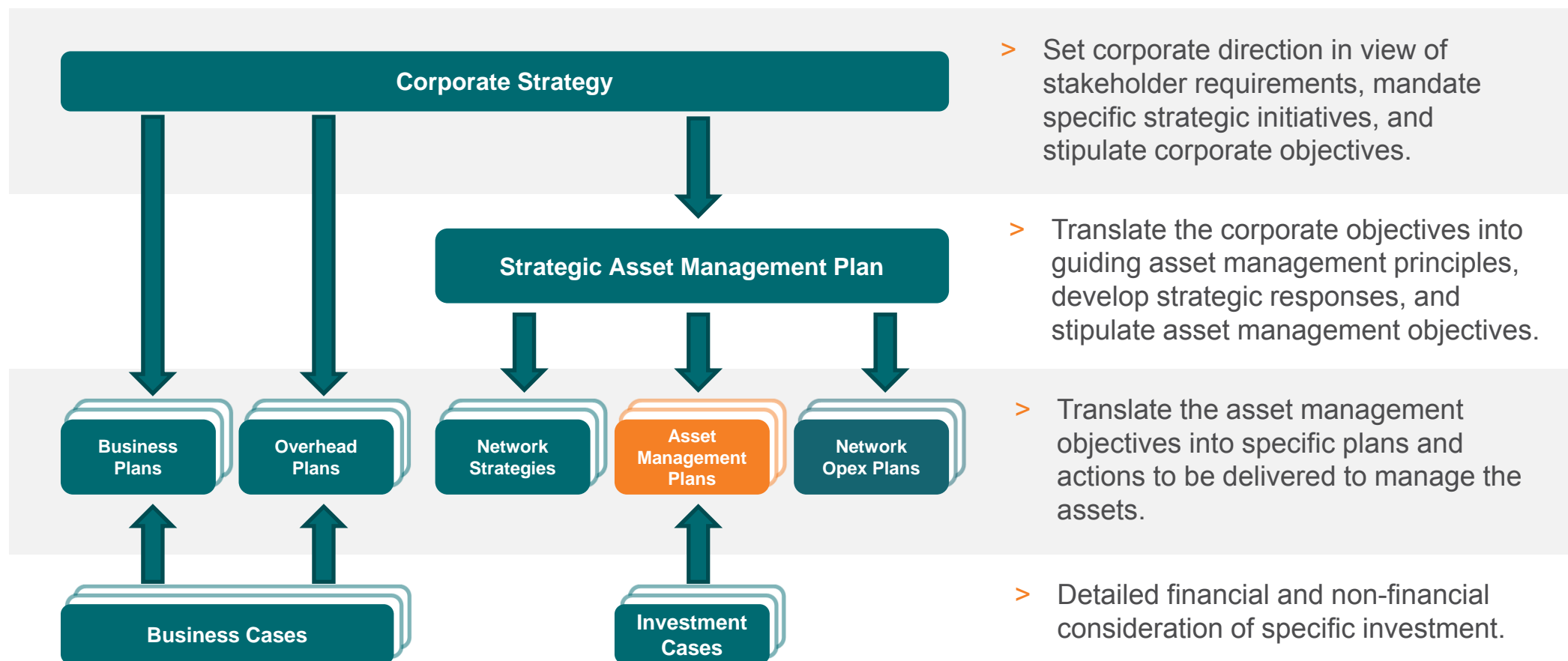
11% of underground network assets are beyond their expected serviceable life

6% of asset-related safety incidents are associated with underground network assets

3% of system reliability performance (SAIDI) is attributable to underground network assets.

¹ Total Replacement cost has been determined from report Optimised Depreciated Replacement Cost of Network Assets. This is not inclusive of all costs for establishing the network system.

Document hierarchy and purpose



Underground Network Assets

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Asset Overview

Underground Network Assets:

- > Connect customers to the power system (distribution).
- > Connect the network to National Electricity Market (NEM) transmission and generation infrastructure (subtransmission).
- > Includes:
 - Underground network assets upstream and downstream of Zone Substations*.
 - High voltage (HV) and low voltage (LV) cables and electrical equipment used to control the network (typically operate from 240/ 415 V up to 132 kV).

** Overhead network assets are addressed in the Overhead Network AMP.*

Risk Management Issues



Safety



Increased
Network Costs

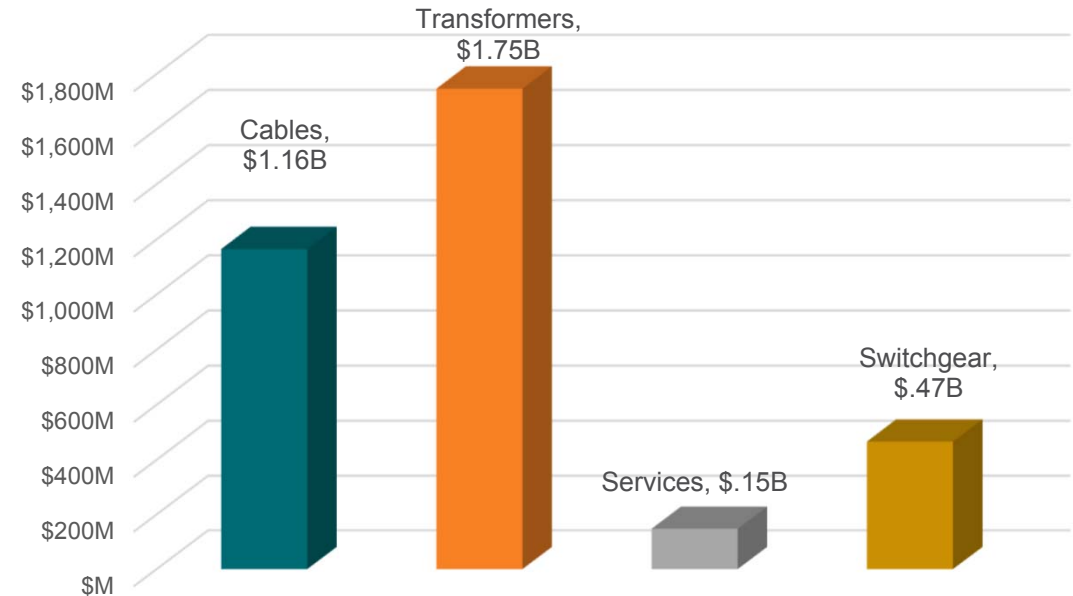


Network
Reliability



Environment
(and bushfire
zones)

Total Replacement Value of Overhead Network Assets



Asset Scope, Population & Management

Scope and Asset Population

	Underground Cable		Service Lines	Switchgear			Transformers	
	High Voltage	Low Voltage	UG Service Lines	Fuse	Switch	Circuit Breakers	Kiosk-Mounted	Ground Outdoor/Indoor Chamber-Mounted
Quantity	2,566	6,517	182,801	28,781	4,081	8,215	6,058	1,220
Average Age – RIN (yrs)	16	20	26	30	27	15	18	22
Expected Serviceable Life (yrs)	52	40	45	-	50	50	65	65

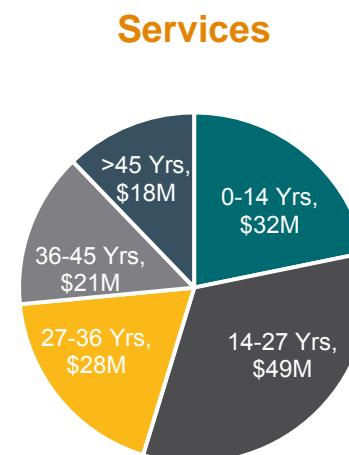
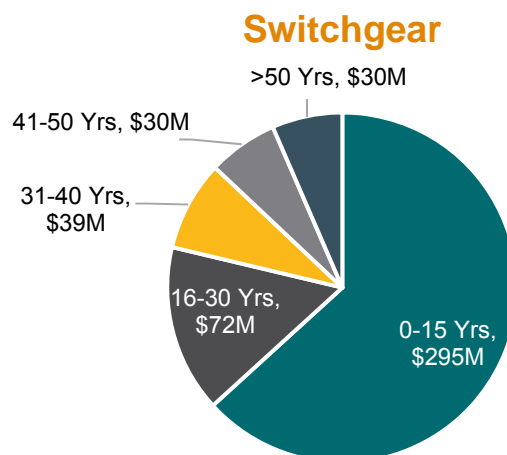
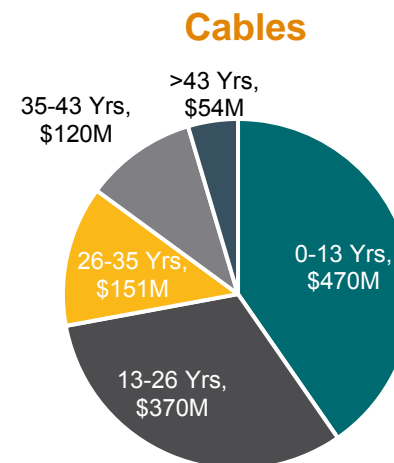
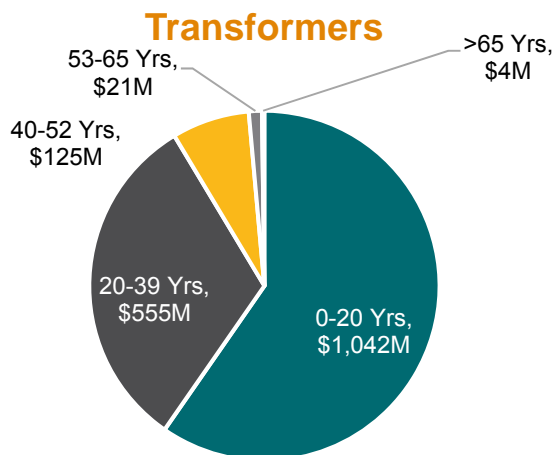
Management Of Assets

- > At a high level, we may use age as a proxy for condition and health, but at an individual level this is not how Essential Energy treats assets.
- > With the use of risk-based differentiators, we optimise our REPEX spend (which may result in an increase in an asset's average age profile) while maintaining the network's overall asset risk profile.
- > Expected serviceable life is the average expected service life of an Essential Energy asset. We arrive at this figure by working out when the risk of continuing to operate the asset will outweigh the reasonable cost of replacing it. The assessment considers the operating environment and total network risk.

Asset Age Profile

- > Each pie chart indicates how far through the assets expected serviceable life they presently are
- > Charts are listed left to right, top to bottom, in terms of overall total value to the network (see Total Replacement Value graph on slide 4).
- > Segments represent
 - 0-30% - Turquoise
 - 31-60% - Dark Grey
 - 61-80% - Yellow
 - 81-100% - Light Grey
 - >100% - Charcoal

Of expected serviceable life consumed.



Key Challenges

Switchgear with type faults

- > Essential Energy has 6,290 enclosed substations on the network.
- > These assets can fail catastrophically when operated - staff are present to operate this equipment.
- > The newly-implemented maintenance program is currently identifying approximately 113 units per annum that need rectification or remediation at a cost of \$6.4M p.a.

**Represents 41% of
asset system CAPEX**

CONSAC cable

- > There is 9,830 km of cable on the network, and approximately 3.6% is CONSAC cable.
- > These cables are prone to sudden failure, posing a significant risk to reliability and safety (broken neutrals) and increasing network costs.
- > Remediation program will target failing CONSAC cable at a cost of \$1.2M p.a.

**Represents 8% of
asset system CAPEX**

Cast iron pothead terminations

- > 380 cast iron pothead terminations on the network, which is 4.5% of the total underground overhead pole terminations.
- > Cast iron potheads fail explosively, making them a large safety risk.
- > Through net present value, the only suitable option is to replace the termination.
- > Replacement program will cover 30 pothead terminations per annum at a cost of \$0.4M p.a.

**Represents 2% of
asset system CAPEX**

Subtransmission Polymer Terminations

- > 95 polymer subtransmission terminations, out of a total population of 107 terminations.
- > These terminations can fail catastrophically and have a significant reliability impact.
- > Through net present value, the only suitable option is to replace the termination.
- > Replacement program will replace the entire population over the next five- years at a cost of \$0.8M p.a.

**Represents 5% of
asset system CAPEX**

Strategic Objectives, Targets and Performance

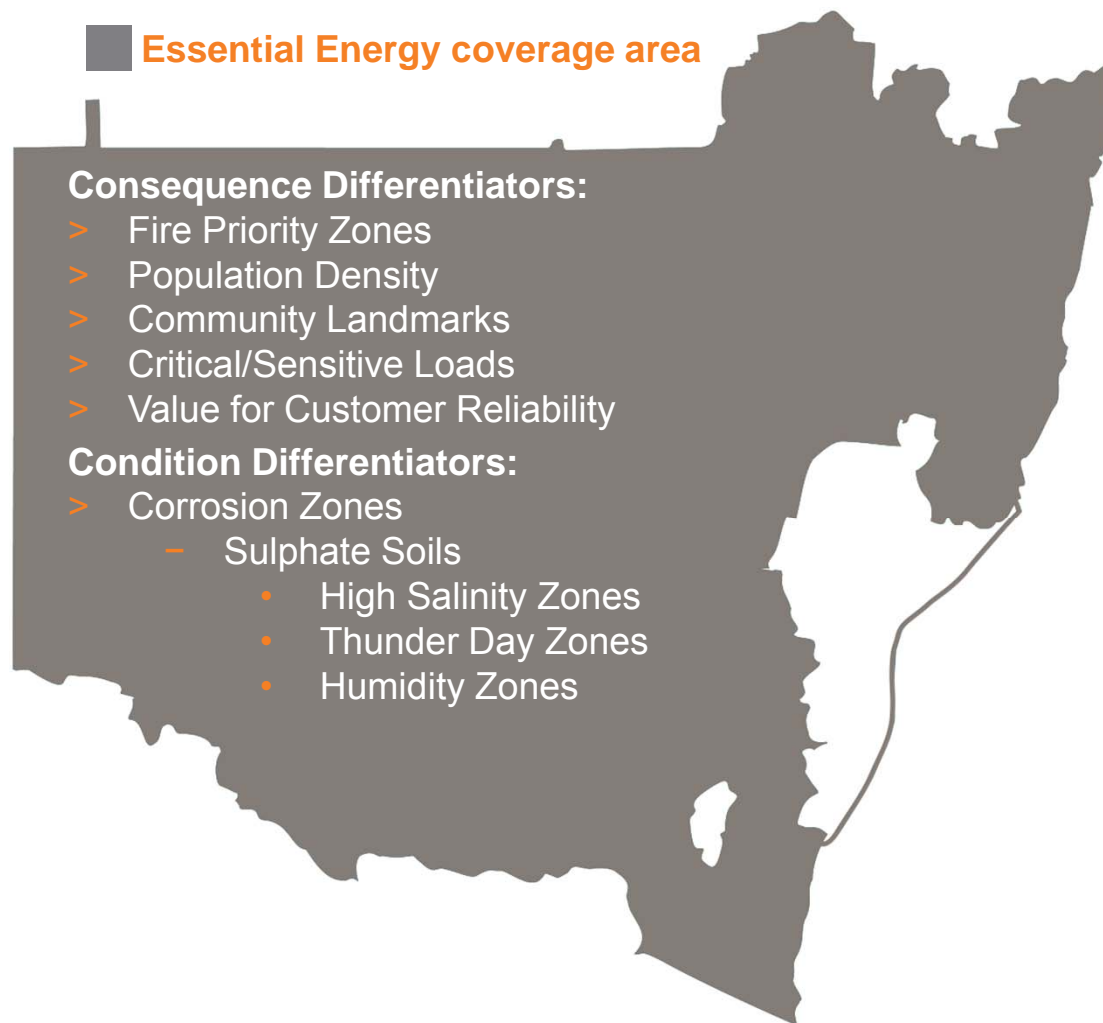
Purpose:	Strategies & Objectives	Targets	Performance (16/17)
<ul style="list-style-type: none"> > Asset Management Plans enable the underground network assets to achieve the objectives and targets established in the overarching strategy documents. > The asset class objectives and targets are designed to achieve the National Electricity Rules (NER) CAPEX and OPEX objectives. > These targets and performance measurements are for underground network assets. 	1. All Strategies		
	National Energy Regulator (NER) Cl. 6.5.6 (a) (1) (2) (3) and (4) To ensure, at the lowest cost, assets are operated and maintained in a manner that extracts maximum value from the assets.	Programs have been valued and optimised by using a consistent, approved Value Framework.	Programs have been valued and optimised using a consistent, approved value framework.
	NER cl. 6.5.7 (a) (2) (3) and (4) To ensure, at the lowest cost, assets are renewed in a manner that extracts maximum value from the assets.	Unit rates captured and benchmarked.	Achieved. Continual improvement items identified and improvement in internal efficiency achieved.
	2. Growth		
	NER cl. 6.5.7 (a) (1) To ensure, at the lowest cost, the network assets have the capacity to meet growth requirements.	Connections: All approved customer connection applications to be connected. Thermal operating limits of assets: All assets remain under continuous/cyclical thermal operating capacity.	Satisfactory. Some assets exceed thermal operating limits.

Strategic Objectives, Targets and Performance

Continued

Strategies & Objectives	Targets	Performance (16/17)
3. Reliability		
NER cl. 6.5.7 (a) (3) Compliance with the NSW Reliability and Performance Licence Conditions for Electricity Distributors (the Licence Conditions).	Achieve network reliability targets.	Network target achieved.
	Achieve full compliance in annual licence conditions audit.	Audit passed (continual improvement items identified).
Achievement of the Service Targets Performance Incentive Scheme (STPIS) targets for Reliability.	Achieve network STPIS targets.	-\$11M
4. Safety & Environment		
NER cl. 6.5.7 (a) (4) To ensure that safety risk minimised as much as practicable; at a minimum, compliance with legislative requirements.	Number of Fatal/Serious Worker injuries attributed to assets in TotalSAFE ≤ 0	0
	Number of Worker HPIs attributed to assets in TotalSAFE ≤ 1	2
	Number of Public IPART Cat 1 incidents attributed to assets in TotalSAFE = 0	0
	Number of Public IPART Cat 2 incidents attributed to assets in TotalSAFE ≤ 1	0
	Number of Public IPART Cat 3 incidents attributed to assets in TotalSAFE ≤ 1	1.3
NER cl. 6.5.7 (a) (4) To ensure that environmental harm is minimised as much as practicable; at a minimum, compliance with legislative requirements.	Number of fire starts caused by assets per financial year ≤ 24 . (Maintain or reduce the risk associated with asset related firestarts. Note: Strategic targets based on historical average)	24
	Reportable contamination incidents = 0. Inadvertent contact with asbestos = 0.	0 0
5. Power Quality		
NER cl. 6.5.7 (a) (3) To ensure, at the lowest cost, that customers are not subject to power quality issues outside the tolerances of equipment that meets AS/NZS standards.	Steady-state voltage levels within nominal voltages +10%, -6%.	Not compliant. Commence alignment this regulatory period.
	Flicker, harmonics and unbalance within required thresholds.	Not compliant. Power quality monitoring at zone substations underway.

Identifying Investment Priorities: Risk Differentiators



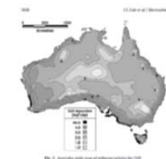
- > Essential Energy's new risk framework has emphasised sophisticated risk differentiators.
- > A differentiator allows an asset to be assessed based on the conditions it will be exposed to and the consequence of a failure, both which depend on an asset's location and purpose.
- > With such a large and diverse network, the use of differentiators will allow us to have greater control of risk and expenditure requirements.



Fire Priority Zones



Sulphate Soils



Corrosion Zones



High Salinity Zones



Thunder Day Zones



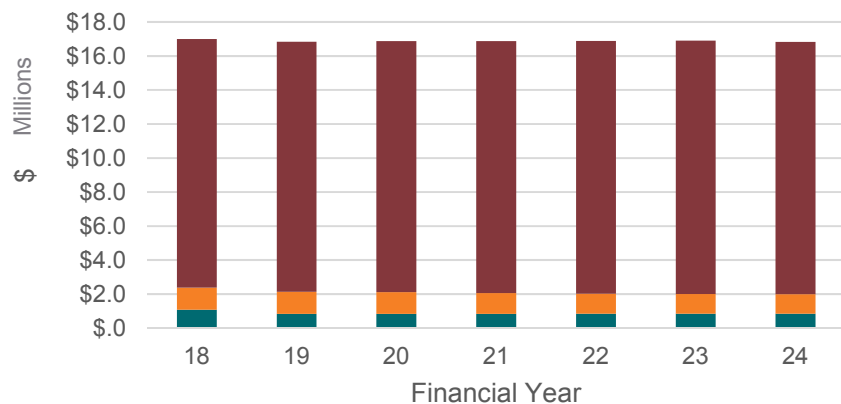
Humidity Zones

Investment Program Summary

OPEX (FY19 \$ millions)

	FY18	FY19	FY20	FY21	FY22	FY23	FY24
Routine Inspections	\$1.1	\$0.8	\$0.8	\$0.8	\$0.8	\$0.9	\$0.8
Planned Maintenance	\$1.3	\$1.3	\$1.3	\$1.2	\$1.2	\$1.2	\$1.2
Unplanned Maintenance	\$14.6	\$14.7	\$14.7	\$14.8	\$14.9	\$14.9	\$14.8
Total	\$17.0	\$16.8	\$16.9	\$16.9	\$16.9	\$16.9	\$16.8

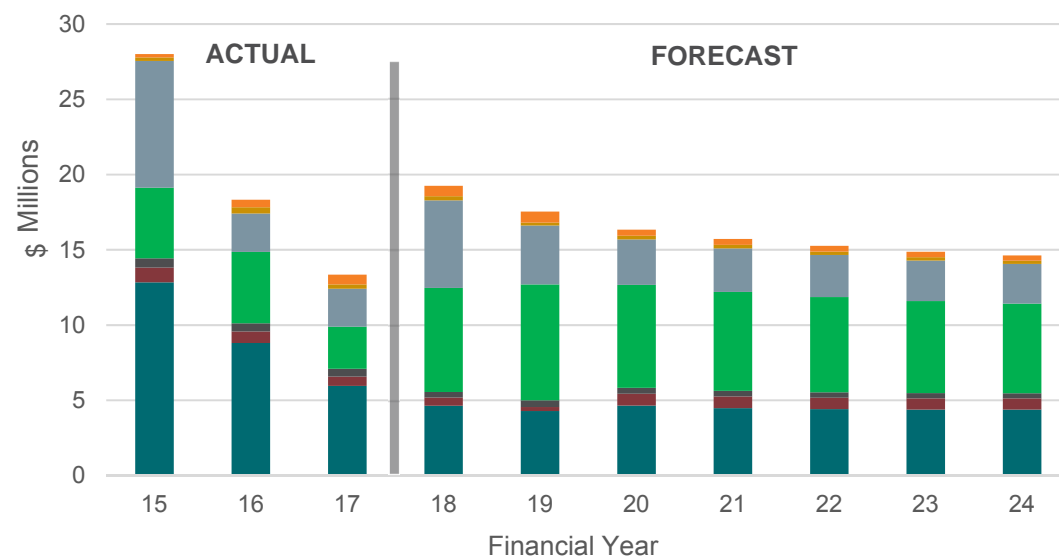
FORECAST



Expenditure Trade-Offs > The proposed CAPEX and OPEX expenditure is a five-year snapshot of the projected long-term strategies that Essential Energy has in place. This expenditure has been through an optimised risk output which included trade-offs between various combinations of OPEX and CAPEX.

CAPEX (FY19 \$ millions)

	FY18	FY19	FY20	FY21	FY22	FY23	FY24
Growth	\$4.6	\$4.3	\$4.6	\$4.5	\$4.4	\$4.4	\$4.4
REPEX - Other	\$0.5	\$0.3	\$0.8	\$0.8	\$0.8	\$0.7	\$0.7
Cables	\$5.8	\$3.9	\$3.0	\$2.9	\$2.8	\$2.7	\$2.6
Pillars	\$0.3	\$0.2	\$0.2	\$0.2	\$0.2	\$0.2	\$0.2
Switchgear	\$0.4	\$0.5	\$0.4	\$0.4	\$0.4	\$0.3	\$0.3
Termination	\$0.7	\$0.7	\$0.4	\$0.4	\$0.4	\$0.4	\$0.4
Transformer	\$6.9	\$7.7	\$6.8	\$6.6	\$6.3	\$6.1	\$6.0
Total	\$19.3	\$17.5	\$16.3	\$15.7	\$15.3	\$14.9	\$14.6



Lifecycle Management Strategy: Secondary Systems Assets

PLAN

- > Identify Need/ Objectives/Risk and align to corporate strategy using the Strategic AMP.
- > Optimise investment portfolio using our Asset Investment Planning System.
- > Cater for growth (incl. growth strategy and subtransmission project scopes).
- > Predict growth and embedded generation impacts on system ratings and capacity.
- > Renewal may be required if the asset is no longer capable of achieving its purpose or if condition deteriorates, to prevent assets failing in service (although some low-risk assets are “run-to-failure”). Renewal can involve replacement or refurbishment:
 - Piecemeal – the underground network is mainly low-volume/high-value assets, with varied lifespans. Most assets are piecemeal renewed e.g. cable replacement.
 - Holistic renewal – when a feeder/asset class/asset subset is experiencing systemic defects/failures it may be preferable to renew the entire feeder or have bulk rectification for the asset class/subset..
- > Plan and set work program

ACQUIRE

- > Procure and negotiate.
- > Decide on lowest whole-of-life costs for product selection.
- > Develop technical specifications and standards.

CONSTRUCT & COMMISSION

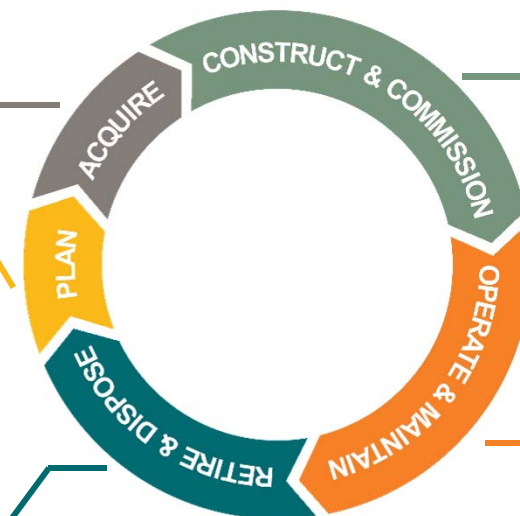
- > Complete design work.
- > Complete construction work.
- > Load as-builts loaded into GIS and Asset Information Management System.

OPERATE & MAINTAIN

- > **Routine Inspections:**
 - > Enclosed substation inspection: Inspection of kiosk, chamber, ground and any other substations that cannot be inspected by overhead asset inspectors.
 - > Pit and pillar inspection: Detailed internal inspection of enclosed components of underground network (excludes assets inspected in enclosed substation inspection program).
- > **Planned Maintenance:** The corrective program prioritises defect maintenance based on risk.
- > **Unplanned Maintenance:** Also required.

RETIRE & DISPOSE

- > Asset is conditionally failed as per specified serviceability criteria, which aligns with corporate objectives.
- > Assets functionally fails through assisted or unassisted means.
- > New technology makes asset obsolete or no longer commercially viable.



Performance Monitoring, Continual Improvement and Supporting Initiatives

Continual Improvement & Support Initiatives:	Performance Monitoring		
	Initiative	Recurrence	Measure of Success
<p>Initiatives aim to leverage new technologies, increase investment program efficiency and effectively manage risk profiles. Measures include:</p> <ul style="list-style-type: none"> > Reviewing and continuing to develop the Risk Management and Value Framework. > Exploring new inspection technologies > Implementing systems to capture and analyse asset data. > Installing condition monitoring technology. > Further developing asset indexing tools to enhance the assessment of asset health and criticality (including C55 asset models). > Improving scheduling processes to reduce unit rates. > Initiatives to prepare for future grid. 	> Update and assess historical spend at the end of each financial year	Annual	Document updated annually
	> Review and assess REPEX model outputs	5-yearly and as required	Updated 5-yearly
	> Assess asset expenditure annually to ensure final portfolio aligns with network and asset strategies	Annual	Documents completed annually and critically analysed
	> Monitor network key performance indicators such as SAIDI, SAIFI and HPIs	As required	Performance aligns with targets

Supporting Documents

Key challenge documents

Key Challenge	Relevant Document	Relevance to the AMP
Switchgear with type faults	IC ESS 31 – Enclosed Substation Refurbishment Program	Provides further discussion and outlines the response in relation to the key challenges for the asset class.
CONSAC cable	IC ESS 43 – CONSAC Cables	
Subtransmission terminations	IC ESS 4009 - Subtransmission Polymer Termination Replacement	
Cast iron pothead terminations	IC ESS 42 – High Voltage Cast Iron Pothead Replacement	
Total Proposed Expenditure	Risk Informed Optimisation	Provides further discussion on proposed spend compared to relevant models

OPEX Plan documents

Document	Relevance to the AMP
OPEX Plan – Routine Inspections	Details the planned activities for executing the maintenance approach as outlined in this AMP.
OPEX Plan – Planned Maintenance	
OPEX Plan - Unplanned Maintenance	

CAPEX Investment Case documents

Documents		Relevance to the AMP
IC ESS 40 & 43 – Underground Cables	IC ESS 31 – Enclosed Substations	Details the fundamental need, options evaluation, and preferred option to be delivered to manage these specific assets.
IC ESS 4009 – Subtransmission Terminations	IC ESS 99 & 100 – Triangular and Potbelly Columns	
IC ESS 42 – High Voltage Cast Iron Potheads	IC ESS 41 – UG Low Voltage Switchgear and Pillars	

Relevant Legislation and Policies

Legislation

Document	Relevance to the AMP
National Electricity Rules	Directs the development of capital expenditure forecasts and compliance with relevant obligations
Work Health and Safety Act 2011	Used to set Asset Management Objective Targets
Electricity Supply Act 1995 and supporting Licence Conditions	
Electricity Supply (Safety and Network Management) Regulation 2014 (NSW)	
Protection of the Environment Operations Act 1997 – Water contamination, asbestos	

Policies

Document	Relevance to the AMP
Bushfire Management Plan (CEOP8022)	Used to set Asset Management Objective Targets
ISO 55000:2014 - Asset Management	Used to develop Asset Management System

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