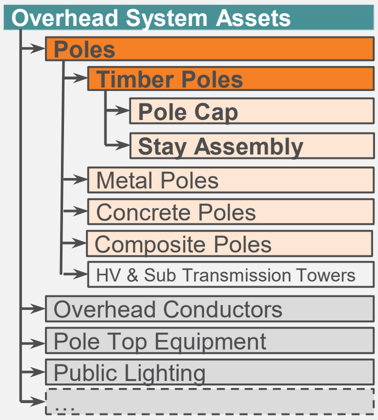
Poles Investment Case

Poles are one of the most visible asset classes across Essential Energy's network and a major contributor to cost, risk and performance. The primary function of a pole is to support conductors and equipment used for the distribution of electricity in a specific spatial envelope. This is to ensure the required clearance between the conductors or equipment and other objects is maintained in order to avoid inadvertent contact or unintentional discharge of electricity.

Scope

This asset class investment case addresses poles and related ancillaries which directly support their installation, safety, and maintainability. This includes high voltage and sub-transmission towers, privately owned poles and pole stay assemblies, although excludes streetlight poles.

The investment is required to meet the capital expenditure objectives (NER 6.5.7) for quality, reliability, safety and security of electricity supply and to meet regulatory and legislative obligations for Standard Control Services.



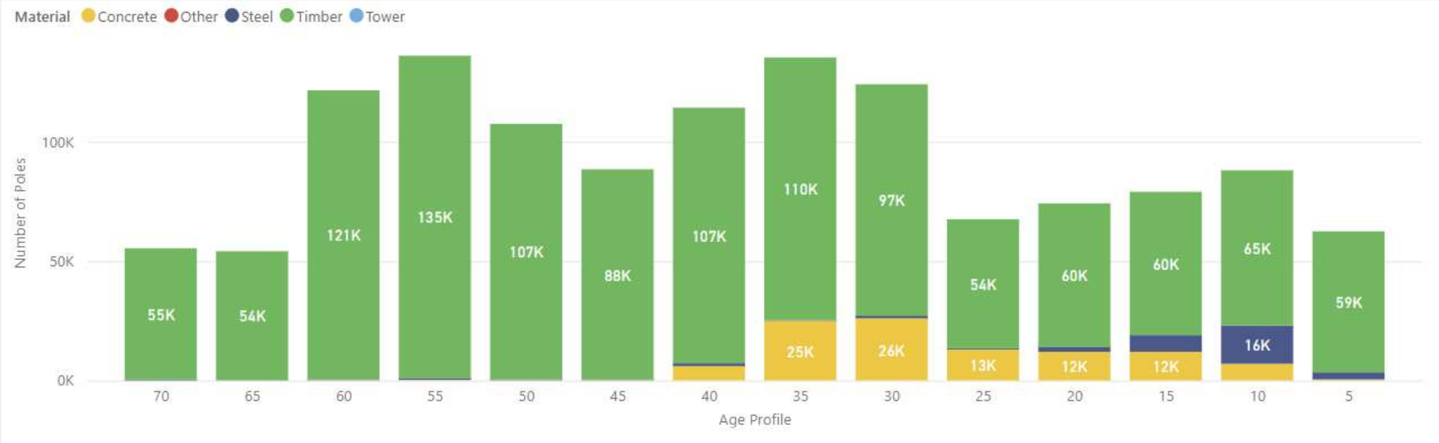
Forecast $FY24

The Poles forecast accounts for 37.3% of the total Repex portfolio for FY25 to FY29.

FY25	FY26	FY27	FY28	FY29
$77M	$78M	$84M	$88M	$91M

Asset Profile/Health

Essential Energy has a wide range of pole types across its network driven by evolving trends across the industry and the different business strategies adopted by previous supply authorities over time. The population of 1.4 million poles is comprised of predominately timber (~85%), with the remainder made up of concrete (~7%), steel (7%) and a small population of composite poles. The figure below shows the age and the different pole material types.



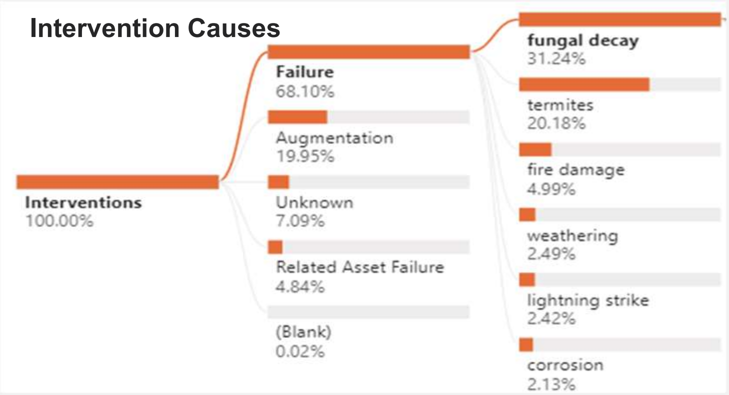
Due to the combination of asset volume, failure modes, and replacement costs, asset age has been used as a proxy for asset health for this asset class.

Risk Analysis

This section provides an overview of the Poles risk model. It is supported by documents and **6.03.02 Network Risk Management Manual, 6.03.03 Appraisal Value Framework and 6.03.04 System Capital Risk and Value Based Investment** methodology.

Probability of Failure (PoF)

Failure modes for a pole have been identified through the Failure Mode Effects Analysis (FMEA) with subsequent analysis focusing only on those failure modes that can lead to an unassisted functional failure. Analysis of historical data from 2015 – 2019 identified ~53,000 asset interventions as either assisted or unassisted asset failure, augmentation or conditional tasks. The key pole PoF differentiators are: intrinsic (i.e. pole material), location (i.e. termite, fungal, fire risk zones), and health (i.e. asset condition compared to expected degradation rate). PoF models have been developed for each material and pole type. Weibull parameters used in the risk model are shown below.



Weibull Functional Failure Parameters

Material	Characteristic Life / Scale (η)	Shape (β)
Concrete	450	2.6
Steel pole	220	3.5
Lattice steel tower	4000	1.5
Timber – CCA	280	4
Timber – Natural	450	2.4
Timber – Other	280	4
Aluminium	220	3.5
Other	192	2.8

Consequence of Failure (CoF)

The consequence model describes the expected impact of an unassisted functional pole failure. Consequences have been monetised using the **6.03.03 Appraisal Value Framework**.

Total consequence of failure (expected *if* all poles were to simultaneously fail) for the current population of poles are shown in the table opposite.

Event Trees combining the likelihood of consequence and cost of consequence have been developed at an individual pole level to determine the key contributors to consequence criticality associated with each pole and the associated pole top equipment. The Poles consequence modelling has been developed using a combination of data where available and Subject Matter Expert (SME) elicitation where insufficient data was available.

Value Measure	Consequence		
	Total $B	Average ($ per crossarm)	Median ($ per crossarm)
Network	$42.8	$31.0k	$4.7k
Safety	$12.5	$8.9k	$9.8k
Bushfire	$22.4	$16.0k	$1.6k
Environment	$0.17	$0.1k	$0
Financial	$4.7	$3.4k	$3.0k

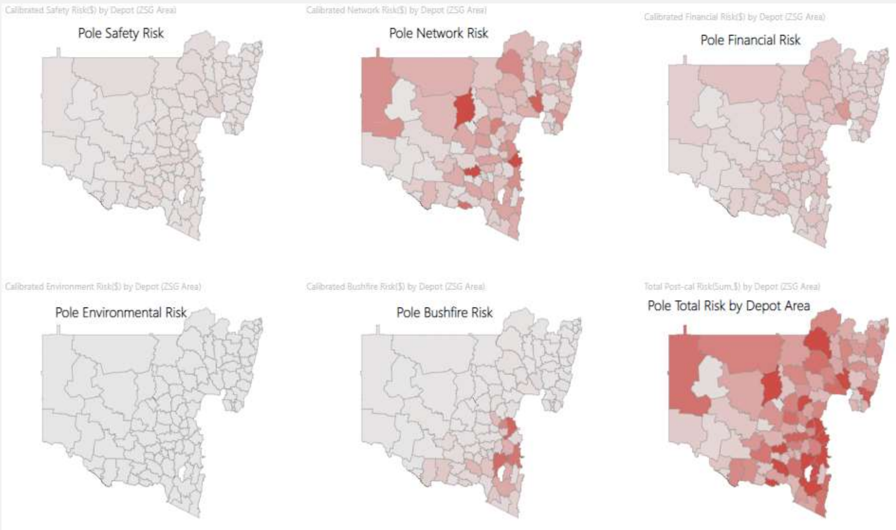
Risk Analysis, cont

Risk Calibration

Asset risk is calculated by applying the PoF and CoF models to individual assets. Asset risk is then aggregated to the total population level to determine the asset class risk.

Model outputs have been calibrated against top-down performance figures for unassisted failures. The table opposite compares the unscaled model outputs with the monetised top-down performance. For implementation, scaling factors are applied to risk model outputs, to align risk forecasts with realised performance.

Value Measure	Safety	Network	Bush fire	Financial	Total
Unscaled Model Outputs ($M)	1.3	3.7	2.4	0.5	7.9
Top-Down Performance ($M)	0.8	4.9	1.6	2.7	10.0



Risk Heatmap (Scaled)

The figure opposite displays the breakdown of the (residual) risk for poles by depot area and value measure. The primary differentiators of risk for poles are the Network and Bushfire consequences, with remote radial fed sub-transmission poles having the highest Network consequence cost, alongside poles in high consequence bushfire areas.

Forecasting Approach

The replacement Capex forecast (FY25-FY29) has been calculated using Essential Energy's optimisation software (Copperleaf) which uses a risk based methodology to maximise the value of the investment portfolio within constraints established by Essential Energy that are consistent with our Corporate Risk Framework, Asset Management System, applicable standards, rules, regulations and licence conditions. To assure efficiency our portfolio has been constrained to meet customer and stakeholder expectations.

In line with NER capital objectives, the objectives of our total replacement portfolio have been informed through extensive stakeholder engagement and consist of:

- Maintain reliability performance (network risk)
- Long term reduction of bushfire start risk by 20% over 20 years (2.5% FY25-29)
- Maintain safety performance

The replacement quantities of Poles consist of the sum of:

1. Forecast **conditional replacement** volumes
2. Forecast **functional failures** volumes
3. Optimised risk-based replacements to maintain overall network risk values within defined objectives.

The above asset interventions utilise a probabilistic approach that has been developed through detailed analysis of historical asset performance to establish Weibull parameters (refer 6.03.03.23)

The probabilistic method has been tested and validated against historical volumes to ensure that it is accurate at the population level.

Forecast investment expenditure has been determined by multiplying the forecast replacement quantities of poles assets by applicable unit rates.

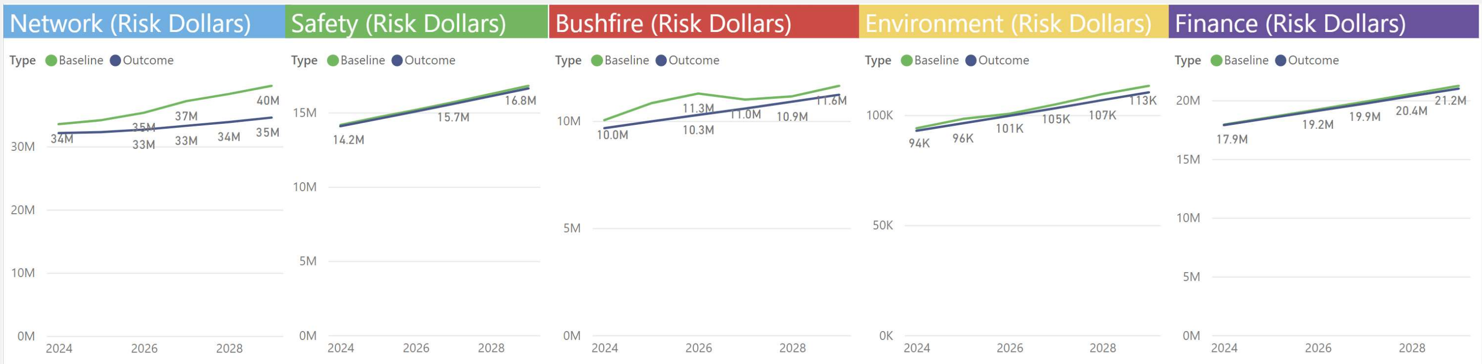
Refer to **6.03.04 System Capital Risk and Value Based Investment** methodology for details on the **portfolio** wide optimisation planning approach and risk outcomes, and **10.01.04 Capital Unit Rates** for unit rates.

Expenditure related to the transition to composite poles has been included in the forecast. Refer **10.02.24 Composite Poles Transition Investment Case.**

Resilience-related expenditure for this asset class has been included in the expenditure forecast. Refer **10.06.01 Resilience Risk Based Pole Replacements Investment Case.**

Optimised Portfolio Outcome

Risk Trend (2024-29 Optimised portfolio)
Over the 5 year regulatory window, total **baseline** monetised risk due to **functional** Poles failure is estimated to increase to $89M by 2030. The figure below depicts the **baseline** scenario and investment **outcomes** ($83.5M) of the optimised program for Poles.



Asset Grouping

The 1.4 million pole assets have been grouped into three broad categories for investment optimisation purposes according to the different modes of replacement:

1. **Conditional** replacement - where an inspection has identified a defect that must be rectified in a predetermined timeframe by asset replacement;
2. **Functional** failure replacement - where the Pole is no longer able to perform its function due to damage and requires immediate replacement;
3. **Risk-based** replacement - e.g. The risk attributed to a crossarm through its combination of probability of failure and consequence of failure is high and replacement is the prudent action to reduce this risk. Assets within this risk-based replacement group have been included in the optimisation process where they will have reached Equivalent Annualised Cost (EAC) positive by FY34.

- 27,121 asset groups were loaded into 1,625 **risk based** investments in Copperleaf to provide flexibility in portfolio optimisation.

- Pole age was used as the primary determining factor of functional or conditional failure likelihood, as other failure types are either random (e.g. struck by lightning), or are considered in the risk-based scenario

Options

1. Poles replacement Capex modelled as like-for-like replacement
2. Pole replacement Capex modelled on composite material
3. Risk based asset groupings are treated as additional optional investments for consideration in the total optimised portfolio to meet overall portfolio objectives.

- Non-network solutions are considered when planning the replacement of a specific asset.

Key Assumptions

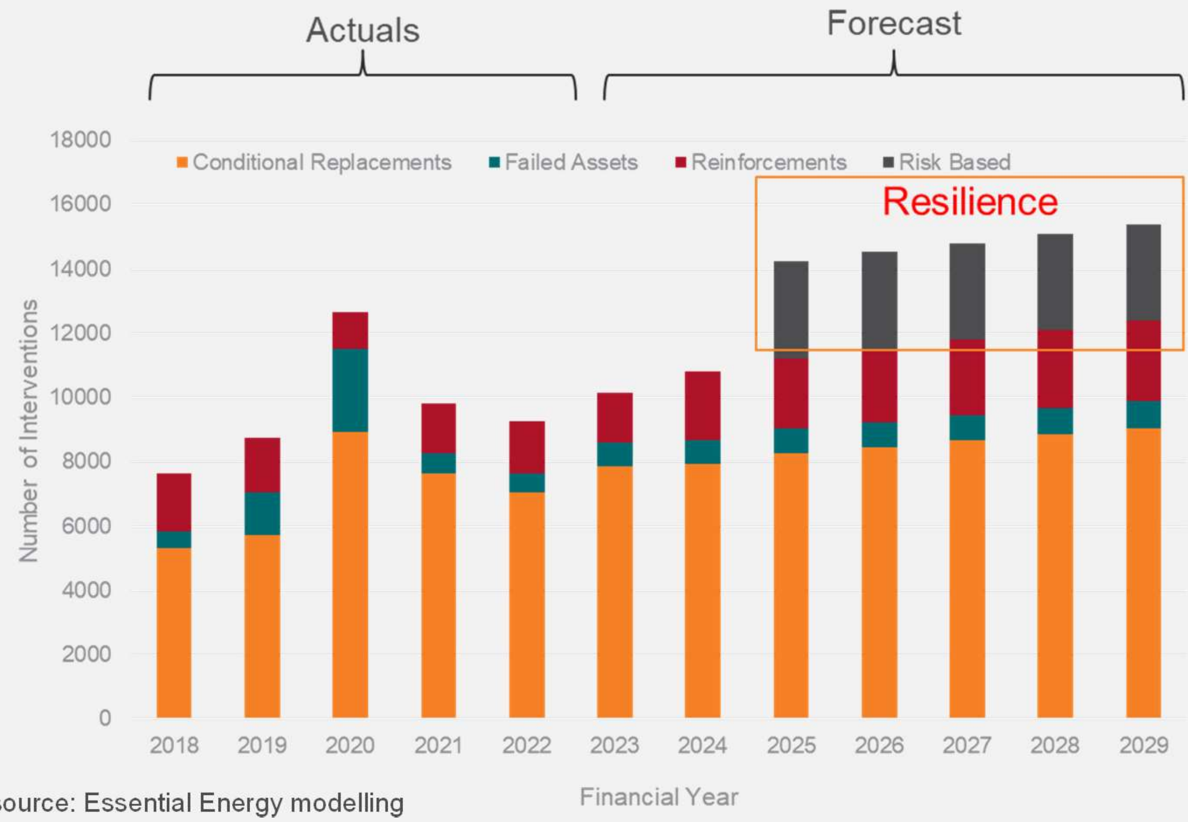
Probability of Failure
- Probability of Failure Weibull parameters generated using survival analysis of historical data from 2015-2019 with an adjustment made to address missing failure data
- Probabilities of failure for assets with small populations with very limited failure information have been based on assets with similar material properties

Consequence of Failure
- Developed in accordance with 6.03.03 Appraisal Value Framework

Risk Calculation
- Application of scaling factors for Safety, Network and Bushfire risk in line with actual performance data where available, in conjunction with SME input.

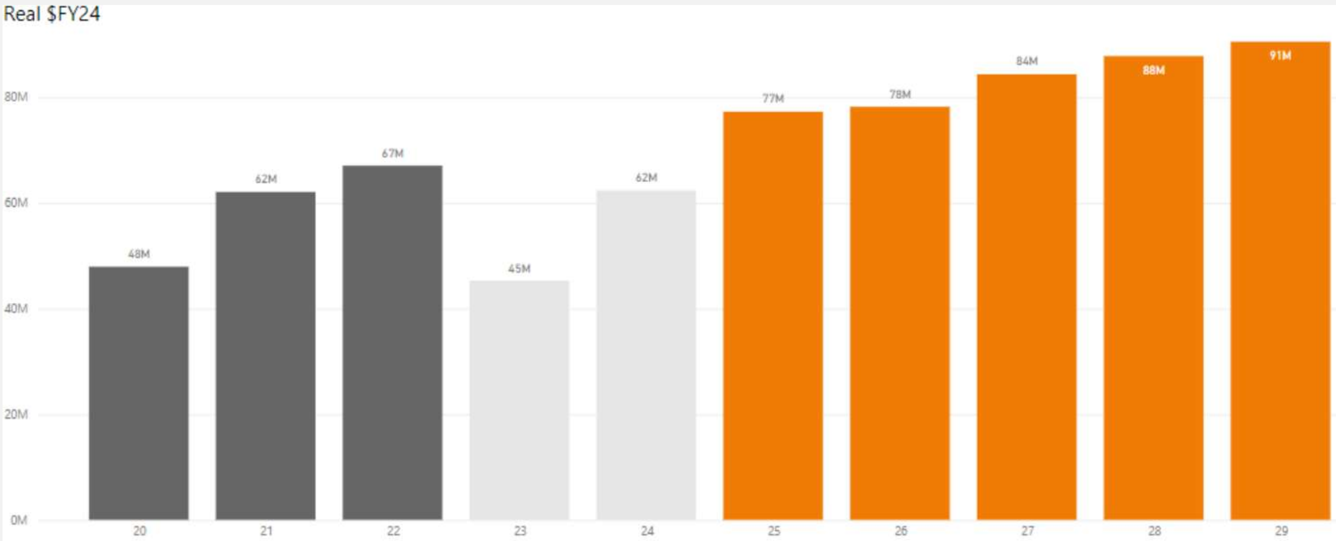
10 Year Replacement Capex Forecast

- Given an ageing asset base the forecast replacement rates are in line with historic trends for conditional, asset failures and reinforcements.
- Additional risk based pole replacements have been optimised into the portfolio based on climate change modelling and customer engagement



Data source: Essential Energy modelling

Forecast replacement expenditure for Poles across the 2024-29 period is $418.3M, averaging $83.7M per annum (includes resilience risk based pole replacement and composite pole transition). Actual and projected expenditure for the remainder of the 19-24 period is $284.8M.



Data source: Actuals: Internal delivery reports, Forecasts: Copperleaf
Note: All values are in FY2023-24 real dollar terms

Justification

We are confident that our approach delivers an efficient and prudent level of investment as:

- **Clear drivers from Asset Management Objectives** for Reliability, Quality, Safety and Compliance (as detailed in 10.01 Strategic Asset Management Plan).
- **NER Capex objectives**: form the basis of our proposal
- **Review and moderation:** Our forecasts have been tested and reviewed by our executive management and the Board, subject to top-down challenges (as detailed in **6.03.04 System Capital Risk and Value Based Investment**) and the forecasts moderated based on feedback and discussion.
- **Customer needs:** Through customer engagement, refer Chapter 4 of our Regulatory Proposal, customers indicated a desire to maintain current levels of safety and reliability, and increase expenditure for resilience based projects. The investment will contribute to maintaining safety and reliability, and improving resilience within the wider Repex portfolio (as per Copperleaf forecast). In AER's *Note on Network Resilience* (April 2022), the AER stated that they consider resilience-related funding, that seeks to achieve **service level outcomes,** is accommodated by the NER.

The major benefits from the proposed Poles investments (against the **change nothing** scenario) are:

- **Reduced bushfire risk:** as a large portion of the pole fleet is in high-bushfire risk areas, maintaining the positive health of the fleet will reduce the probability of bushfires resulting from pole failures.
- **Improved resilience:** as the climate continues to change, presenting increasingly harsh environments in which our network operates, our pole infrastructure will be able to more readily endure such hostile conditions (Refer **6.01 Climate Impact Assessment**).
- **Improved safety:** provide poles, equipment and other objects in order to avoid inadvertent contact or unintentional discharge of electricity and bushfire starts.
- **Maintain levels of service for our customers:** Maintaining the health of assets through addressing locations of highest risk, will result in fewer unplanned failures from asset degradation and therefore will enable us to maintain service reliability for customers.

Forecast Poles Repex expenditure for the 2024-29 period is $418.3M. The increase from 2019-24 actual/forecast of $284.8M is due to:

- increase in volume of reinforcements due to the aging pole fleet
- increase in unit rate for transition to composite poles - refer **10.02.24 Composite Poles Transition Business Case.**
- Increase in Resilience risk based pole replacements - refer **10.06.01 Resilience Risk Based Pole Replacements Investment Case.**

Strategic Direction

We shall

Acquisition

Selection Criteria

Continue to use timber as the default pole material until approval is received for composite as the default

Continue the controlled roll out of composite poles in high value locations based on risk value outcomes

Continue the use of steel and concrete poles only in exceptional circumstances for Subtransmission

Procurement

Hold emergency pole stock across depots to ensure the network is resilient against isolated increases in pole failures

Review the criticality of poles within depots to inform emergency stock holding levels.

Ops & Maintenance

Preventative Maintenance (Testing & Inspections):

Continue to **inspect** poles with a cycle frequency of **4.5 years**, in accordance with CEOP2446 and CEOM7005

Continue to identify corrective maintenance tasks during inspections and classify using the Network Asset Health Catalogue (NAHC)

Continue capturing information at inspections necessary to monitor pole condition and determine serviceability

Corrective and Breakdown Maintenance:

Continue to rectify minor corrective maintenance tasks where the work delivers positive value

Continue to replace poles on failure, using the material type as per 'Selection Criteria'

Interventions

Serviceability

Continue determining serviceability as per CEOP2446

Develop an enhanced serviceability criteria that leverages the engineering model in the digital twin (E.g. pole tip loading)

Prioritisation

Continue to prioritise tasks by severity, asset criticality

Investigate methods to improve task prioritisation based on value

Repairs

Continue to **reinforce poles** whenever it is the highest value option (CEOM7005)

Continue to apply **temporary struts** to poles to mitigate risk and enable more cost effective scheduling of pole replacement

Replacements

Continue to **replace poles** once they are no longer serviceable (see Acquisition above)

Disposals

Individual Assets

Continue disposal of poles in accordance with CEOF6139, or CECM1000 (pole butts and fire damaged CCA poles).

Investigate options for recycling composite poles.

Entire Variants

Develop a disposal plan as per CEOP8074 to ensure asset support systems and data is appropriately managed

Asset Support

Process & Information

Develop methods to improve existing condition data and failure reporting data.

Continue improving inspection processes to allow identification of asset condition during inspection so that corrective tasks can be raised after the inspection with consideration of other factors and data

Develop processes and logic to generate work tasks from inspection condition data, so the task creation considers consequence of failure and asset criticality

Supply Chain

Maintain long term supply contracts for poles to meet the required demand

Establish processes for reusing composite poles

People & Training

Leverage pole asset class forecasts to inform future trade training and workforce demand modelling