

Asset Management Plan

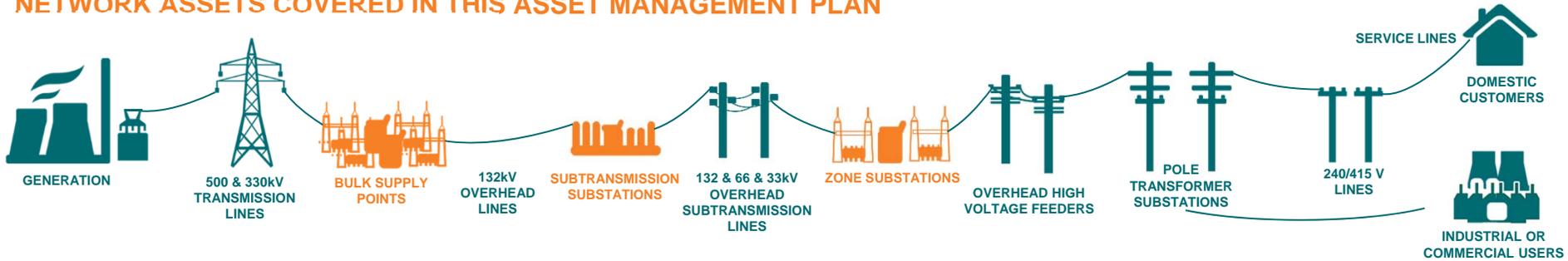
Zone Substation Assets

April 2018

Supporting Document 12.1.10

Executive Summary

NETWORK ASSETS COVERED IN THIS ASSET MANAGEMENT PLAN



ASSET CLASSES:

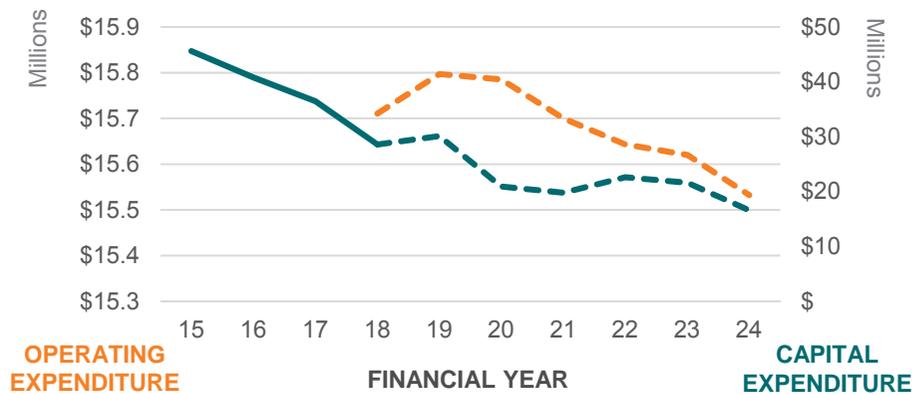
PROPERTY | TRANSFORMERS | STATION BATTERIES | SWITCHGEAR | PROTECTION | INSTRUMENT TRANSFORMERS | SURGE DIVERTERS

THIS ASSET MANAGEMENT PLAN REPRESENTS:

\$3.31B OF TOTAL ASSET SYSTEM REPLACEMENT COSTS¹

12% OF TOTAL NETWORK REPLACEMENT COSTS¹

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



PROPOSED ANNUAL CAPITAL EXPENDITURE (CAPEX)

0.7%

OF TOTAL ASSET SYSTEM REPLACEMENT COSTS¹

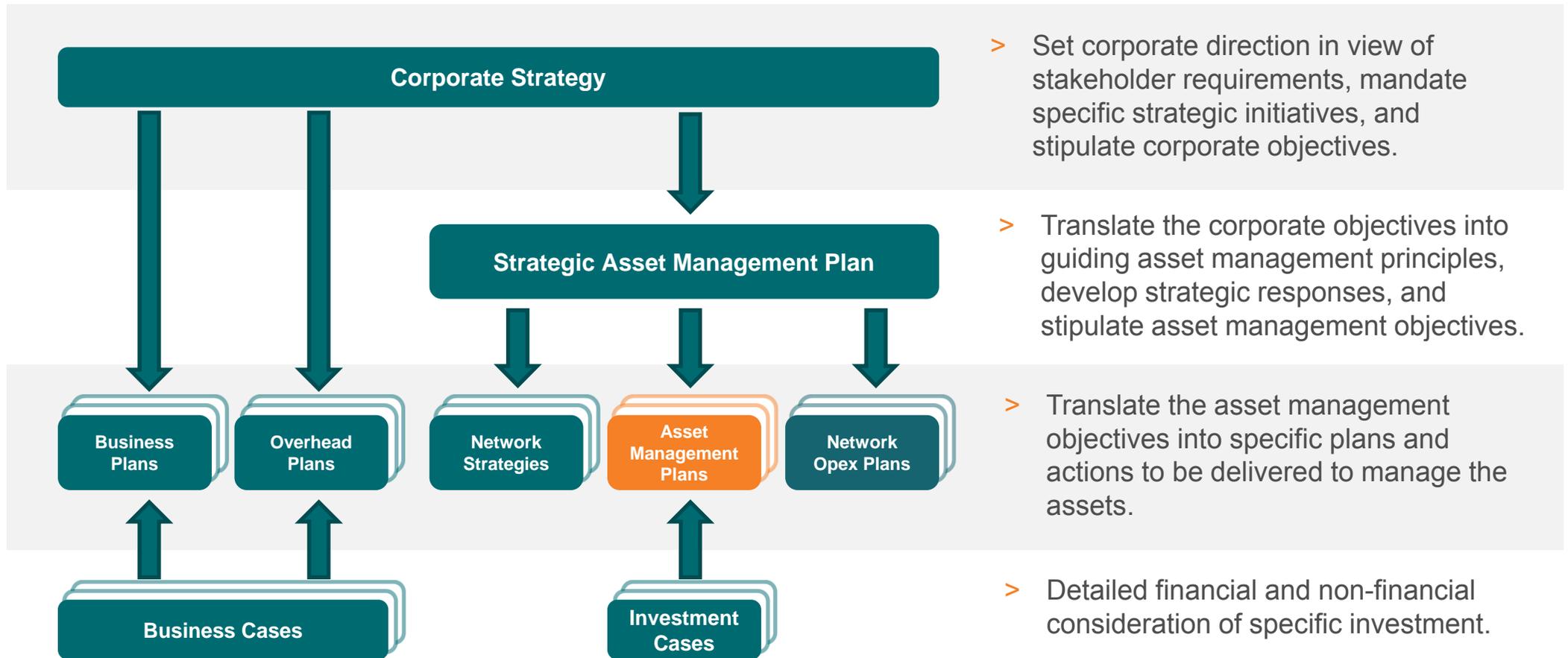
17% of zone substation assets are beyond their expected serviceable life

2% of asset-related safety incidents are associated with zone substation assets

4% of system reliability performance (SAIDI) is attributable to zone substation 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



Zone Substation Network Assets

Asset Overview

5

Asset Scope, Population & Management

6

Asset Age Profile

7

Key Challenges

8

Strategic Objectives, Targets and Performance

9

Identifying Investment Priorities: Risk Differentiators

11

Investment Program Summary

12

Lifecycle Management Strategy
Overhead Assets

13

Performance Monitoring, Continual Improvement and Supporting Initiatives

14

Supporting Documents

15

Relevant Legislation and Policies

16

Asset Overview

Overhead Network Assets:

- > Transform power from subtransmission voltages to distribution voltages.
- > Connect the subtransmission and distribution networks.
- > Includes:
 - > All electrical and non-electrical assets within the zone substation including buildings, protection relays and transformers *.
 - > These assets typically operate from 240/415 V up to 132 kV

* **SCADA (remote controlling systems), metering and telecommunications assets are addressed within the Secondary Systems AMP.**

Risk Management Issues



Safety



Increased Network Costs

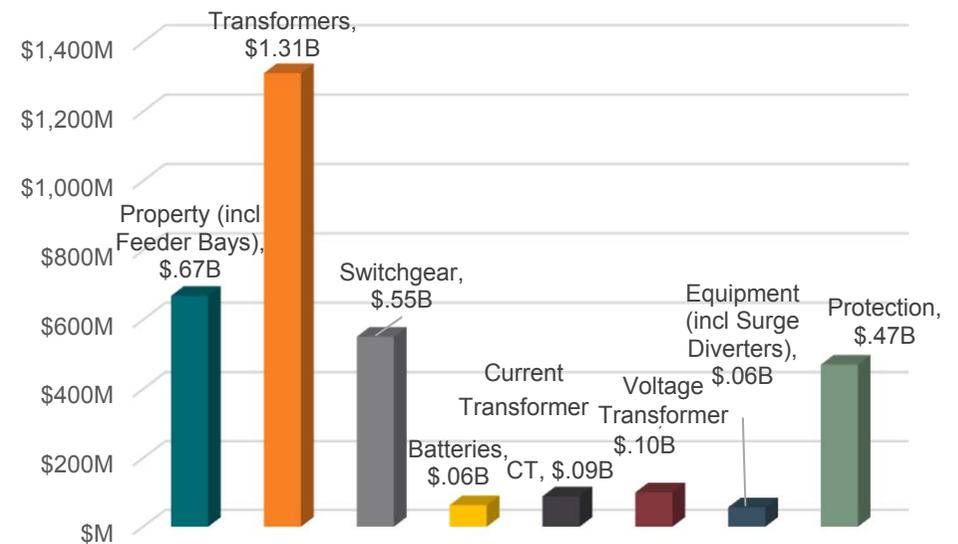


Network Reliability



Environment (and bushfire zones)

Total Replacement Value of Zone Substation Assets



Asset Scope, Population & Management

Scope and Asset Population

	Transformers	Switchgear		Property	Station Batteries	Instrument Transformers		Surge Diverters	Protection Equipment
	Ground Outdoor / Indoor Chamber-Mounted	Switches	Circuit Breakers	Zone Substation Property	Zone Substation Batteries	Current Transformers	Voltage Transformers	Zone Substation Surge Diverters	Protection Relays
Quantity	801	7,726	3,650	362	691	1,462	2,120	5,580	5,179
Average Age – RIN (yrs)	29	32	15	32	9	21	16	13	14
Expected Serviceable Life (yrs)	50	50	34	60	20	45	45	25	30

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

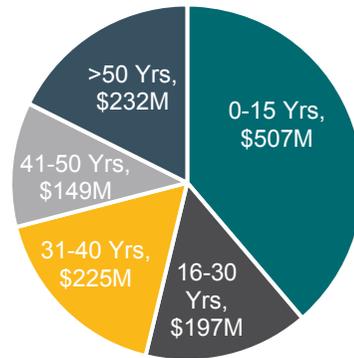
> Each pie chart indicates how far through the assets expected serviceable life they presently are

> 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).

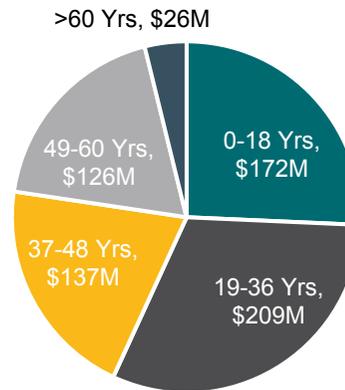
> Segments represent
 0-30% - Turquoise
 31-60% - Dark Grey
 61-80% - Yellow
 81-100% - Light Grey
 >100% - Charcoal

Of expected serviceable life consumed.

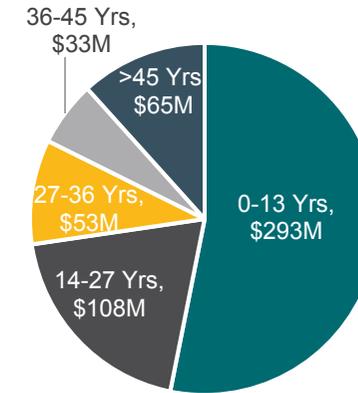
Transformers



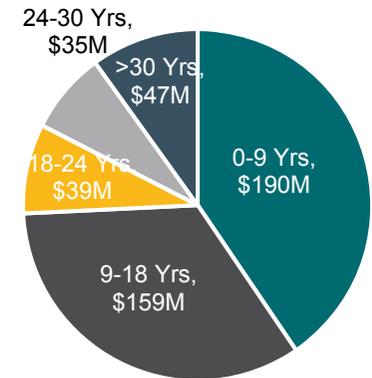
Property



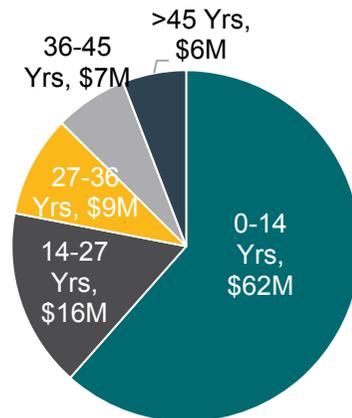
Switchgear



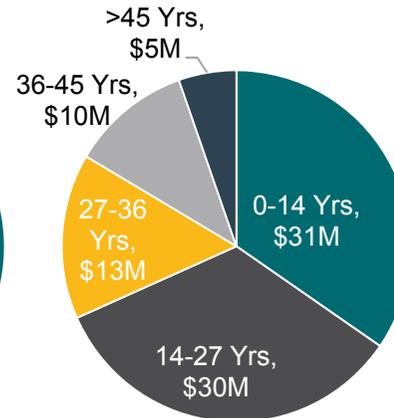
Protection



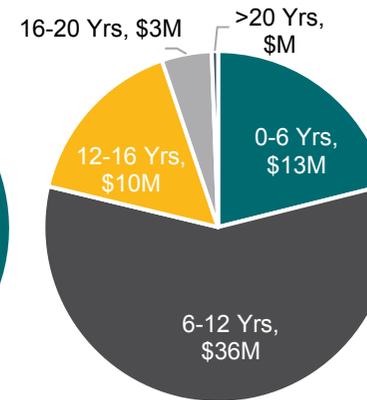
Voltage Transformers



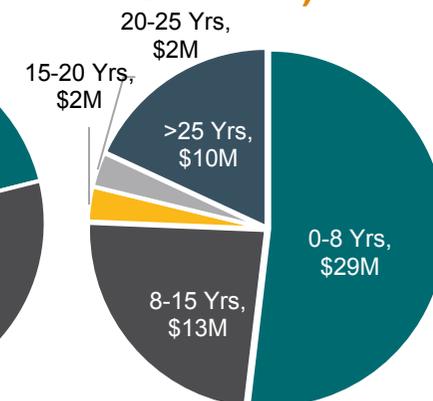
Current Transformer



Batteries



Equipment (Inc. Surge Diverters)



Key Challenges

Managing the Power Transformer fleet

- > 807 power transformers within zone substations.
- > Any single failure would result in 5% fluctuation to the proposed budget.
- > Remediation program (replacement and refurbishment) will target approximately 170 transformers per annum at an annual cost of \$4.6M p/a.

Represents 23% of asset system CAPEX

Circuit Breakers with type faults

- > 3,400 circuit breakers within zone substations, and 4.2% are considered to need replacement in the next 5 years due to type faults.
- > Remediation program will treat 28 circuit breakers per annum at a cost of \$2.4M p/a.

Represents 12% of asset system CAPEX

Increase in critical Zone Substation security

- > 362 zone substations, we have identified 3.5%(14 sites) as critical sites requiring greater security because their critical network role means they may be targeted for terrorist activity.
- > Remediation program will target three zone substations per annum at \$0.19M p.a.

Represents 1% 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 zone substation assets to achieve the objectives and targets established by overarching strategy documents. > The asset class objectives and targets established within the overarching strategy documents are designed to achieve the National Electricity Rules (NER) CAPEX and OPEX objectives. > These targets and performance measurements are for zone substation 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.	Satisfactory.
	Thermal operating limits of assets: All assets remain under continuous/cyclical thermal operating capacity.	Satisfactory.	

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.	Achieve network STPIS targets.	STPIS targets achieved.
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 ≤ 0.5	0
	Number of Worker HPIS attributed to assets in TotalSAFE ≤ 1	1
	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 = 0	0
	Number of Public IPART Cat 3 incidents attributed to assets in TotalSAFE = 0	0
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 ≤ 2 (Maintain or reduce the risk associated with asset related firestarts. Note: Strategic targets based on historical average)	5
	Noise complaints exceeding POEO Act = 0.	0
	Major SF6 equipment leak = 0.	0
	Reportable contamination incidents = 0.	0
	Inadvertent contact with asbestos = 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 coverage area

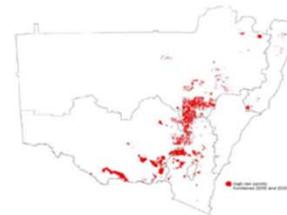
Consequence Differentiators:

- Fire Priority Zones
- Population Density
- Community Landmarks
- Critical/Sensitive Loads
- Value for Customer Reliability

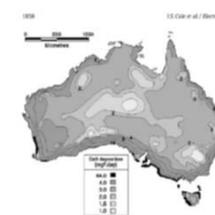
Condition Differentiators:

- Corrosion Zones
- High Salinity Zones

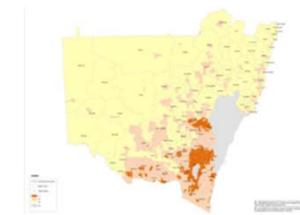
- > Essential Energy's new risk framework has emphasised sophisticated risk differentiators.
- > A differentiator allows an asset to be assessed based on the conditions it will be exposed to and the consequence of a failure, both which depend on an asset's location and purpose.
- > With such a large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



High Salinity Zones



Corrosion Zones



Fire Priority Zones

Investment Program Summary

OPEX (FY19 \$ millions)

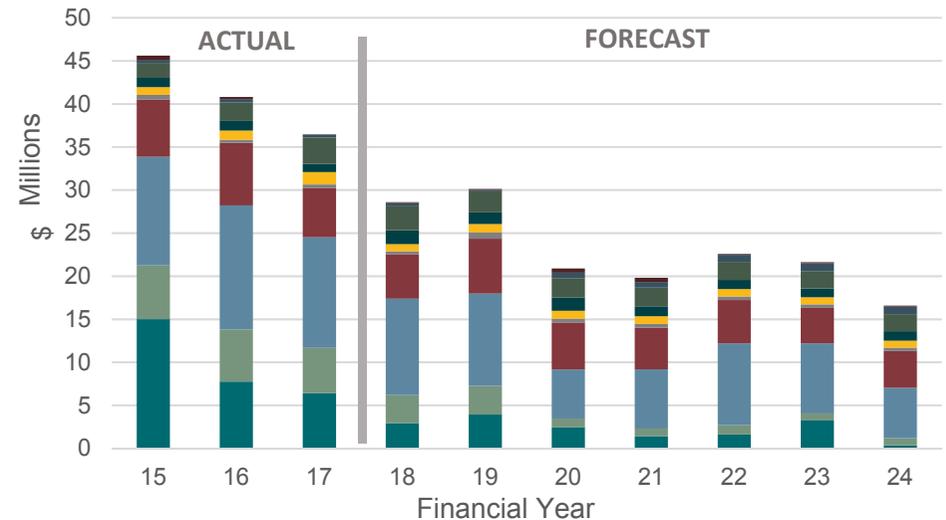
	FY18	FY19	FY20	FY21	FY22	FY23	FY24
Routine Inspections	\$10.9	\$11.0	\$11.0	\$11.0	\$11.1	\$11.1	\$11.1
Planned Maintenance	\$4.8	\$4.8	\$4.8	\$4.7	\$4.6	\$4.5	\$4.5
Unplanned Maintenance	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0
Total	\$15.7	\$15.8	\$15.8	\$15.7	\$15.6	\$15.6	\$15.5



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	\$2.9	\$3.9	\$2.4	\$1.4	\$1.6	\$3.3	\$0.4
REPEX – Other ¹	\$3.3	\$3.3	\$1.0	\$0.9	\$1.1	\$0.8	\$0.8
Transformer	\$5.2	\$6.4	\$5.4	\$4.8	\$5.0	\$4.1	\$4.3
Voltage Transformer	\$0.3	\$0.7	\$0.4	\$0.4	\$0.4	\$0.4	\$0.4
Current Transformer	\$0.8	\$1.0	\$0.9	\$0.9	\$0.9	\$0.8	\$0.8
Property	\$1.6	\$1.4	\$1.5	\$1.2	\$1.1	\$1.0	\$1.1
Protection Relays	\$2.9	\$2.4	\$2.3	\$2.2	\$2.1	\$2.0	\$2.0
Station Battery	\$0.3	\$0.2	\$0.6	\$0.7	\$0.8	\$0.9	\$0.9
Surge Diverter	\$0.1	\$0.1	\$0.5	\$0.5	\$0.1	\$0.1	\$0.1
Switchgear	\$11.2	\$10.7	\$5.7	\$6.9	\$9.5	\$8.1	\$5.8
Total	\$28.6	\$30.1	\$20.9	\$19.8	\$22.6	\$21.6	\$16.6



1 REPEX - Other includes projects which contained multiple asset classes and may have a safety and environmental focus.

Lifecycle Management Strategy: Secondary Systems Assets

PLAN

- > Identify Need/ Objectives/Risk and align to corporate strategy using the Strategic AMP
- > Optimise investment portfolio using out Asset Investment Planning System.
- > Cater for growth (inc. 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 its condition deteriorates, to prevent assets failing in service (although some low-risk assets are “run-to-failure”). Renewal can involve replacement or refurbishment:
 - Piecemeal – zone substations consist of mainly low-volume/high-value assets, with varied lifespans. Some assets may be piecemeal renewed due to type faults e.g. circuit breaker replacement program
 - Holistic renewal – when a zone substation/asset class/asset subset is experiencing systemic defects/failures/constraints it may be preferable to renew the entire zone substation or have bulk rectification for the asset class/subset..
 - Workshop renewal – high-value assets such as transformers and switchgear are removed from service, refurbished in the workshop and redeployed.
- > 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

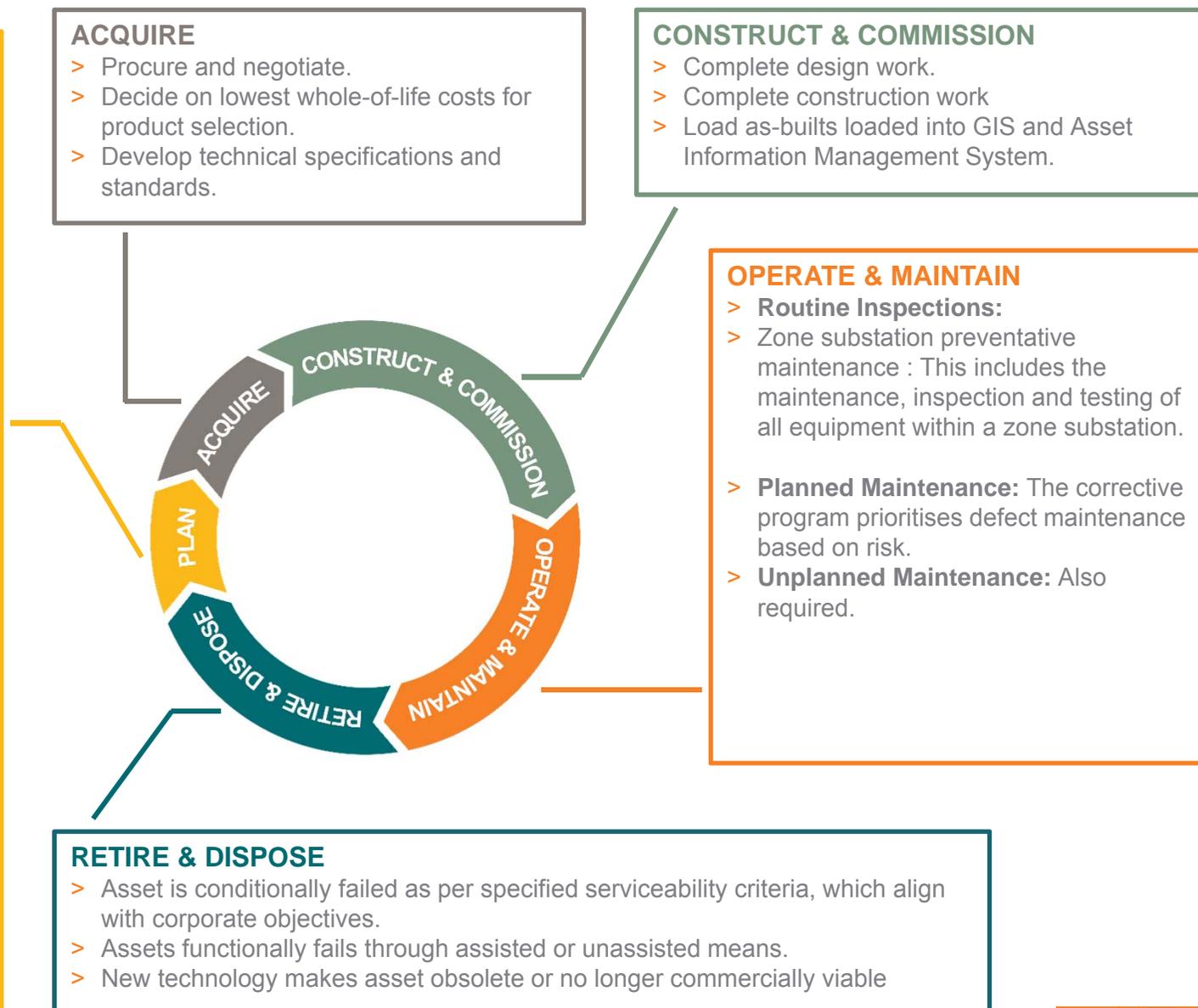
- > Complete design work.
- > Complete construction work
- > Load as-builts loaded into GIS and Asset Information Management System.

OPERATE & MAINTAIN

- > **Routine Inspections:**
- > Zone substation preventative maintenance : This includes the maintenance, inspection and testing of all equipment within a zone substation.
- > **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 align 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:

Initiatives aim to leverage new technologies, increase investment program efficiency and effectively manage risk profiles. Measures include:

- > 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.

Performance Monitoring

Initiative	Recurrence	Measure of Success
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
Circuit breakers with type faults	ESS_78 Circuit Breaker Replacement Strategy	Provides further discussion and outlines the response in relation to the key challenges for the asset class.
Increase in critical zone substation security	IC ESS 75, 76, 86, 88 & 89 – ZS Civil & Environment	
Managing the power transformer fleet	IC ESS 70, 71, 72, 73 & 74 – ZS Power Transformers	
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 2006 – ZS Capacitor Banks	IC ESS 70, 71, 72, 73 & 74 – ZS Power Transformers	IC ESS 83 – ZS Surge Diverters	Details the fundamental need, options evaluation, and preferred option to be delivered to manage these specific assets.
IC ESS 4004 – Outdoor Bus and Isolators	IC ESS 75, 76, 86, 88 & 89 – ZS Civil & Environment	IC ESS 87 – ZS Earthing	
IC ESS 78 – ZS Circuit Breakers	IC ESS 85 – ZS Protection	IC ESS 79 – ZS Switchboards	
IC ESS 80 – ZS Station Batteries	IC ESS 81 & 82 – ZS Voltage & Current Transformers	ESS_1030 Googong to Tralee 132kV feeder Detailed Options Report	
ESS_1005 Cobaki Detailed Options Report	ESS_4016 Morrow St ZS Detailed Options Report	ESS_4022 Casino - Urbenville Detailed Options Report	
	ESS_5019 Googong Town 2nd Transformer Detailed Options Report	ESS_5025 Tharbogang to Tabbita Lane 33kV feeder Detailed Options Report	

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	
National Greenhouse and Energy Reporting Act 2007	

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

Essential Energy

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