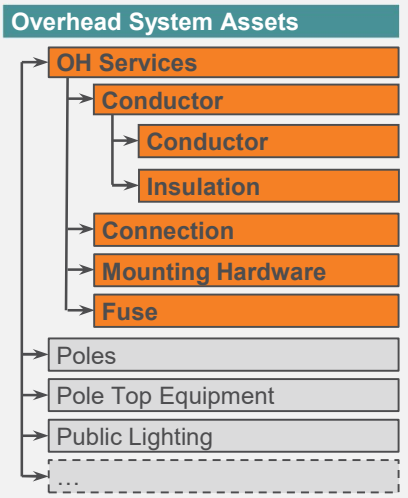
Overhead Customer Service Connections Investment Case

Overhead Customer Service Connections (OH Services) form the bridge between Essential Energy's LV distribution network and its customers. They are typified by 2 or 4 core insulated twisted conductors ≤25mm^2.

Scope

This investment case addresses Overhead Customer Service Connections including the conductor, insulation, mounting hardware, connection hardware and fuses which support the installation, safety, and maintainability of the asset. This scope includes all equipment required to connect the customer's point of connection to the LV distribution network (as defined by the NSW Service & Installation Rules).

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



Forecast $FY24

The OH Services forecast accounts for **2.87%** of the total Repex portfolio for FY25 to FY29.

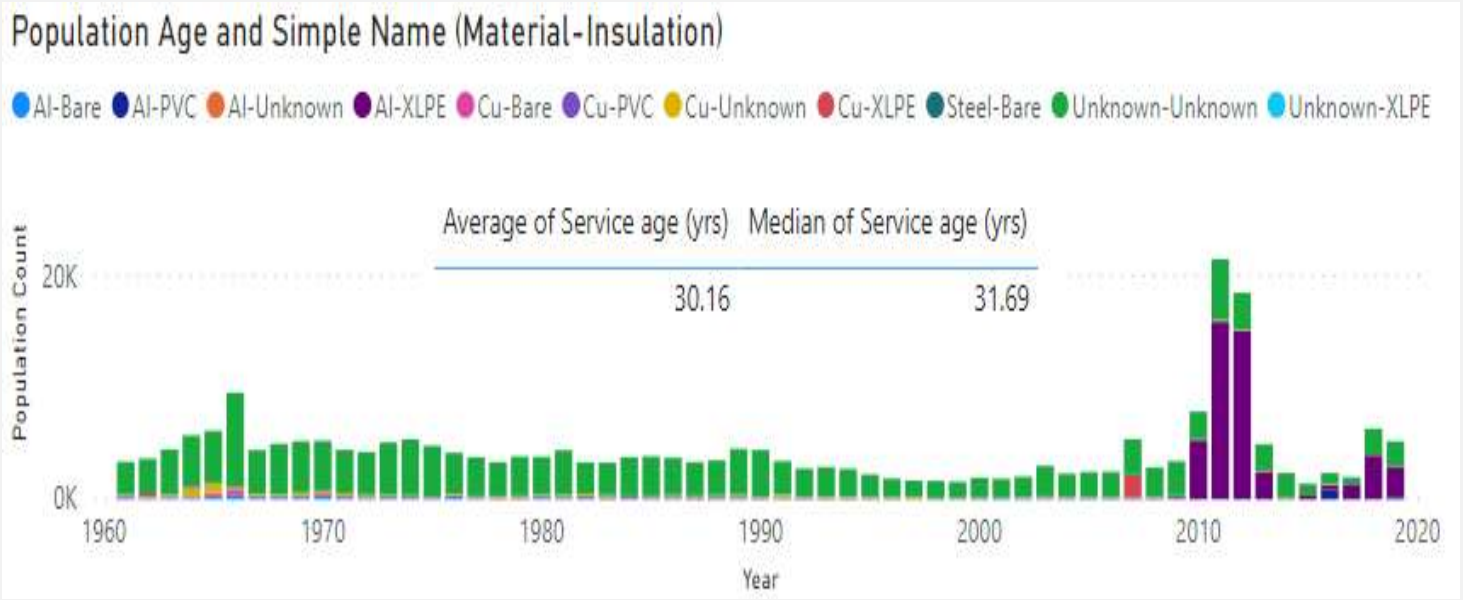
FY25	FY26	FY27	FY28	FY29
$6.3M	$6.3M	$6.4M	$6.5M	$6.6M

Asset Profile/Health

Asset Profile

Essential Energy's network includes approximately 532,000 OH Service conductor segments recorded in Essential Energys GIS. The current connection standard is 25mm^2 Cross-linked polyethylene (XLPE) insulated aluminium.

Prior to 2010 little data was recorded regarding conductor type, however the predominant conductor of previous standards encountered on the network is reported to be Polyvinyl chloride (PVC) coated copper conductor.
46% of the OH Services population data contains anomalies ranging from incorrect installation data to erroneous or incorrect conductor types. This effect is predominantly seen with large installation peaks recorded as 1900 and 1961. These years, where notional installation is prior to 1961, are treated as unknown for this asset class.



This section provides an overview of the OH Services 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

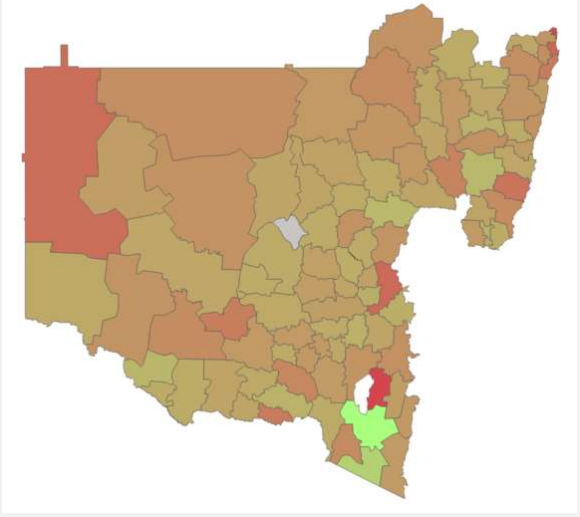
Failure modes for a service have been identified through a Failure Mode Effects Analysis (FMEA) with subsequent analysis focusing only on those failure modes that can lead to a substantial short-term consequence. Analysis of historical data from 2015 – 2019 identified ~25 000 asset interventions as predominantly either conductor, connection, or mounting hardware failures. The use of historical data inherently incorporates the preventative controls currently employed for the treatment of failure risk. Weibull parameters used in the risk model are shown below.

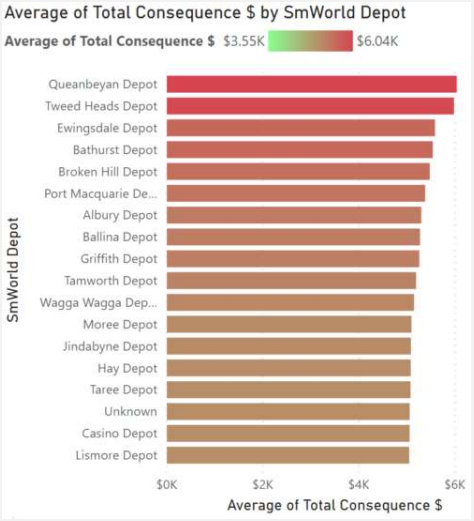
Probability of Failure Model	Alpha	Beta
All component failures	91.4	1.97

Consequence of Failure

The consequence from failure of an OH Service describes the impact of a failure where there is potential for substantial short-term consequence.
Consequence costs are dominated by Network and Safety.
All assets have an individual calculated safety fatality rate conforming with the acceptable criteria as per **6.03.02 Network Risk Management**. Consequences have been evaluated using the **6.03.03 Appraisal Value Framework.**

Component	Total ($ billion)	Average ($ per service)	Median ($ per service
Network	1.11	2,168.24	1,949.00
Safety	0.97	1,893.00	1,893.00
Bushfire	0.02	35.62	5.86
Financial	0.42	825	825



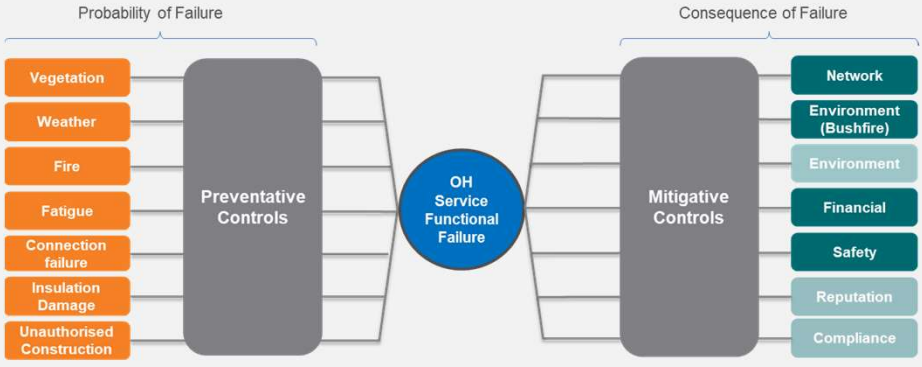


The graph shown on the left displays the summary of the asset criticality (quantified by the average of total consequence per segment failure) for OH Services by depot.

OH Services have a relatively flat consequence profile due to their low rate of fire starts per failure and low number of customers per segment.

Network Risk

Asset risk is a function of the probability of failure and the consequence of failure. The risk model has been developed using the Asset Risk Management framework, and represents the relationship between the primary drivers behind OH Services functional failures and the components used to determine the consequence of failure.



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

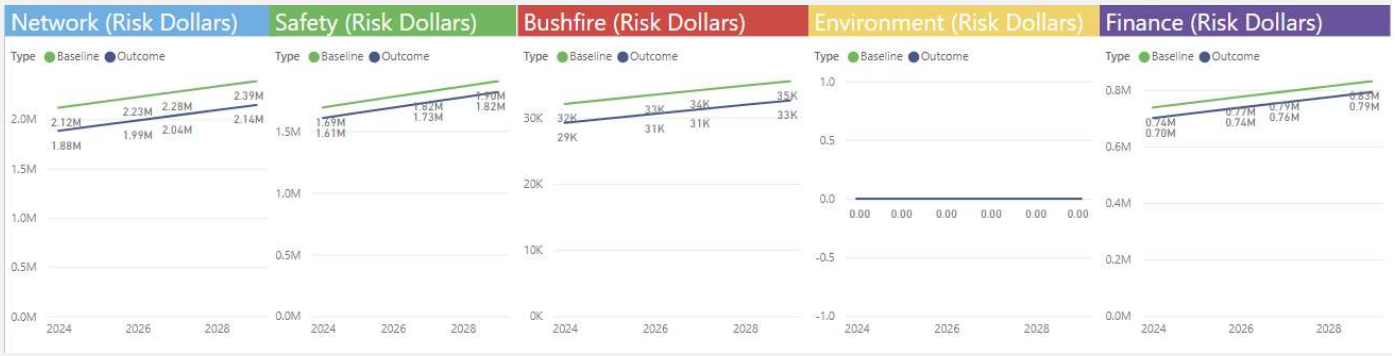
The replacement quantities of OH Services consist of the sum of:

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.
Forecast investment expenditure has been determined by multiplying the forecast replacement quantities of OH Services 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.

Optimised Portfolio Outcome

Risk Trend (2024-29 Optimised portfolio)
Over the 5 year regulatory window, total **baseline** monetised risk due to **functional OH Services** failure is estimated to increase to $7.4M by 2030. The figure below depicts the **baseline** scenario and investment **outcomes** ($5.5M) of the optimised program for OH Services.



Grouping

The OH Services 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 asset 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 an asset 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.

- 260,556 asset groups were loaded into 186 investments in Copperleaf to provide flexibility in portfolio optimisation.

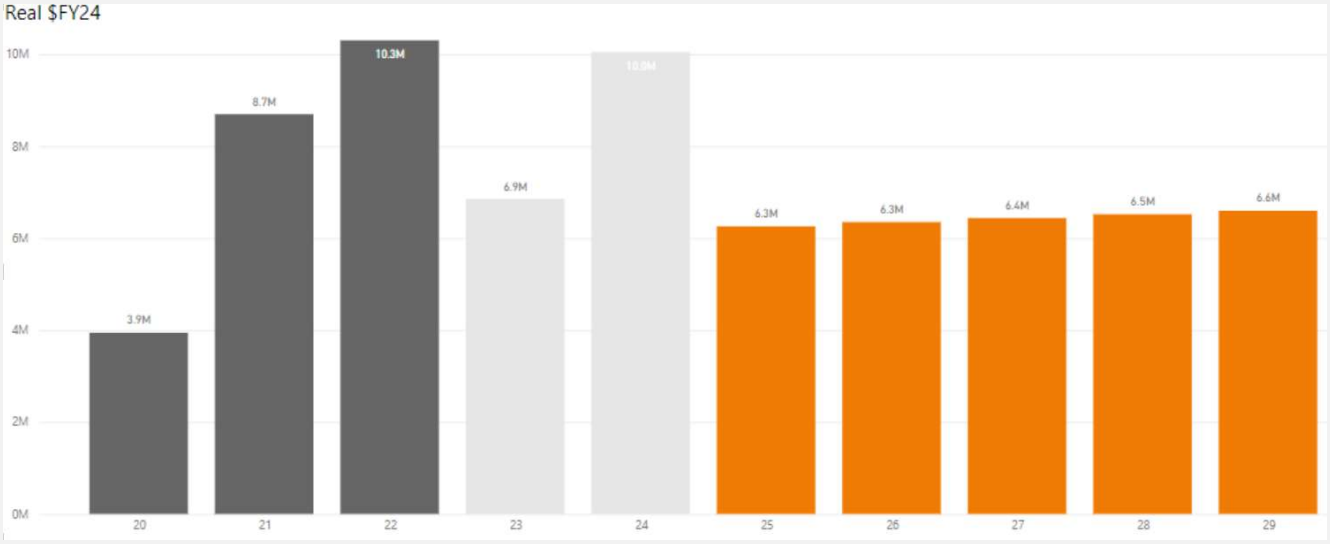
Investment Options

1. OH Services replacement expenditure has been modelled on a replace with current standard or like-for-like.
2. 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 not considered when planning the replacement of this asset class.

10 Year Replacement Capex Forecast

Forecast replacement expenditure for Overhead Services across the 2024-29 period is $32.2M, averaging $6.4M per annum. Forecast expenditure for 19-24 period is $39.8M.



Data source: Actuals: Internal delivery reports, Forecasts: Copperleaf
Note: All dollar values are Direct, $FY24.

Justification

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

- **Clear, prudent drivers from Asset Management Objectives (detailed in 10.01 SAMP) for Reliability, Quality, Safety and Compliance:** Our forecast has been developed in line with the asset management objectives for this asset class include: maintaining present reliability levels for our customers; maintaining safety incidents at or below present levels; and reducing unassisted fire starts; and
- **NER Capex objectives**: form the basis of our proposal
- **Review and moderation:** Our forecasts have been tested and reviewed by our customers, our executive management and the Board, and the forecasts have been moderated based on feedback and discussion.
- **Deliverable:** Adequate resources are available to deliver the work.

The major benefits expected from these investments are:

- **Maintain network and safety risk**: through continuation of the Bulk Replacement program, we will proactively address locations of greatest risk across our overhead network, and in a manner that minimises costs; and
- **Maintained service level outcomes:** management of asset health will result in better control of unplanned failures thus will maintain network reliability.

Forecast Overhead Services Repex expenditure for the 2024-29 period is $32.2M. The reduction from 2019-24 actual/forecast of $39.8M is due to:

- reduction in volume of replacements to achieve overall risk targets.

Assumptions

- **To fit a Weibull to historical failure data (and extract α, β),** the age at task date was taken to be the pole age at task date rather than OH Service segment age directly because tasks are not currently attributable to OH Service segments. In some cases, when a pole was replaced after an OH Service task, this produced negative age at task date values which were excluded from the curve fitting analysis.
- **To predict future failures (using α, β),** the current population age was taken to be the OH Service segment age recorded in Smallworld. Expected failures per depot were calculated at an individual asset level for assets with valid installation dates (≥1961), with the total number of expected failures for the depot aggregated then scaled up based on the total population size including those with invalid installation dates. This is likely to result in a slightly optimistic bias because the OH Services of unknown age are likely to be skewed towards older end of the population due to better recent data capture practices.
- Failure analysis assumed no major difference in service life between PVC and XLPE OH Service segments. This is a conservative estimate of OH Service life, as XLPE is expected to be more durable than PVC.
- Consequence costs for Safety, Network, & Bushfire have been taken from 6.03.03 Appraisal Value Framework.

Strategic Direction

We shall

Acquisition

Selection Criteria
Continue to select OH Service materials for installations in accordance with CEOM7097 and the *Bulk Service Mains Replacement Program Technical Specification*. The current standard is to use 2 or 4 core 25mm2 XLPE-insulated aluminium.

Maintain current installation roles, with new connections installed by Accredited Service Providers (ASPs) on behalf of the customer, and replacements performed by Essential Energy or Contracted Service Providers (CSPs) on behalf of Essential Energy.

Procurement
Maintain and monitor current inventory management system to ensure current levels of material, quality and documentation is maintained for service replacements

Ops & Maintenance

Preventative Maintenance (Inspections):
Continue to inspect OH Services with a cycle frequency of 4.5 years, in accordance with *CEOP2446* and *CEOM7005*.
Investigate opportunities to enhance inspection techniques, preferably with measurable outcomes.
Investigate opportunities to enhance inspection data collection to fill data gaps (e.g. conductor type) which inform failure likelihood.

Corrective Maintenance (Repairs):
Continue to repair OH Services in accordance with *CEOM7094*, *CEOM7005*, and *CEOP2446*. This includes re-tensioning of conductors, rectification of clearance issues, and modification of mounting hardware.

Breakdown Maintenance:
Continue to carry out breakdown maintenance on OH Services in accordance with *CEOM7094*, *CEOM7005*, and *CEOP2446*.

Interventions

Serviceability
Continue to assess serviceability in accordance with *CEOP2446, CEOM7005, and the Bulk Service Mains Replacement Technical Specification.* This is predominantly determined by adherence to type specifications, but may be triggered by power quality, fault and emergency, or network improvement events.

Continue to rectify serviceability issues where identified through replacement.

Rate of Replacement
Maintain the current rate of planned replacements for the current regulatory period (2020-2024) at 7,700 p.a.

Review replacement rates and utilisation of bulk program as smart meter data becomes available.

Prioritisation
Continue to prioritise rectification of defects identified through inspections and maintenance regime.

Continue to prioritise depots to be visited by the Bulk Service Mains Replacement Program based upon per-unit monetised risk in accordance with *CECG1140*.

Disposals

Individual Assets or Entire Asset Variants
Continue to require CSPs to be responsible for handling, storage & recycling of all service segments removed through the Bulk Service Mains Replacement Program.

Continue to dispose of other service segments in accordance with *CECP8074* to ensure asset support systems and data are appropriately managed.

Hazardous Materials
Continue to manage hazardous materials in accordance with the *Bulk Service Mains Replacement Technical Specification* and *CECM1000.10*.

Asset Support

Process & Information
Establish OH Services as assets recorded in the EAM system, so that work tasks can be raised against them directly.

Enhance detailed reporting of safety severity for Shocks & Tingles incidents.

Continue to remediate data gaps in asset information with high quality data collected through the Bulk Service Mains Replacement Program.

Enhance processes to remediate private asset encroachment where this prevents work task completion on OH Service assets.

People & Training
Continue to verify CSP competence through Essential Energy training centres.

Supply Chain
Continue to maintain stock to address F&E incidents at an individual depot level.

Enhance traceability of assets installed on the network by requiring CSPs to record conductor batch identification where installed, enabling rectification of batch faults.