

UG Pits, Pillars & Cubicles Investment Case

UG Pits, Pillar and Cubicles (UGP) are one of the most integrated and accessible assets classes for the general public and a major contributor to Essential Energy's underground network risk and performance.

Scope

This investment case addresses Pits, Pillar and Cubicles in the underground network and related ancillaries which directly support the reliability, safety, and maintainability of the network.

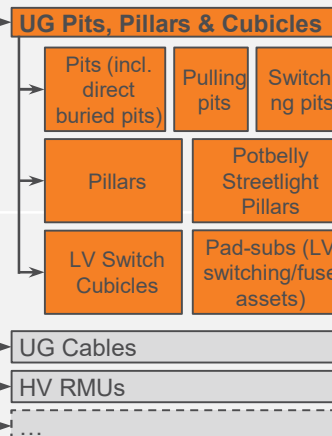
The investment is required to meet the capital expenditure objectives (NER 6.5.7) for quality, reliability, safety and security of electricity supply and to meet regulatory and legislative obligations for Standard Control Services.

Forecast \$FY24

The UGP forecast accounts for 0.79% of the total Repex portfolio for FY25 to FY29.

FY25	FY26	FY27	FY28	FY29
\$1.8M	\$1.8M	\$1.8M	\$1.8M	\$1.8M

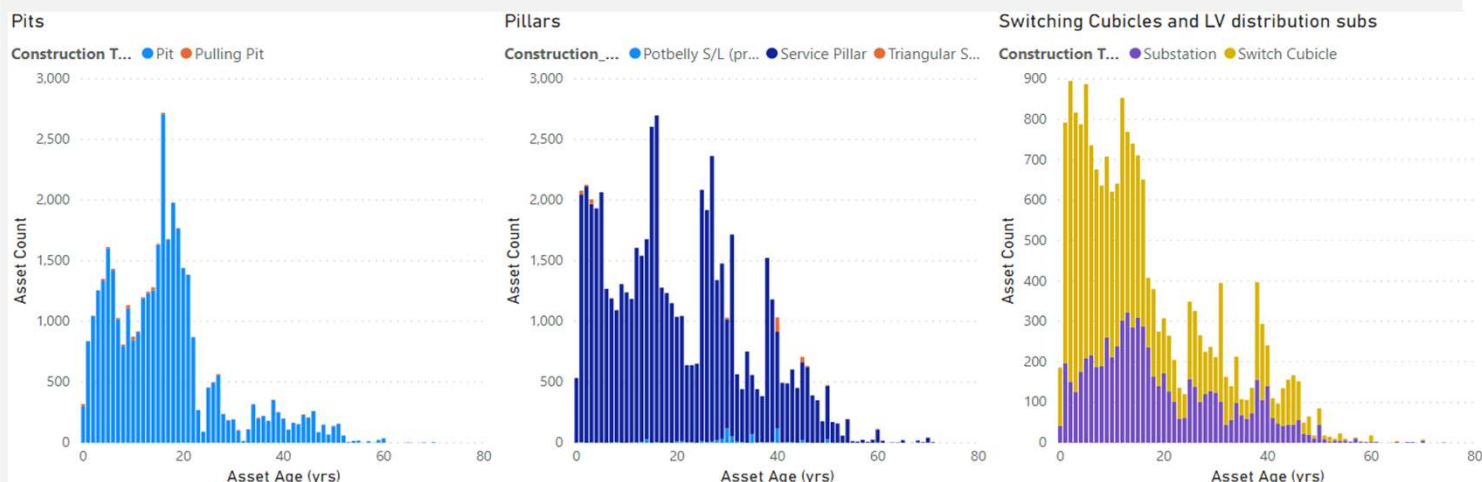
Underground System Assets



Asset Profile/Health

Asset Profile

Essential Energy network comprises approximately of ~37,200 pits, ~63,400 pillars, ~12,500 switching cubicles and ~6,900 substation LV distribution, as per data records. Due to lack of asset data prior to 2010, age of the pits and service pillars has been estimated from the age of their originating substations. This asset class is heavily impacted by having numerous varying legacy design, construction and installation standards across depots.



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.

This risk section provides an overview of the UGP 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)

Assisted Failures (~37% of total failures)

- Vehicle Accidents and Vandalism were identified as the largest contributors of assisted failures.
- Probability of failure modelling (with a multivariate linear regression model) indicates a positive correlation between the PoF and the following factors,
 - asset type (Switch Cubicles, Service Pillars and Pits)
 - major land use (areas with Likely Vehicle Use & Over Public Road).
- OFGEM DNO guidelines for switching cubicles, LV substations and pot-belly/triangular pillars.

Unassisted Failures (~63% of total failures)

- Environment-initiated degradation/corrosion and faulty connections were identified as the largest contributors.
- Level 1 probability of unassisted failures (as a function of age and location for sub-population) was evaluated with:
 - 2-parameter Weibull distribution for pits
- Weibull parameters used in the risk model are shown below.

Asset	< 10km from coast		> 10km from coast	
	α	β	α	β
Pit	215.82	2.79	864.60	1.57

Consequence of Failure (CoF)

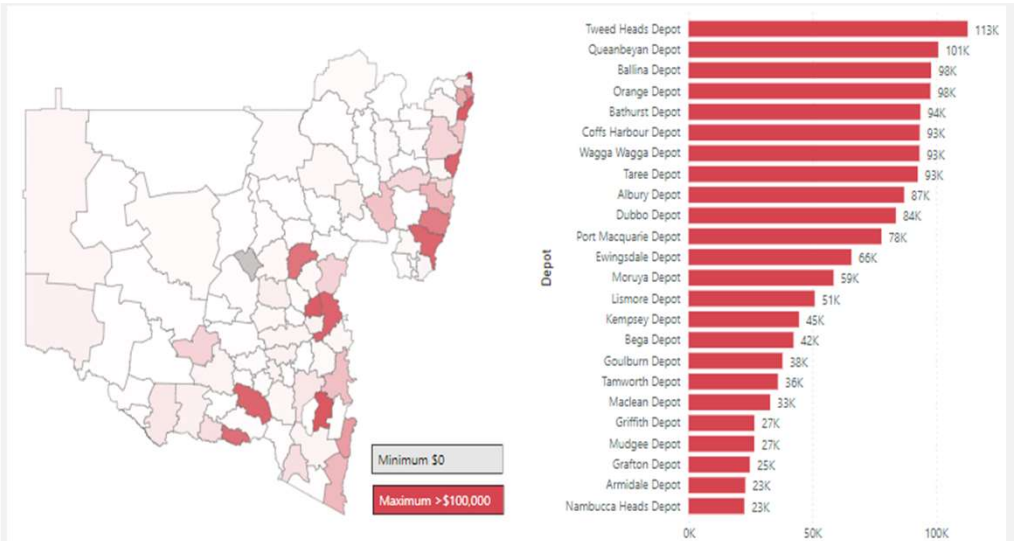
The consequence from failure of a UGP describes the impact of a functional failure.

Consequences have been evaluated using the **6.03.03 Appraisal Value Framework**. The consequence categories have been ranked based on consequence cost (assuming simultaneous failure).

Category	Consequence (m\$)			Average of			Median of		
				Consequence \$			Consequence \$		
Asset	Pits	Pillars	Cubicle	Pits	Pillars	Cubicle	Pits	Pillars	Cubicle
Safety	\$ 59.14	\$127.29	\$ 27.05	\$1,583	\$2,042	\$ 2,158	\$1,508	\$ 1,975	\$1,975
Network	\$145.03	\$328.10	\$ 66.21	\$3,881	\$5,262	\$ 5,283	\$ 3,326	\$ 3,188	\$3,455
Bushfire	\$ 1.50	\$ 2.54	\$ 0.85	\$ 40.32	\$40.81	\$67.97	\$4.93	\$ 3.38	\$3.38
Financial	\$ 26.20	\$ 84.06	\$ 24.09	\$ 701.20	\$1,348	\$ 1,922	\$ 701.20	\$1,348	\$1,922

Risk Model (Scaled)

The “heatmap” on the left and bar graph on the right (higher risk depots only) display the distribution of calculated total risk for the asset class by depot region. Note that the risk has been scaled in line with scaling factors described above.



Risk Model Calibration

Asset risk is a function of the probability of failure and the consequence of failure.

The asset risk has been calibrated against top-down performance figures. The table to the right shows the difference or delta between the risk model output and the monetised performance, the scaling factors applied, and key commentary describing the delta for each value measure.

Value Measure	Safety	Network	Bushfire	Financial	Total
Unscaled Model Outputs (\$M)	0.25	0.63	0.01	0.16	1.04
Top-Down Performance (\$M)	0.40	0.23	0.16	0.98	1.78

The Network Consequence (and Risk) is composed of mainly 2 aspects EE Costs and the Value of Customer Reliability (VCR). Current modelling accounts for number of customers affected and nominal rectification times. The 1st iteration modelling has limitations with depicting the staging process of bring customer back online dependent on the location and severity of the faults

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 UGP consist of:

1. Flat forecast **failure** volumes in line with current allocations for the 2019-24 regulatory period.

A probabilistic evaluation has been developed through detailed analysis of historical asset performance to establish Weibull parameters (refer 6.03.03.28) for a subset of categories within this asset class. These have not been utilised in deriving the forecast volumes except as a means of comparison.

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

Risk Trend (2024-29 Optimised portfolio)

Due to limitations in the PoF development for a number of sub-category assets in this program a risk profile is not available for this program. Forecasts have been based on maintaining the current levels of replacement to maintain the population.

In the lead up to the revised 2024-29 regulatory period Essential Energy will continue to improve the PoF modelling for the sub-category assets to validate and adjust forecast volumes as appropriate to manage portfolio risks.

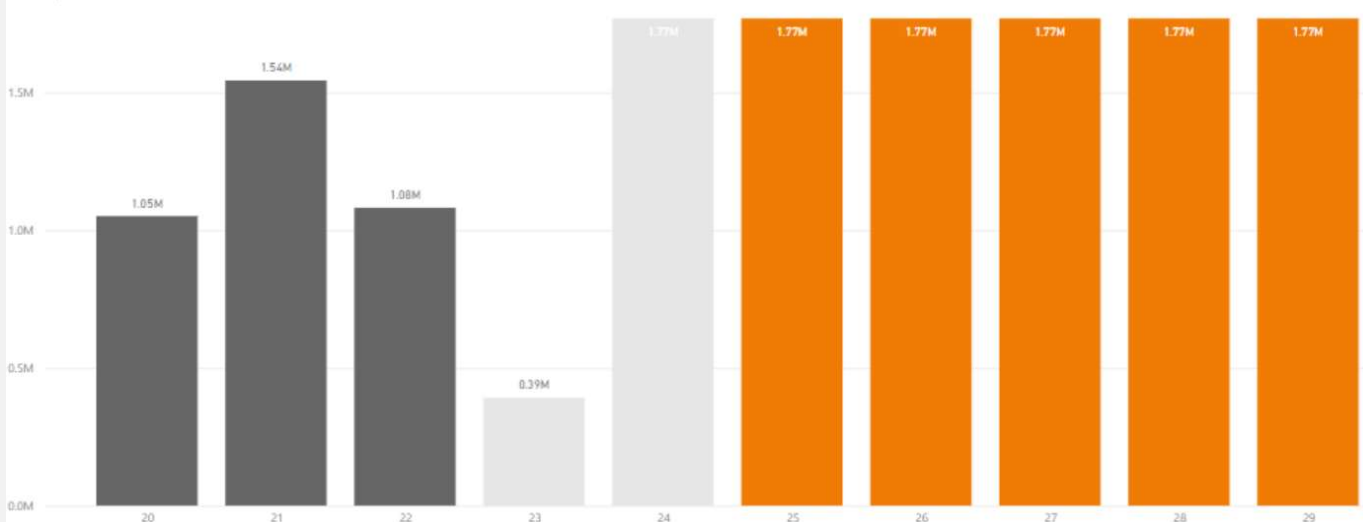
As the forecast is a flat projection based on 2019-24 allocations with no age uplift this approach is conservative in nature i.e. no increase in volumes of replacement.

Due to being a defined program of replacements asset groupings were not utilised for this investment.

1. UGP replacement expenditure has been modelled on a replace with like-for-like replacements.

Forecast replacement expenditure for UGPs across the 2024-29 period is \$8.9M, averaging \$1.8M per annum. Actual and projected expenditure for the remainder of the 19-24 period is \$5.8M.

Real \$FY24



Data source: Actuals: Internal delivery reports, Forecasts: Copperleaf

Note: All values are in FY2023-24 real dollar terms

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 **Attachment 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.
- **Critical Environmental Factors:** Risk associated with UGP due to location and access by public.

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

- **Improved network risk and maintainability:** Investment in this asset class will reduce network risk through replacement of UGP of degraded condition and/or in high risk locations with more resilient materials of acceptable condition; and
- **Improved service level outcomes:** management of asset health will result in fewer unplanned failures thus reducing unplanned outages and over time will improve network reliability.

Forecast UG Pits, Pillars and Cubicles Repex expenditure for the 2024-29 period is \$8.9M. The change from 2019-24 actual/forecast of \$5.8M is due to:

- Increase of unit rates
- Increase volume of replacements for an aging population to achieve portfolio risk tasks
- Changes in asset reporting categories that have been previously allocated to other asset investment cases i.e. LV switchboards combined into padmount substation expenditure.

Estimation of Asset Profile

- For assets with missing "year of installation" age has been estimated from the year of installation of their parent/originating substations (as per network/GIS data).
- Age and location data could not be estimated for 4502 (~3.6%) and 678 (~0.5%) of the assets respectively.

Estimation of asset performance as per network objectives:

- Safety: A baseline safety scenario of "minor" for Category 3 and 4 incidents (cost component of \$70,000/incident) and moderate for Category 2 incidents (cost component of \$240,000/incident).
- Reliability: \$ consequence as per **6.03.03 Appraisal Value Framework**.

Estimation of Probability of Failure

- Assisted PoF/year estimated with a linear regression model for all assets (as function of depot, land use & type).
- Unassisted PoF/year estimated with hazard rates for pits (using a 2 factor Weibull model), and OFGEM parameters for switching cubicles, substations and triangular/potbelly pillars and pillars.

Network Failure and Replacement Forecast

- The baseline risk forecast assumed a zero replacement rate for assets.
- Asset failures are calculated by combining both assisted and unassisted failures.
- Asset replacement model assumes PoF as key driver for increasing risk (with constant \$ CoF across the years).
- Desired replacement rate is estimated by identifying/replacing high risk assets, whose replacement reduces the overall PoF (and consequently the risk) to acceptable levels.

Strategic Direction	Acquisition	<p>Selection Criteria</p> <p>In the short term, continue to</p> <ul style="list-style-type: none"> Select pits, pillar, switching cubicle specifications for new installations as per relevant guidelines (CEOM7098, CEOM7199 and CEOM7202) Padmount as per CEOS5122 (for Essential Energy) and CEOM7004 (for ASP) procured assets <p>Continue to drive replacement decisions by inspection based assessment of asset risk and remaining life.</p>	<p>Procurement</p> <p>Continue to allow ASPs to procure assets for new installations and EE procurement for replacements.</p> <p><i>Investigate opportunities</i> to forecast procurement volumes to replace legacy, non-compliant designs based on population risk.</p> <p>Stock holdings</p> <p>Continue to hold stock at all depots (based on historical usage) at the suppliers in the short term.</p> <p><i>Review stock holdings</i> at the warehouses and suppliers based on the projected asset demand from the risk model.</p>
	Ops & Maintenance	<p>Preventative Maintenance (Inspections)</p> <p>In the short term, continue to perform defect identification and categorisation as per</p> <ul style="list-style-type: none"> CEOP8010, CEOP8069 & "Pit & Pillar Inspection Program" for pits/pillars (10-year interval) CEOP2474 for LV assets in pad-mount subs & cubicles (inspected every 5/10/15 years based on HV switchgear type/insulating media and distance from coast). CEOP2034 for critical assets (inspected annually) <p>Review benchmark maintenance practices across DNSPs until sufficient level of data, to support inspections and replacement decisions, has been gathered.</p> <p>Review inspection intervals and enhance inspection techniques for high-risk assets, preferably with measurable outcomes.</p>	<p>Preventative Maintenance (continued)</p> <p><i>Increase asset inspections</i> to meet inspection cycle and prioritise inspections on older asset (40 to 45% of the assets installed before 2010 were not inspected within the last 10 year inspection cycle)</p> <p><i>Construct a focused inspection</i> program to gather relevant asset attributes and current condition assessment.</p>
	Interventions	<p>Serviceability</p> <p>Continue to identify UGP assets for replacement using inspection fault reporting, as per the relevant guidelines (CEOP7804, CEOP8069, CEOP2474), in the short term.</p> <p><i>Prioritise replacement</i> of high risk legacy installations, i.e. pillars and pits with hazardous material (asbestos, steel and concrete) and triangular/potbelly pillars with recommended alternatives by assessing the risk trade-off, in the short and medium term.</p>	<p>Rate of Replacement</p> <p>Continue to identify high risk legacy installations at depot/maintenance area level and develop focused replacement plans supported by Capex allocation.</p>
	Disposals	<p>Hazardous Materials</p> <p>Continue to dispose assets with hazardous components (e.g. Asbestos and PCBs) as per relevant EE guidelines.</p> <p>Individual Assets</p> <p>Identify replacement options for unsupported and discontinued assets (e.g. FARGO connectors).</p> <p>Continue to Dispose assets in accordance with EE standards</p>	<p>Entire Asset Variant</p> <p><i>Develop disposal plan</i>, in the short term, for legacy asset variants (as per CEOP8074), to ensure support systems and data are appropriately managed out of service.</p> <p><i>Investigate opportunities</i> to retire legacy asset variants in the medium term.</p>
	Asset Support	<p>Process & Information</p> <p><i>Remediate gaps</i> in asset attribute and performance data (e.g. condition and failures) and leverage the EAM system upgrade to address inaccuracies & inconsistencies in data sources.</p> <p><i>Investigate opportunities</i> to link safety and fire-start events to relevant assets in the EAM system, in the medium term.</p> <p><i>Investigate opportunities</i> to incorporate UGP risk models in the C55 prioritisation tool, in the medium term.</p> <p>Improve PoF modelling to utilise failure data across all sub-categories of assets.</p>	<p>People & Training</p> <p><i>Develop</i> standards to assist with asset inspections and maintenance.</p> <p><i>Investigate opportunities</i> to forecast quarterly maintenance and resource demand in the medium term, by leveraging inspection data and risk models.</p> <p><i>Utilise</i> trained UG personnel for all associated UG inspections.</p>