

# Asset Management Plan

## Overhead Network Assets

April 2018

Supporting Document 12.1.13

# Executive Summary

## NETWORK ASSETS COVERED IN THIS ASSET MANAGEMENT PLAN



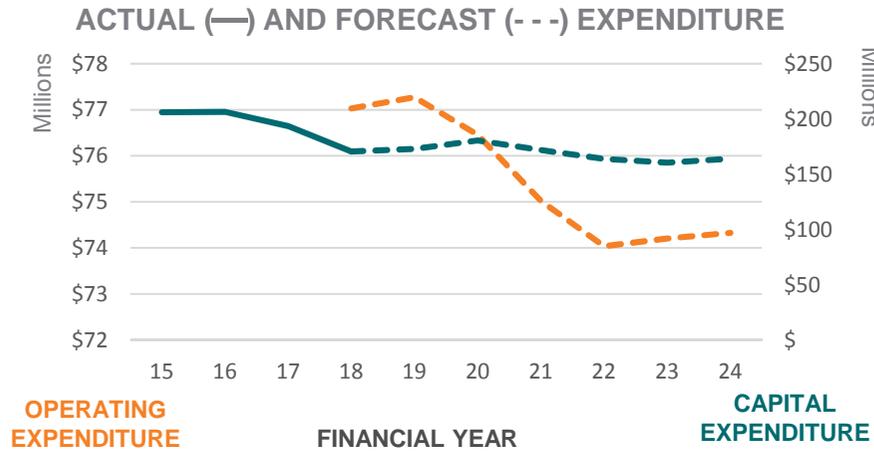
### ASSET CLASSES:

POLES | CONDUCTORS | SERVICE LINES | SWITCHGEAR | POLETOP STRUCTURES | TRANSFORMERS

THIS ASSET MANAGEMENT PLAN REPRESENTS:

**\$20.3B** OF TOTAL ASSET REPLACEMENT COSTS<sup>1</sup>

**74.3%** OF TOTAL NETWORK REPLACEMENT COSTS<sup>1</sup>



PROPOSED ANNUAL CAPITAL EXPENDITURE (CAPEX)

**0.8%**

OF TOTAL ASSET SYSTEM REPLACEMENT COSTS<sup>1</sup>

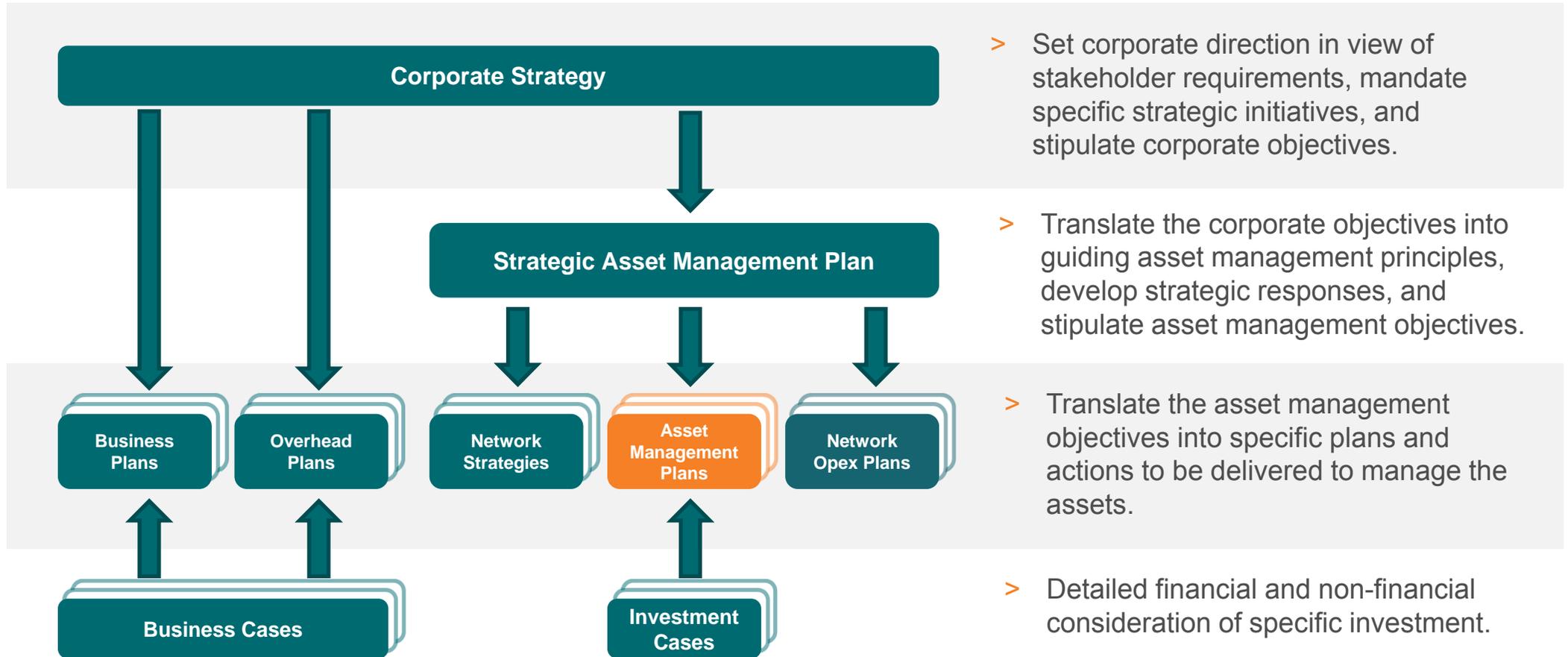
**17%** of overhead network assets are beyond their expected serviceable life

**82%** of asset-related safety incidents are associated with overhead network assets

**83%** of system reliability performance (SAIDI) is attributable to overhead network assets.

<sup>1</sup> 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



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# Asset Overview

## Overhead Network Assets:

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

\* **Underground assets are addressed in the Underground Network AMP.**

## Risk Management Issues



Safety



Increased Network Costs

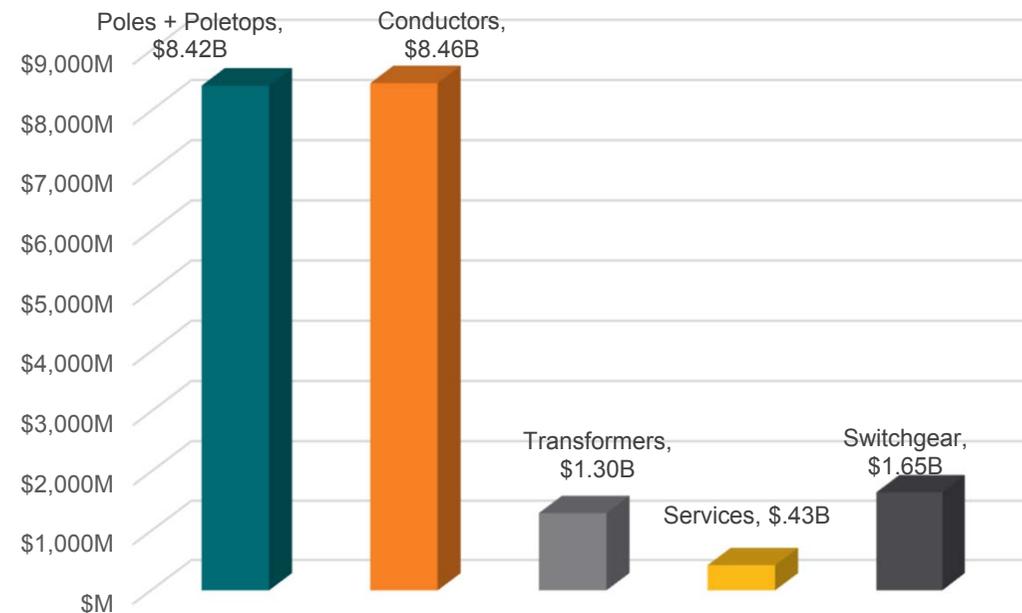


Network Reliability



Environment (and bushfire zones)

## Total Replacement Value of Overhead Network Assets



# Asset Scope, Population & Management

## Scope and Asset Population

	Overhead Conductor		Poles			Poletop Structures	Switchgear			Service Lines	Transformers
	High Voltage (km)	Low Voltage (km)	Staked Wood Poles	Wood Poles	Other	Cross-arms	Fuse	Switch	Circuit Breakers	Service Lines	Pole Mounted
Quantity	157,786	28,899	20,880	1,141,066	155,981	1,695,194	314,459	109,736	4,543	525,885	131,603
Average Age – RIN (yrs)	48	47	14	38	22	22	30	30	16	34	28
Expected Serviceable Life (yrs)	75	75	17	65	52	35	40	40	25	40	55

## Management Of Assets

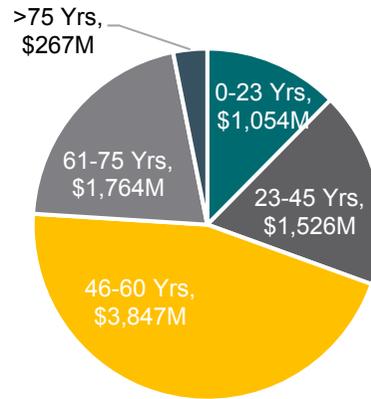
- > At a high level, we may use age as a proxy for condition and health, but at an individual level this is not how Essential Energy treats assets.
- > With the use of risk-based differentiators, we optimise our REPEX spend (which may result in an increase in an asset's average age profile) while maintaining 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

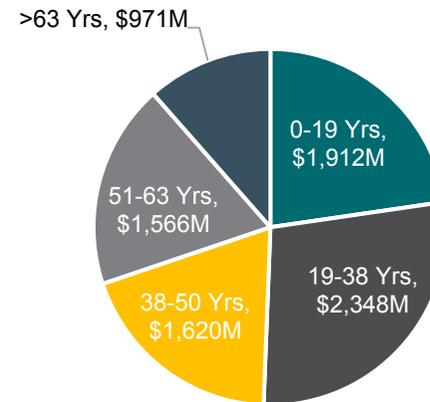
- > Each pie chart indicates how far through the assets expected serviceable life they presently are
- > Charts are listed left to right, top to bottom, in terms of overall total value to the network (see Total Replacement Value graph on slide 4).
- > Segments represent
  - 0-30% - Turquoise
  - 31-60%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

Of expected serviceable life consumed.

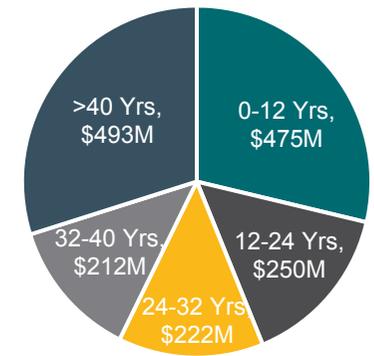
### Conductors



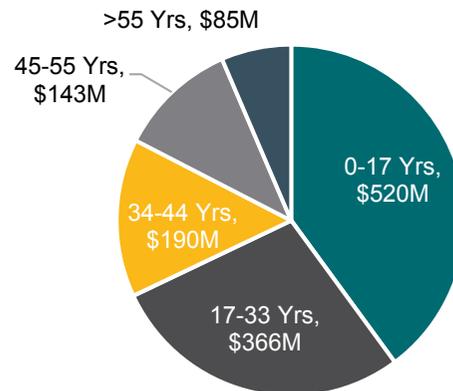
### Poles + Poletops



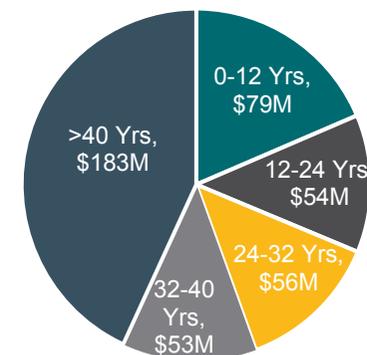
### Switchgear



### Transformers



### Services



# Key Challenges

## Failure rates per annum for assets in key challenge areas

- > Legacy natural round wood poles are **15 times** more likely to fail than other EE poles and **2.4 times** more likely than the industry average pole.
- > Hard drawn copper (HDC) overhead conductor is **6.5 times** more likely to fail than other EE conductors, **3 times** more likely than the industry average failure rate.
- > PEC and laminated (a subset of timber) crossarms are **3.2 times** more likely to fail than other EE crossarms, **4 times** more likely than the industry average failure rate.

## Conductor clearance defects

- > Technology improvements in measuring clearance distances (i.e. LiDAR) have significantly increased identified defects on the network (0.7% were extreme; 1.4% were high-risk).
- > Remediation program will target the highest risks of about 4,500 low clearance issues annually at over \$21.81M p/a.

Represents **13%** of asset system CAPEX

## Small-bodied conductor

- > 116,000km small-bodied, bare overhead conductor (includes HDC) on the network out of a entire population of 187,000km of conductor.
- > Not suitable for reinforcement.
- > Replacement program will target 240km of conductor annually at a cost of over \$11.17M p/a.

Represents **7%** of asset system CAPEX

## Natural round poles

- > 392,000 natural round wood poles on the network out of a total 1.3M poles, of which 190,000 have some form of decay.
- > Combined reinforcement and replacement program will treat around 5,500 natural round poles per annum at a cost of \$18.81M p/a.

Represents **11%** of asset system CAPEX

## Timber crossarms

- > 1.15M timber crossarms on the network, out of a population of 1.7M crossarms.
- > Not suitable for reinforcement.
- > Replacement program will treat approximately 19,925 crossarms p/a at a cost of \$33.02M.

Represents **20%** of asset system CAPEX

# Strategic Objectives, Targets and Performance

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

# Strategic Objectives, Targets and Performance

## Continued

Strategies & Objectives	Targets	Performance (16/17)
<b>3. Reliability</b>		
<b>NER cl. 6.5.7 (a) (3)</b> Compliance with the NSW Reliability and Performance Licence Conditions for Electricity Distributors (the Licence Conditions).	Achieve network reliability targets.	Network target achieved (Some feeders not meeting reliability targets).
	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.
<b>4. Safety &amp; Environment</b>		
<b>NER cl. 6.5.7 (a) (4)</b> 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 $\leq 2$ Number of Worker HPs attributed to assets in TotalSAFE $\leq 2$ Number of Public IPART Cat 1 incidents attributed to assets in TotalSAFE = 0 Number of Public IPART Cat 2 incidents attributed to assets in TotalSAFE $\leq 4$ Number of Public IPART Cat 3 incidents attributed to assets in TotalSAFE $\leq 42$	1 1 0 6.7 40
	Non-conformances meet Australian Standard AS 6947-2009 Crossing of waterways by electricity infrastructure = 0.	All sites have been rectified to very low risk
<b>NER cl. 6.5.7 (a) (4)</b> 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 $\leq 236$ (Maintain or reduce the risk associated with asset related firestarts. Note: Strategic targets based on historical average)	238
	Reportable contamination incidents = 0.	1
	Inadvertent contact with asbestos = 0.	0
<b>5. Power Quality</b>		
<b>NER cl. 6.5.7 (a) (3)</b> 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. PQ 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:

- > Above Ground Decay Zones
- > In-Ground Decay Zones
- > Corrosion Zones
  - > Sulphate Soils
  - > High Salinity Zones
  - > Thunder Day Zones
  - > UV Index Zones
  - > Humidity Zones

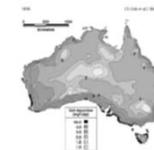
- > Essential Energy's new risk framework has emphasised sophisticated risk differentiators.
- > A differentiator allows an asset to be assessed based on the conditions it will be exposed to and the consequence of a failure, both which depend on an asset's location and purpose.
- > With such a large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



Above Ground Decay Zones



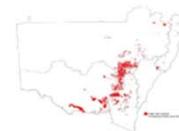
In-Ground Decay Zones



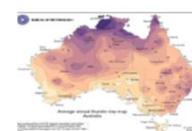
Corrosion Zones



Sulphate Soils



High Salinity Zones



Thunder Day Zones



Humidity Zones



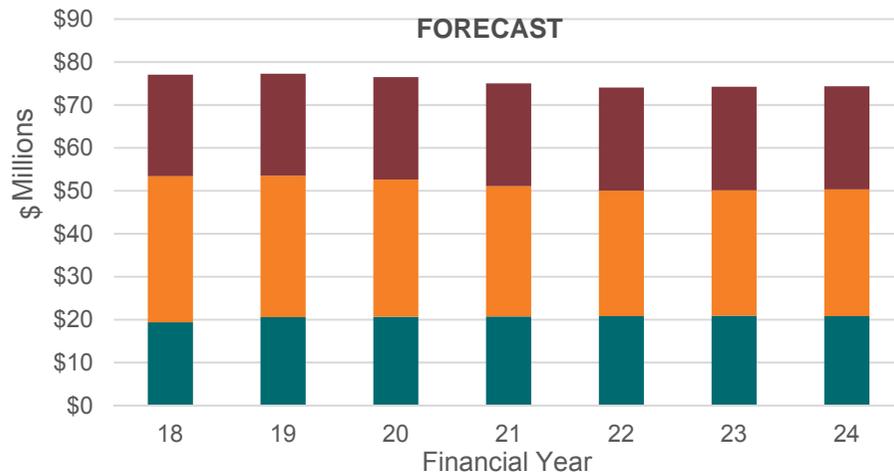
UV Index Zones



Fire Priority Zones

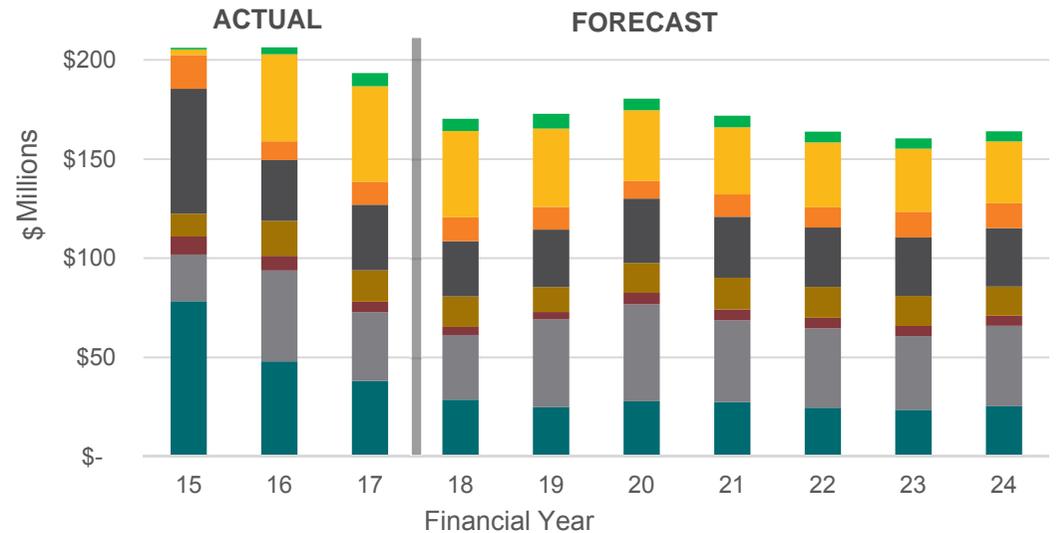
# Investment Program Summary

OPEX (FY19 \$ millions)							
	FY18	FY19	FY20	FY21	FY22	FY23	FY24
Routine Inspections	\$19	\$21	\$21	\$21	\$21	\$21	\$21
Planned Maintenance	\$34	\$33	\$32	\$30	\$29	\$29	\$30
Unplanned Maintenance	\$24	\$24	\$24	\$24	\$24	\$24	\$24
<b>Total</b>	<b>\$77</b>	<b>\$77</b>	<b>\$76</b>	<b>\$75</b>	<b>\$74</b>	<b>\$74</b>	<b>\$74</b>



**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	\$29	\$25	\$28	\$27	\$25	\$24	\$25
REPEX – Other <sup>1</sup>	\$33	\$44	\$49	\$41	\$40	\$37	\$41
Switchgear	\$4	\$4	\$6	\$6	\$5	\$5	\$5
Transformer	\$15	\$13	\$15	\$16	\$16	\$15	\$15
Pole	\$28	\$29	\$32	\$31	\$30	\$30	\$30
Conductor	\$12	\$11	\$9	\$11	\$10	\$13	\$13
Poletop	\$43	\$40	\$36	\$34	\$33	\$32	\$31
Services	\$6	\$8	\$6	\$6	\$5	\$5	\$5
<b>Total</b>	<b>\$170</b>	<b>\$173</b>	<b>\$181</b>	<b>\$172</b>	<b>\$164</b>	<b>\$160</b>	<b>\$164</b>



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



# Lifecycle Management Strategy: Overhead 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 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** – the overhead network is mainly high-volume/low-value assets, with varied lifespans. Most assets are piecemeal renewed e.g. pole renewal program.
  - **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.
  - **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

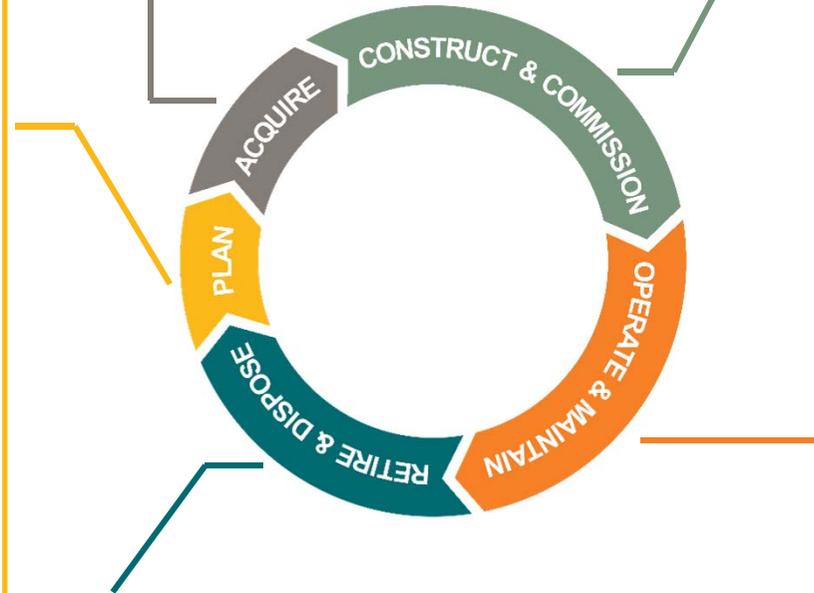
- > Complete design work.
- > Complete construction work completed
- > Load as-builts GIS and Asset Information Management System.

## OPERATE & MAINTAIN

- > **Routine Inspections:**
  - Routine ground inspections: Asset inspector periodically patrols the overhead network assets.
  - Critical equipment condition monitoring: Inspection of substations and switchgear that supply critical loads.
  - Distribution protection preventative maintenance: Test and battery exchange for distribution electronic protection.
  - Earth testing OH equipment: Earth integrity testing for pole substations, regulators and HV-only earth sites.
  - Regulator inspection: Mechanical testing of regulators without remote communications.
  - Subtransmission radial live line inspection: Poletop inspection of radial subtransmission lines.
  - Thermo-vision inspection: Annual patrol of high-risk, high-voltage feeders.
  - Tower inspection: Inspection of subtransmission steel towers.
  - Visual aerial patrol: Rural lines in high bushfire areas.
  - LiDAR aerial patrol and analysis (AP&A) inspection: Program covers network every 5 years.
- > **Planned Maintenance:** Corrective program prioritises defects based on risk.
- > **Unplanned Maintenance:** Also required.

## RETIRE & DISPOSE

- > Asset is conditionally failed as per specified serviceability criteria, which aligns with corporate objectives.
- > Asset’s 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
Natural round wood poles approaching end of life	IC ESS 15,17 & 46 – Poles	Provides further discussion and outlines the response in relation to the key challenges for the asset class.
Natural timber, pigment emulsified creosote (PEC), and laminated cross-arms approaching end of life	IC ESS 4005 & 4019 - Distribution Poletops	
Overhead conductors approaching end of life	IC ESS 16 – Bare OH Conductor	
Managing identification of additional conductor clearance defects identified using LiDAR	IC ESS 1023 & 1024 – Low Clearances	
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 15,17 & 46 – Poles	IC ESS 4005 & 4019 - Distribution Poletops	IC ESS2009 – Network Blackspots	IC ESS 45 – Subtrans Poletops	Details the fundamental need, options evaluation, and preferred option to be delivered to manage these specific assets.
IC ESS26 – LV Services	IC ESS 1023 & 1024 – Low Clearances	IC ESS 38 – Two Pole Substations	IC ESS 32 – Distribution OH Substations	
IC ESS13 – HV Regulators	IC ESS23 – Low Voltage Spreaders	IC ESS 16 – Bare OH Conductor	IC ESS 12 – OH Switchgear	
IC ESS14 – Poletop Reclosers	IC ESS 30 – Distribution Transformers	IC ESS 22 – Navigable Crossings		
ESS_1005 Cobaki Detailed Options Report	ESS_1030 Googong to Tralee 132kV feeder Detailed Options Report	ESS_4022 Casino - Urbenville Detailed Options Report	ESS_4021 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	

## Policies

Document	Relevance to the AMP
Bushfire Management Plan (CEOP8022)	Used to set Asset Management Objective Targets
Australian Standard AS 6947 Crossing of waterways by Electricity Infrastructure 2009	
ISO 55000:2014 - Asset Management	Used to develop Asset Management System

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