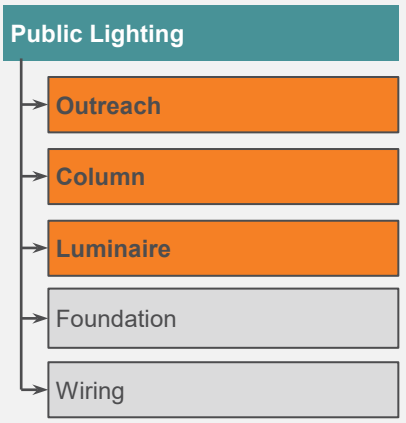
13.03.01 Public Lighting System Strategy

Asset classes that together form the Overhead System are the most visible across Essential Energy's network and a major contributor to cost, risk and performance.

Scope

- This System Strategy (SS) addresses **lifecycle activities** of the Public Lighting Assets considered as a coordinated system. This iteration of the strategy considers the highlighted subpopulations (at right) within these asset classes.
- The duration of this strategy is for the remainder of the current regulatory cycle (FY19-24), plus the following two regulatory cycles.



Purpose

- The System Strategy provides strategic direction on the Asset Management decisions required to ensure Public Lighting lifecycle decisions meet the system objectives. Specifically, the strategy:
  - Efficiently reduces uncertainty on the state of the network;
  - Provides a 15 year plan with options, consisting of short term (current regulatory cycle), medium term (next regulatory cycle) and long term (next regulatory cycle+1). These will result in program level options for C55.

Performance

AM Objective	Current System Performance	System Target
AM0-03 Meet corporate targets for network value and expenditure	CAPEX av. an. (FY21)('000) / BLR / Baseline Direct cost total: 21,802 / 1,531 EE Funded: 7,147 EE Revenue: 11,432 EE Delivery: 1,081 OPEX: 6,993	Short - After the completion of LED upgrade project, capital expenditure to step back to steady state management of population. Long – Identify suitable LED replacement interval and assess new technologies that emerge.
AM0-04 Demonstrate network safety risk is managed SFAIRP, and achieve corporate network safety targets	TotalSafe records of Near Miss incidents attributable to Public Lighting physical assets. FY18: 16 FY19: 17 FY20: 25	Short/Medium/Long: Reduce safety incidents below current levels.
AMO-05 Demonstrate prudency and efficiency in network-related decision making, supporting downward pressure on prices	LED bulk replacement program which continues to drive down energy consumption costs for councils. LED: 120,000 Non-LED: 40,000	Short - LED bulk replacement program to be completed by 2025 Long - Proactive investment in future customer needs through public lighting advancements
AMO-06 Deliver the sustained network performance (safety, reliability, quality) our customers expect	FY20: 10,491 FY21: 9,572 FY22: 1,791 (projected 8,000)	Short - Continued reduction in defects (A203) raised.
AMO-07 Reduce the environmental impact of our network where it is efficient to do so	LED technology in a greenhouse gas emission reduction on average of 0.28(t CO2-e/MWh)GHG per installation. Waste from disposals is considered in cooperation with FluoroCycle.	Long - continue to explore technological advancements such as solar, composite and multi-use (smart poles) poles etc
AMO-08 Maintain compliance with our network-related obligations.	Compliance as per IPART, AER, NSW Public Lighting Code exceed for 33% of defects. Priority: - / 5.3 General: 8 / 11.7 Specific: 25 / 28.1	Short - Compliance to relevant parties.
AMO-14 Establish the capability to deploy non-network solutions, at scale.	Zero (0) solar powered lights on EE network	Short - Trial solar powered lights on our network where business case viable.

Current Position

Network Risk by Asset Class

Within the Public Lighting system, Network Risk has been calculated through a combination of Probability of Failure and Consequence of Failure, the latter evaluated using the *Appraisal Value Framework*. The resultant network risk for each of the asset classes, by significant subpopulations, is as follows:

Consequence of Failure			
Type	Total Risk ($ million)	Average ($ per asset)	Median ($ per asset)
Column	313	4,630	4,408
Outreach	108	1,102	1,008
Other	2,.8	1,010	1,003

Total Consequence of Failure by Category						
Type	Safety ($)	Network ($)	Finance ($)	Compliance ($)	Reputation ($)	Bushfire ($)
Column	114,926	7,014,620	304,965,990	746,472	258,309	157,707
Outreach	62	10,821,732	96,131,500	969,500	335,486	56,304
Other	184	301,309	2,434,460	63,349	21,921	1,951

The total Consequence of Failure and Risk are illustrated on the right. Probability of failure parameters were estimated through calibration. The data driven parameters were not suitable due to poor data quality.

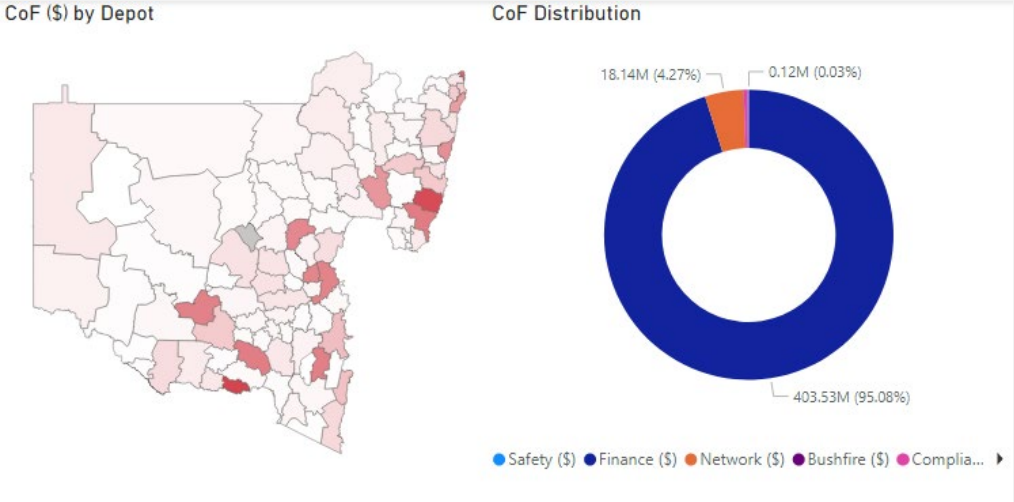
These charts will be influenced by number of assets.

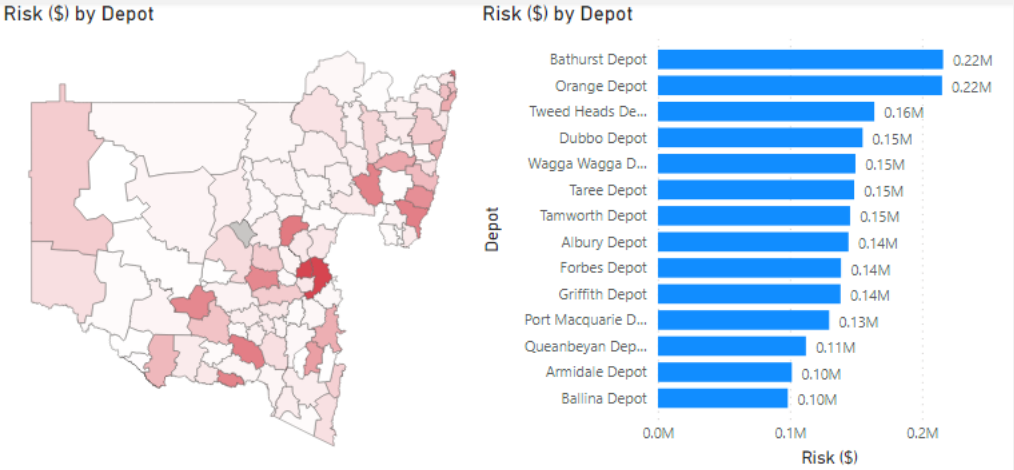
The primary Consequence category is Finance for the asset replacement on failure followed by Network which is a low consequence individually.

The Risk analysis has omitted the Value of Lost Light and focused on the broader asset failures with hazards such as falling and touch potentials. The implications of Lost Light have been included in the Compliance and Reputation.

The Appraisal Value Framework does not have a Value of Lost Light and further work could be performed to quantify and perform an NPV analysis.

This strategy has undertaken 2 studies to address key decisions with an increase or decrease in the unit of Value of Lost Light.





Current Network Inspection & Maintenance Tasks

- Night Patrol inspects 25,000 assets on a 6 monthly frequency.
- This frequency is to be reassessed post bulk LED upgrade.
- A study has been performed to assess the night patrol inspection frequency based on historical population 100% non-LED to future state 100% LED.
- Initial calculations indicate we can realise an 82% reduction in defects found and a 64% reduction in Lost Light while extending the frequency to 12 months.
- For non-LEDs the actual failure rate has been applied. For LEDs the manufacturers data has been utilised to estimate Weibull parameters.

Public Lighting				
Task	Cycle	$ per task	Annual tasks	Total $
Night Patrol	6 monthly	$4.2	50,000	$214,000

Current Position

SWOT: This analysis presents the known investment risks and needs impacting Overhead Network decisions.

Strengths:

- High level of confidence in the condition and identification of public lighting across the Essential Energy network due to the LED bulk replacement projects in addition to desktop data cleansing.
- Delivery of bulk replacement program when significant improvements in technology are developed.
- Ability to scale the project with long term contractual arrangements with multiple suppliers
    - An option of internal and external delivery teams to complete the work.
    - Flexibility provided to Councils regarding funding of the project to garner timely commitment to upgrades.

Weaknesses:

- Lack of confidence in ownership and maintenance arrangements of public lighting. Historical, often undocumented agreements with councils, confusion regarding private assets and which assets should be maintained by Essential Energy versus Transport for NSW. This has led to issues with undertaking inspections and maintenance.
- Limited visibility of task-based costs, reducing the ability to determine profitability of public lighting.
- Lack of automated billing solutions resulting in high manual labour, increasing risk of billing errors.
- The end-to-end process of Minor Capital Works (MCW) requires an uplift in the ability to effectively forecast, plan/schedule works, and recover costs
- Decorative lights transitioning to limited LED offerings has resulted in push-back from stakeholders.

Opportunities:

- Smart controllers will provide real time monitoring of luminaires which can be drawn upon to improve asset management decisions and reduce overall OPEX costs. There is also an opportunity to explore smart metering of public lighting through the smart controller.
- Smart technology could provide energy savings to customers with ability to dim output and use timing profiles to reduce consumption. This will result in network relief and may decrease maintenance activity.
- Uplift billing process to recover glareshield assessment and minor capital work assessment costs, currently unrecovered.
- Government grants and policies at a state and federal level are supporting public lighting smart technology advancements.
- Physical structures in the community raise an opportunity for third party peripherals

Threats:

- Potential lack of luminaire supply – pressure on supply of LEDs across the Australian market. DNSPs and private customers are moving to LEDs which could create reduced supply or extended timeframes for delivery of LEDs for the LED Upgrade.
- Energy Saving Credit (ESC) scheme is up for renewal – Essential Energy could see reduced uptake of the LED Upgrade from Councils where this benefit is lost.
- Cessation of high residual value funding from Department of Planning, Industry and Environment (DPIE) – Essential Energy could see reduced uptake of the LED Upgrade from Councils.
- New technology is coming onto the market with increasing customer engagement at a rate faster than the economical life of the asset.
- Long lead time on customer preferred materials – decorative LEDs.

Future Position

To develop the recommended future position, the line of sight from corporate objectives through to asset management and network objectives has been assessed.

In the Short term: Realise the benefits of LED by updating the maintenance and replacement cycles to leverage the improved performance. Achieve a satisfactory level of compliance with the Public Lighting Code and continue to foster positive relationships with key stakeholders. Continue to improve data and integration of systems regarding task classification, asset ownership and work performed to ensure correct accounting of costs.

In the Medium term: Monitor new technologies for additional cost reduction or revenue generating opportunities. Continue to improve data quality to enable more refined decision making.

In the Long term: Address the LED replacement requirements and opportunity for shift in technology with concurrent replacements.

The following scenarios forecast the risk, cost and failures under four criteria to align with other system strategies. This approach is not currently applied in Public Lighting and the data underlying this assessment is immature. This exercise provides an indicative risk based outcome to be improved upon in future iterations. These criteria are aligned with the core asset management objectives and provide envelopes for key decision outcomes.

The scenarios are as follows:

- Risk 1: No Planned Replacements forms the baseline performance of the system without preventative replacement intervention.
- Risk 2: Constant Risk achieves a core corporate objective to maintain current system risk levels. This scenario increases unit replacements towards the end of the forecast period.
- Risk 3: Positive Value determines when a replacement expenditure provides greater risk reduction. The risk reduction is calculated using the probability of failure Weibull over a 40 year Net Present Value. This aligns to our current investment value calculators.
- Risk 4: Replace at Age is an indicative scenario representing an asset population turnover approach. This scenario doesn't account for asset criticality.

There are several key insights presented in these scenarios.

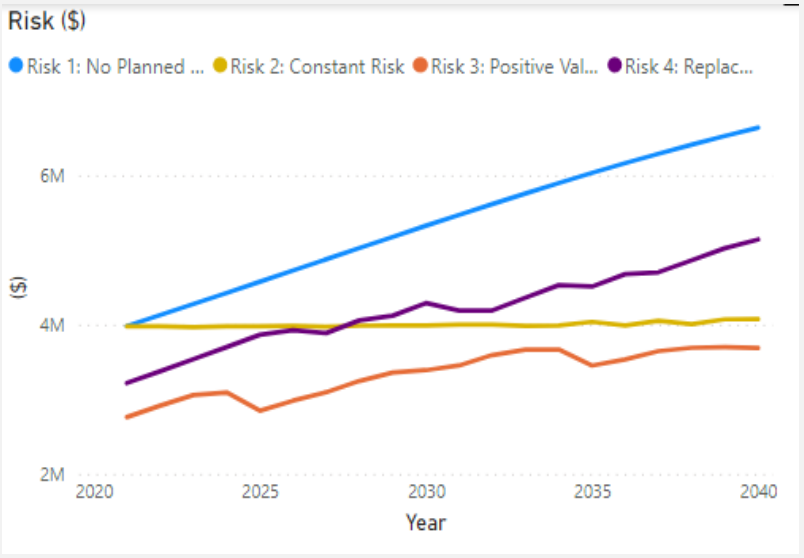
- There is a reasonable number of economically viable replacements. This is a sensible pool of replacements for consideration in meeting operational requirements and wider asset management principles.
- A key factor is that early replacements contribute to the risk reduction for the complete forecast, not just in-year risk. This has a compounding effect on the risk reduction.

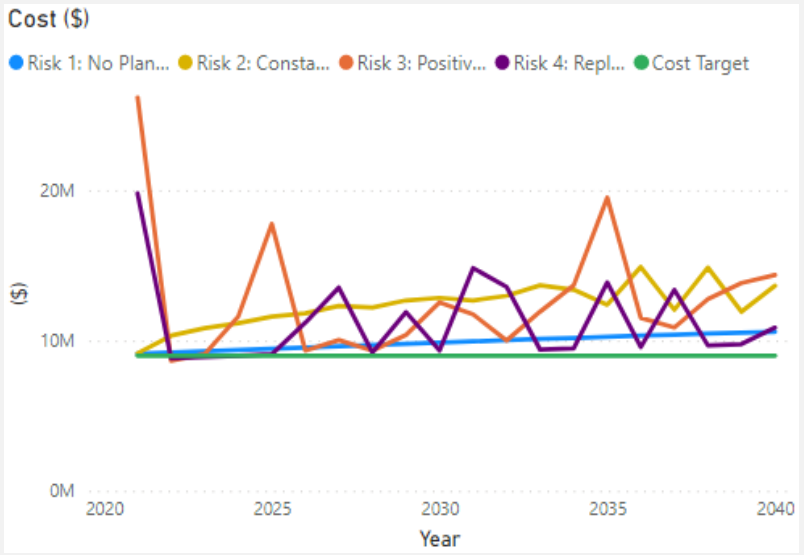
A study has been performed in regards to the bulk lamp replacement program (BLR) based on historical population 100% non-LED to future state 100% LED.

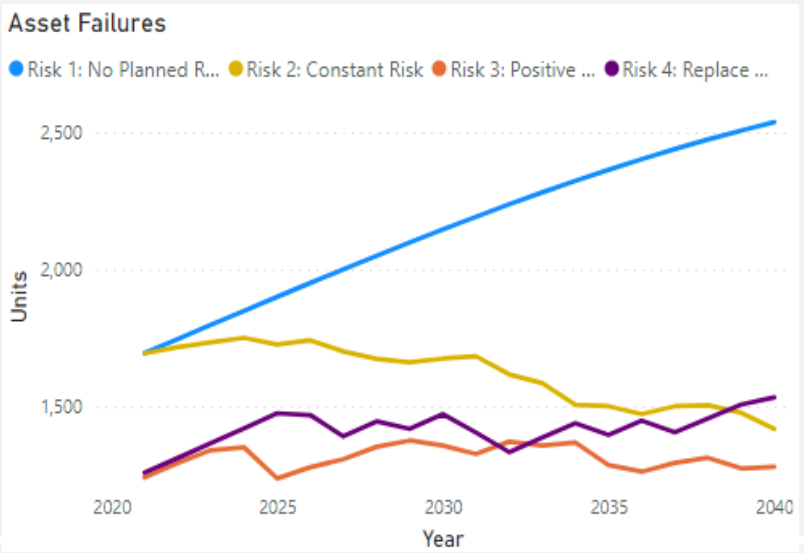
- The BLR is a 4 yearly lamp replacement that will be substituted with a 6 yearly clean for LEDs. This program is driven by the light output intensity but also has benefits for probability of failure. The replacement of the LED luminaire is to be assessed over time as the failure rate data matures. Initial calculations indicate we can realise an 85% reduction in defects and annual replacements while extending the replacement cycles to 30 years. Including a risk based replacement cycle could reduce Lost Light by a further 20% and cost by 5% by shortening the cycle for high criticality sites.

For non-LEDs the actual failure rate has been applied. For LEDs the manufacturers data has been utilised to estimate Weibull parameters. Current LED failure rates are above estimated values, this is likely due to wear-in failure modes not captured in a single Weibull.

The Value of Lost Light once quantified could be used to perform and NPV and Optimal timing calculation for the replacement interval.







Current expenditure is approximately $1.5mil outside of BLR program. With the transition to LED's the approximately $20mil BLR will cease and a portion of that expenditure will extend to the $1.5mil program.

Strategic Options

Acquisition

Selection Criteria
- Continue to select Public Lighting assets as per current EE design specifications
- Designs have been consolidated to achieve cost reduction.
- Maintain awareness of supplier developments in technology
- Continue Quality Assurance tests.

Procurement
- Continue the current period contract approach with vendors.
- Maintain awareness of obsolescence issues and availability of critical components.
- Identify supplier limitations and organise alternatives accordingly.

Operations & Maintenance

Inspections:
- All maintenance of public lighting assets is outlined in the Public Lighting Management Plan CEOP1023
- Continue to inspect assets as per CEOP8010 electrical Asset Inspection and CEOM7005 Asset inspection Manual
- Night Patrols of major roads are performed on a periodic basis in line with CEOS5126.02
- 6 month Night Patrol frequency to be reassessed post bulk LED upgrade.

Corrective Maintenance (Repairs):
- Continue to replace or repair defective components. Customer reporting provides several means for public lighting customers and the community to report streetlight faults

Breakdown Maintenance:
Continue to rectify failures with an economic viability assessment of repair or replacement, with larger investments undergoing a value calculation. Maintain identification of Warranty issues.

Preventative Maintenance:
- Continue to maintain assets as per CEOP8010 electrical Asset Inspection and CEOM7005 Asset inspection Manual. Essential Energy uses a standardised Maintenance Requirements Analysis (MRA) process to develop maintenance requirements by analysis of the application of Failure Modes, Effects and Critical Analysis (FMECA).

Operations:
Implement additional Operational Technology monitoring where viable – Smart Technology

Interventions

Replacement programs
- Essential Energy has adopted a Cyclic Replacement program known as Bulk Lamp Replacement (BLR). Timing of the replacement programs (including future replacement of LED technology) are detailed in the Public Lighting Maintenance Instruction CEOS5126.02.
- 4 yearly BLR will not apply to LEDs, a 6 yearly clean is substituted. The replacement interval for LED luminaires will be assessed.
- Continue to develop a risk-valued replacement program to maintain acceptable risk level across the public lighting asset population.

Prioritisation
- Continue to prioritise replacement projects with the value calculators and investment optimisation process

Installations
- Continue Night Watch security lighting program, Glare shield installations and Minor Capital Works which provide additional cost recovery.

Disposals

Individual Assets
Continue to dispose of assets as per CECP8074.01 Company Policy Asset Disposal

Hazardous Materials
Essential Energy is a signatory to FluoroCycle – a voluntary product stewardship scheme that seeks to increase the national recycling rate of waste mercury-containing lamps – CERM1000.75f

Asset Support

Process & Information
- Continue to improve internal process to ensure on time compliance reporting, accurate asset ownership information and financial recovery
- Enhance asset risk-value assessments leveraging capabilities of new and existing software platforms.
- Align our process with other business units with similar objectives/assets – Private Assets Team, Tel BU, Finance.

People & Training
- Continue to manage knowledge and skills to enable fluency of process and continuity of knowledge base.
- Manage work forecasts to maintain a stable skill base. Improve forecasting of staffing levels and requirements for specialist skills required for ongoing workloads and future bulk deployment programs
- Drive awareness through communications with the broader business, in particular Customer and Network Services on compliance requirements under the Public Lighting Code, and implications of non-compliance

Supply Chain
- Manage spares with appropriate level spares holdings to match expected failure rates and procurement lead times and applying asset criticality assessment.
- Continue to provide detailed forecasts to suppliers
- Maintain awareness of obsolescence issues and availability of critical components.

Key Assumptions

Task Classification

- Tasks were classified against the components listed in the scope. Functional and Conditional failure identified through the task description and cause description. There is some ambiguity in these classifications.

Estimation of Probability of Failure

- Clarifying the age against the asset at the time of the task was difficult as the Asset ID is a placeholder for the site and the dates are changed. This led to a small percentage of tasks and failures with an age for the Weibull curve fitting.
- The age of the LED luminaire fleet (0-4yrs) made Weibull curve fitting prohibitive.
- The calculated PoF parameters were assessed and through calibration and SME feedback were modified for the Risk Forecast.

Consequence of Failure

- The value of lost light was not quantified in the CoF. The repercussions of lost light were addressed under Reputation and Compliance.

Age

- For the risk assessment focused on steel columns and outreach hazards, the age of the asset was the column or outreach effective date else the luminaire effective date.

Cost

- Capital costs have been given as actuals from FY21, other expenditure data is undergoing significant improvements and will be clarified in iteration two.

Enablers

Enabling tools include

- Event trees
- Realigned FMEA/RCM with Component Issue Reason
- Power BI Models (Asset performance dashboards)
- Asset POF, COF, Risk vs Replacement Model

Governance

Roles & Responsibilities

This strategy is owned by:

Public Lighting Strategy Lead

Information & Interfaces

Information

Reliability DB, Fire Starts Register, IPART DB, AER Submission, Smallworld, WASP

Interfaces

- **Internal:** Network Strategy Leads, Engineering, Investment Delivery, Asset Performance, Planning, C&NS.
- **External:** Customers, IPART, External auditors and the AER.

Governance

This strategy has the following review cycle:

Minor – Annually
Major – 2 years (or when triggered)

All updates are to be approved by the Group Head, Asset Engineering, Risk & Compliance.