Asset Management Plan

Public Lighting Services

April 2018

Supporting Document 17.4.1

Public Lighting Services

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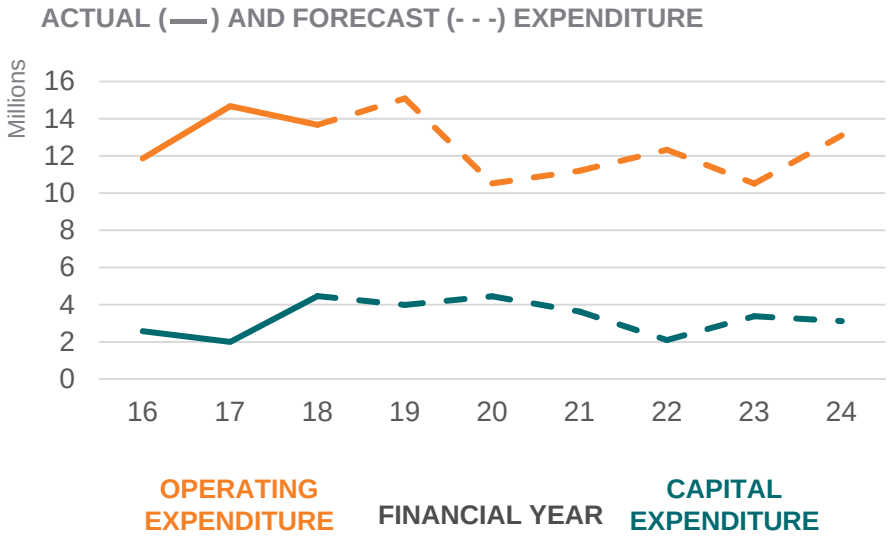
Executive Summary

Public Lighting Services included within this asset management plan:

ASSET COMPONENTS:

LUMINAIRES | POLES / COLUMNS | BRACKET | PE CELL | CONNECTION AND WIRING

Public lighting is a vital community service provided to a range of organisations including Local Councils and Roads and Maritime Services NSW.



Proposed Opex Expenditure $57.65 M

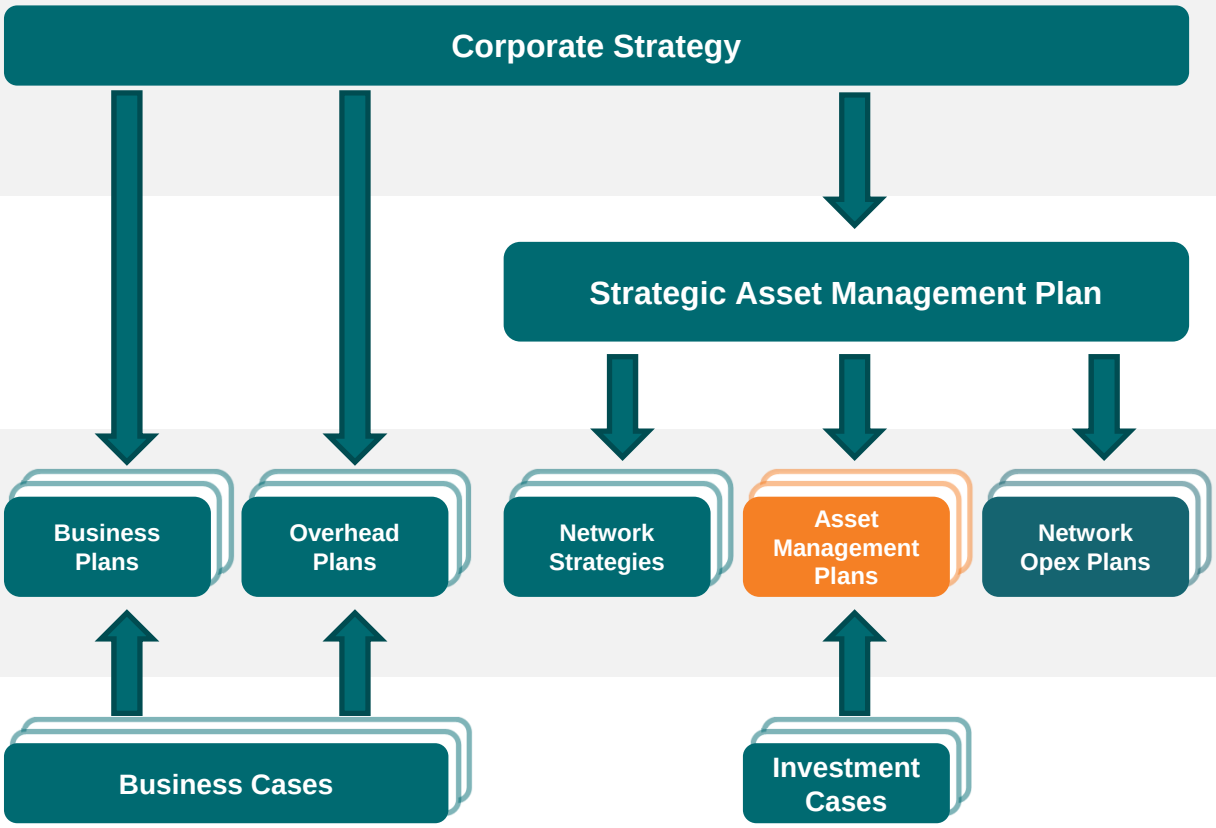
Proposed Capex Expenditure $16.77 M

25% of luminaires installed at July 2019 are forecast to be LED

Bulk upgrades to LED completed in conjunction with public lighting customers, funded by customers

90% of luminaires installed at June 2024 are forecast to be LED

Document hierarchy and purpose



> Set corporate direction in view of stakeholder requirements, mandate specific strategic initiatives, and stipulate corporate objectives.

> Translate the corporate objectives into guiding asset management principles, develop strategic responses, and stipulate asset management objectives.

> Translate the asset management objectives into specific plans and actions to be delivered to manage the assets.

> Detailed financial and non-financial consideration of specific investment.

Strategic Objectives, Targets and Performance

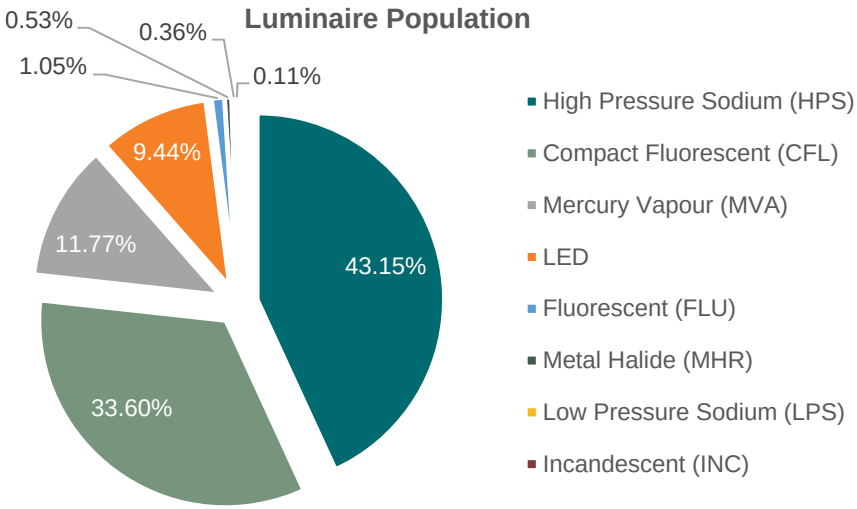
Purpose:

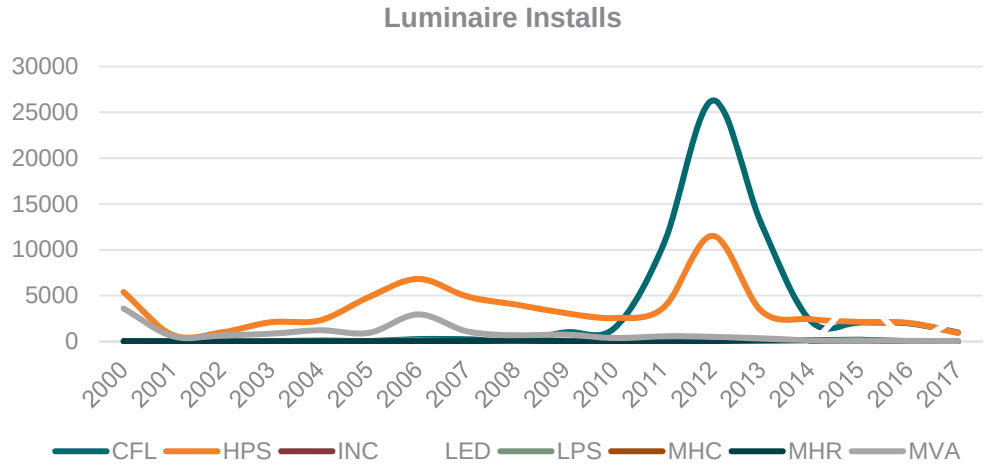
- Asset Management Plans enable the overhead network assets to achieve the objectives and targets in the overarching strategy documents.
- The asset class objectives and targets are designed to achieve the National Electricity Rules (NER) CAPEX and OPEX objectives.
- These targets and performance measurements are for public lighting assets.

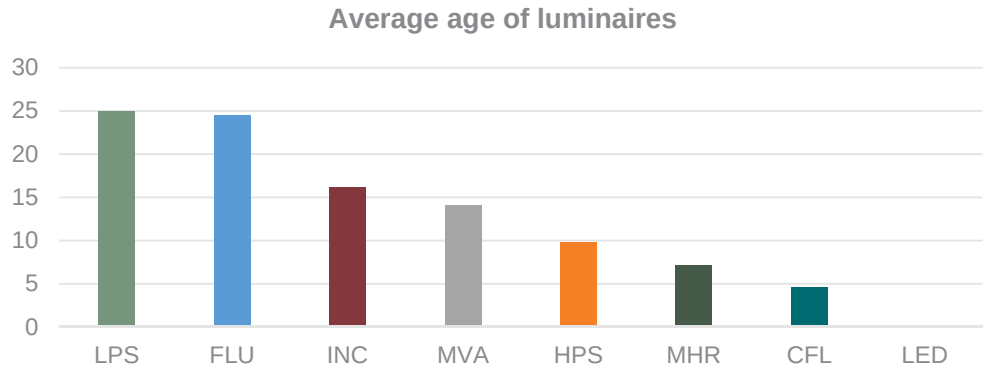
Strategies & Objectives	Targets	Performance
1. All Strategies		
National Energy Rules (NER) Cl. 6.5.6 (a) (1) (2) (3) and (4) Lowest cost, assets are operated and maintained in a manner that extracts maximum value from the assets.	Asset investment programs are optimally targeted to ensure risk is aligned with the Corporate Risk Tolerance.	All programs have been valued and optimised using a consistent, Board-approved value framework.
NER cl. 6.5.7 (a) (2) (3) and (4) To ensure, at the lowest cost, assets are renewed in a manner that extracts maximum value from the assets.	Unit rates captured and benchmarked internally and externally.	Achieved. Continual improvement items identified and improvement in internal efficiency achieved.
2. Reliability		
NSW Public Lighting Code (2006) To operate a public lighting scheme safely, efficiently and effectively in accordance with the in-service values specified in AS/NZS1158	Average Annual Defect Repair Time < 8 business days	Achieved. Streetlights repaired in a timely manner
Electricity Supply (General) Regulation 2014 To ensure maintenance of public lighting assets is completed in accordance with customer expectations	Maximum individual lighting installation repair time < 12 business days	Achieved. Streetlights repaired in a timely manner in accordance with customer expectations

Asset Overview - Luminaires

- Essential Energy's public lighting assets consist of approximately 160,000 luminaires of varying types and ages
- The technological and commercial viability of LED technology are major drivers in asset base shifts and bulk changeouts as Customers and Essential Energy seek to drive down public lighting costs.
- Essential Energy has completed bulk luminaire upgrade programs to increase efficiencies of the public lighting service:
  - Over the 2010 to 2014 period there upgrades were completed to replace old technology such as 80W Mercury Vapour luminaires with 42W Compact Fluorescent luminaires
  - LED technology trials were completed from 2011, with LED's formally offered to councils for Category "P" luminaires from 2017, which has shown a sharp increase in adoption of LED luminaires.



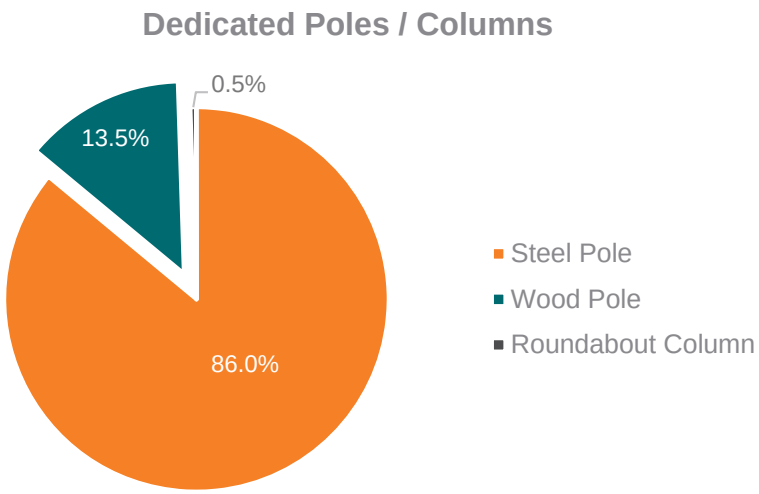


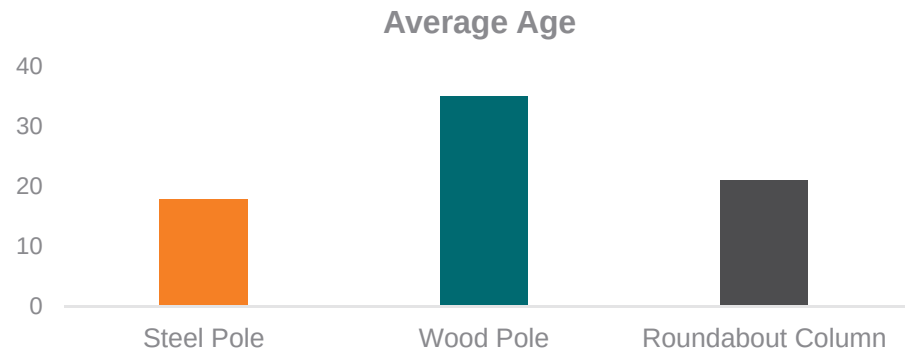


- Traditional luminaires have a useful life of 20 years, with LED's likely to be closer to 10 years due to technological redundancy
- Low Pressure Sodium, Fluorescent, Incandescent, and Mercury Vapour luminaires have the oldest average age and are targeted for priority replacement with LED technology due to their age and design.

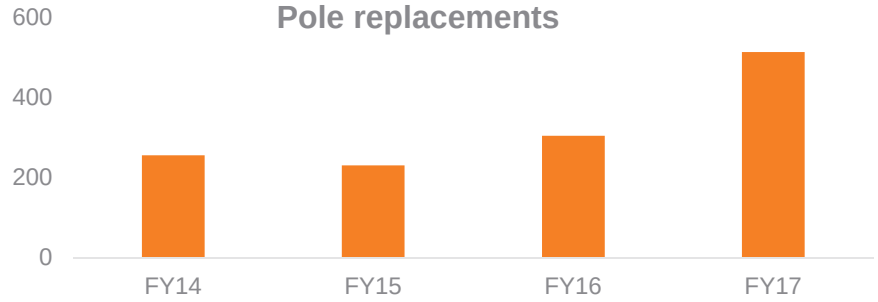
Asset Overview - Dedicated Poles / Columns

- The majority of public lighting assets are attached to shared infrastructure, i.e. Essential Energy distribution poles.
- Shared infrastructure is managed within standard control services, as the infrastructure is primarily used for the provision of safe and reliable electricity supply to customers.
- Poles and columns are considered to be dedicated if they are principally for the purpose of providing public lighting, with no overhead distribution components attached to the pole inclusive of mains and services.
- As at 30th June 2017 Essential Energy's dedicated streetlight column inventory included 65,403 poles/columns





- The vast majority of dedicated streetlight support structures are steel poles.
- Poles / columns have an estimated useful life of 35 years
- An increasing number of pole replacements are being completed as the age of the assets increase.



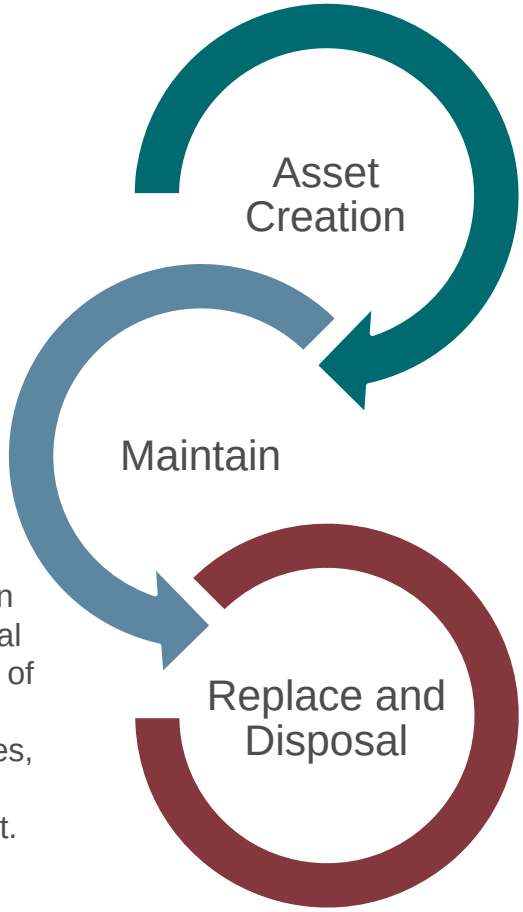
Lifecycle Management Strategy: Public Lighting Equipment

Asset Creation

> Essential Energy's asset creation strategy is geared to ensure that street lighting assets can continue to achieve the service level objectives at the lowest life cycle cost. Creation strategy is based on the following strategic elements:
  - New public lighting assets are designed and constructed by the customer and attached to Essential Energy's network at completion
  - Essential Energy requires that any new infrastructure is selected from our approved standard material list (CEOM7004).

Replace and Disposal

- Cyclic maintenance activities, and unplanned failure responses combined with replacement in lieu of maintenance where it is more economical to do so, result in replacement of a percentage of the luminaire population each year. In the absence of other planned replacement initiatives, luminaires are typically run until failure or the unavailability of parts necessitates replacement.
- All lamps and lighting waste collected by Essential Energy staff and contractors will be disposed of in an environmentally responsible manner in accordance with Essential Energy's waste disposal management processes (CECM 1000.75)



Operate and Maintain

> Essential Energy has developed a suite of programs to maximise the efficiency of Essential Energy's street lights assets whilst minimising costs to both ourselves and Essential Energy's customers

Maintain Luminaires

- Bulk Cyclic Lamp Replacement - "non LED" lighting installations in Essential Energy's inventory will be visited for maintenance every 4 years, with lamps replaced and diffusers cleaned. PE cells will be replaced every 2nd cycle.
- LED lights will be visited every 8 years for maintenance such as PE cell replacement and diffuser cleaning
- Night patrols on Category "V" lighting twice annually with a view to ensuring 95% uptime of the asset base
- Spot repair and replacements, are carried out as required, based on customer reports and internal night patrols

Maintain Dedicated Columns / Poles

- The primary source of maintenance activities for street light repair or replacement is from the pole inspection program
- The current inspection cycle for dedicated street light columns and poles is every 4 years and is completed in conjunction with Essential Energy's inspection of distribution assets.

Unplanned Failure

> Luminaires are susceptible to a number of failure modes dependant on the technology of light source. These can include but are not limited to:
  - **Lamp Failure** – Lamp failure can occur due to a number of factors including; physical damage (vibration, impact, vandalism), reduced output or dimming and lamp voltage rise.
  - **Control Gear Failure** – Traditional lamp based luminaires are affected by corrosion whilst LED drivers are susceptible to damage by voltage spikes and temperature.
  - **Cable Failure** – From physical, UV damage, underrated cable size and surges etc.
  - **Visor Damage/Deterioration** – Deterioration or yellowing of plastics or the physical damage of clips or the visor which inhibit the effectiveness of the Ingress Protection (IP) or light distribution.
  - **Housing Damage** – Through corrosion or physical damage to the luminaire housing thus reducing the IP rating of the luminaire.
  - **PE Cell Failure** – Through UV deterioration of plastics including yellowing of photodiode aperture, mechanical failure of contactors (from vibration and wear) and reduced photosensitivity of photodiode.

> As part of the previous determination Essential Energy moved from a 3-year bulk lamp replacement program to a 4-year program, due to the percentage of luminaires in the asset base that have higher expected lifespans.

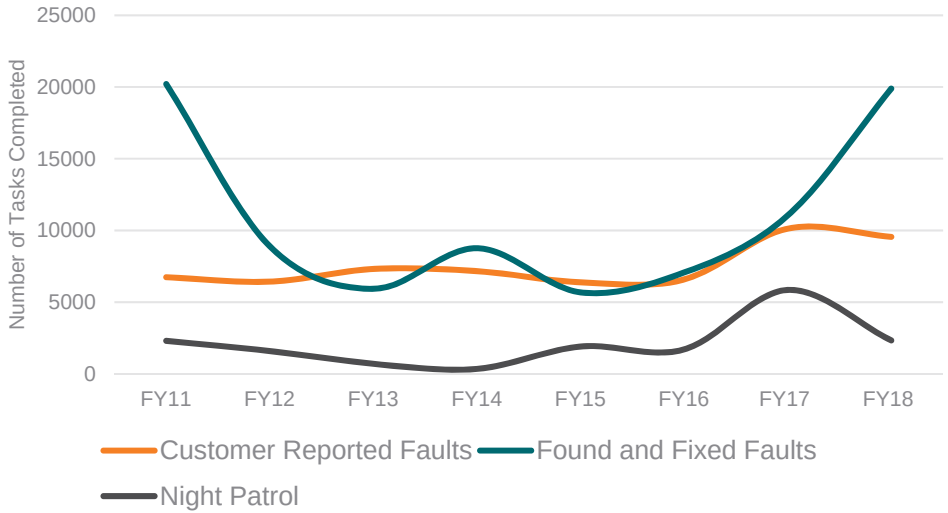
Failure rates for the 10 most common types of luminaires*

Luminaire Type	Number of Luminaires	Failure Rates Used In Model (%)
Compact Fluorescent 42	59,034	4.88%
High Pressure Sodium 70	29,611	14.29%
High Pressure Sodium 250	24,224	5.30%
Mercury Vapour 80	16,132	6.54%
High Pressure Sodium 150	10,225	5.21%
Street LED 22W/17W	4,652	1.56%
High Pressure Sodium 400	2,483	4.92%
High Pressure Sodium 50 Twin Arc	2,756	3.08%
Evolve LED 25W	2,502	3.01%
Fluorescent 40	1,156	2.98%

*Failure rates have been derived looking at an average failure of the lamp technology by review of leading lamp manufacturers for a 4 year bulk lamp program.

Defect volumes

> The FY17/18 period Essential Energy has seen an increase in reported tasks especially in regard to “Found and Fixed” faults reported by Essential Energy staff.



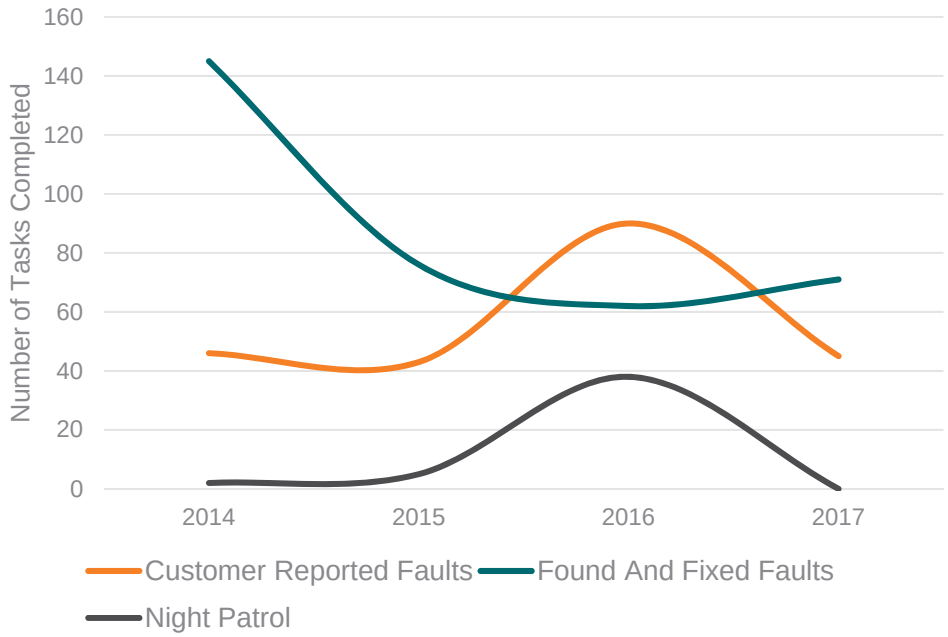
> The change has been primarily due to improved reporting, with paper based work tasks phased out and a new digital form introduced, improving the data capture demonstrating an increased total number of work tasks completed on an annual basis.

> This change makes it difficult to predict the number of reported faults that will occur in the future years. This is further complicated by the introduction of LED luminaires to Essential Energy.

> As traditional luminaires are replaced with LED, reductions in maintenance tasks can be expected.

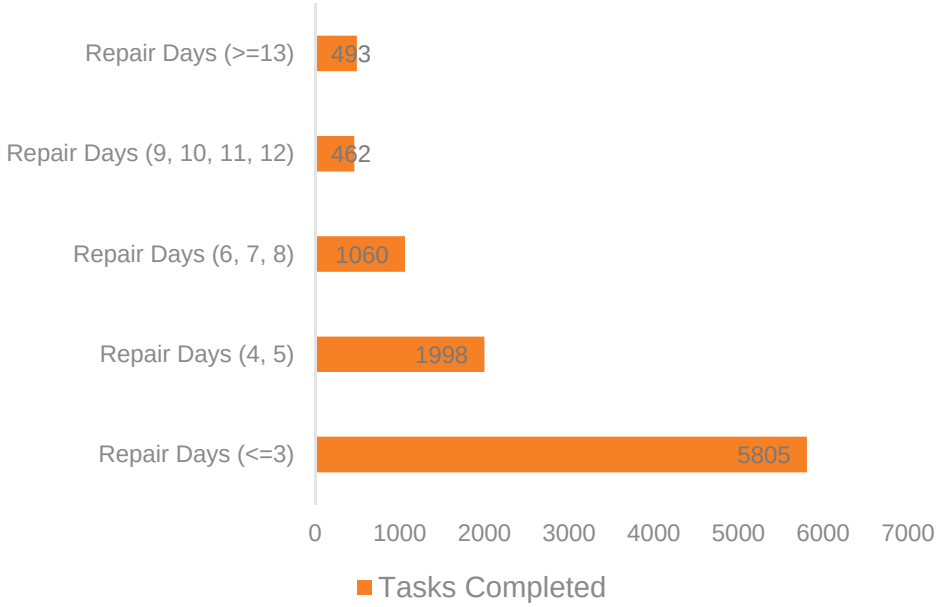
> Essential Energy’s largest LED technology deployment to date has been in the Eurobodalla LGA where 2,453 lamp based luminaires were replaced with LED’s. Reductions in work tasks completed in Eurobodalla have been seen across all three categories.

Impact of LED Rollout in Eurobodalla



Defect rectification performance

- Essential Energy has two targets to meet in terms of defect rectification:
  - average of eight business days (Public Lighting Code); and
  - maximum of 12 business days (Electricity Supply (General) Regulation).
- For FY17 there were 9,818 defects raised by customers, with 60% of tasks completed within three business days. The total average repair time for this period was 4.3 calendar days. To achieve this result Essential Energy had an internal rectification timeframe of 10 calendar days.



- To improve efficiencies Essential Energy will re-aligned internal rectification timeframes with the PLC, changing from 10 calendar days to 16 calendar days (12 business days).
- In changing the rectification timeframe Essential Energy encourages field staff to bundle tasks on a weekly or fortnightly basis to improve efficiencies.
- Moving from a 10 to a 16 calendar day rectification timeframe the average repair time in business days is expected to increase from 4.4 to 5.84. This has also projected an improvement in the average number of tasks completed on a daily basis by field staff from 1.48 to 2.74.

Metric	Historical Result (10 Calendar days)	Estimated Result (16 Calendar days)
Average repair days (Business)	4.4	5.84
Average number of tasks in a day (Depot Based)	1.48	2.74

- The increase in rectification time frame remains within the limits set in the PLC.
- The continued growth in the share of LED technology in “P” Category lighting installations, and the extension to “V” Category lighting will continue to reduce both maintenance and operating costs for customers.

Technology obsolescence

> Changing environmental standards and usage patterns are increasing the risk that Essential Energy will no longer be able source some replacement lamps, or be able to source them from reputable manufactures at reasonable cost.

> These lamps include:

Lamp Type	Details	Action Plan
Mercury Vapour	Changing environmental standards relating to the use of Mercury, particularly in Europe, threaten the ongoing availability of lamps. Through its bulk replacement program, Essential Energy has already achieved a significant reduction in the use of Mercury Vapour lighting. However, there are still in excess of 19,000 installations utilising this technology.	With this in mind, Essential Energy will engage with its customers with a view to replacing at least 20% (approximately 4000) of these installations over the life of this plan.
Incandescent	Incandescent lamps are inefficient and are costly to maintain because of short lamp life.	Essential Energy will engage with its customers with a view to replacing the remaining 150 (approximately) installations over the 2019-24 period.
Low Pressure Sodium	The poor colour rendering of this technology (orange) means that LPS use is in significant decline worldwide. As a consequence, the number of manufactures of replacement lamps is declining, and the cost of replacement lamps is increasing significantly.	Essential Energy will engage with its customers to progressively replace the remaining 640 (approximately) over the life of this plan.
Compact Fluorescent	Even though a comparatively recent technology, compact fluorescent lamps contain small amounts of mercury. As such, ongoing availability is potentially under threat in the absence of technology innovation. Essential Energy perceives this as an emerging issue, but given the high number of installations in service (approximately 60,000) and the relatively low average life (less than 5 years) does not propose a bulk replacement program.	Essential Energy will, however: oEngage with its customers to limit the number of new installations utilising this technology. oConsistent with its approach to all technologies, stringently enforce its handling and disposal procedures on new and used CFL lamps.

Safety Programs

- **Public lighting control wire** – redundant overhead public lighting control wire installed on poles. These small conductor types are prone to condition failure. As the control wire is now redundant, aged and often in a deteriorated condition for safety reasons it needs to be removed.

- Essential Energy's strategy is:

  Wherever major "group" lighting upgrades are occurring remove the control wire as part of the capital cost of the project

  Co-ordinate with both Standard Control Service line inspectors and Public Lighting maintenance crews to identify high risk installations of control wire and remove as a program. Over the 2019-24 period, Essential Energy has budgeted to remove 100 km of public lighting control wire.

- **Redundant Control Boxes** – centralised control boxes were used to control supply to the wires. In many cases, they are now redundant and should be removed when technically and financially viable to do so.

- Essential Energy's strategy is:

  Wherever control wires are being removed as part of a capital or maintenance works, remove the control box where technically viable to do so

  Coordinate with inspection/ maintenance staff to identify high risk installations and remove control boxes. Essential Energy has budgeted to remove 20 per annum (100 in 2019-24 period)

- **Redundant Choke boxes –** some older street light installations have the control gear installed in a choke box mounted on the pole separate from the luminaire head installed on the bracket. Not all of these have been removed where new luminaires having their own, embedded control gear have been installed.

- Essential Energy's strategy for dealing with these is:

  When new luminaires are installed, redundant choke boxes must be removed

  When any other form of maintenance is being conducted on an installation (e.g. bulk lamp replacement, spot repair), redundant choke boxes will be removed.

  Essential Energy has budgeted to remove 250 choke boxes over the 2019-24 period.

- **Pot Belly and Triangular Columns** – There are a number of instances where street lighting connections are intermixed with service connections in the bottom of so-called "pot belly" and "triangular" columns, a number of which are reaching end of life due to structural corrosion or other damage.

- Essential Energy's strategy in relation to these columns is:

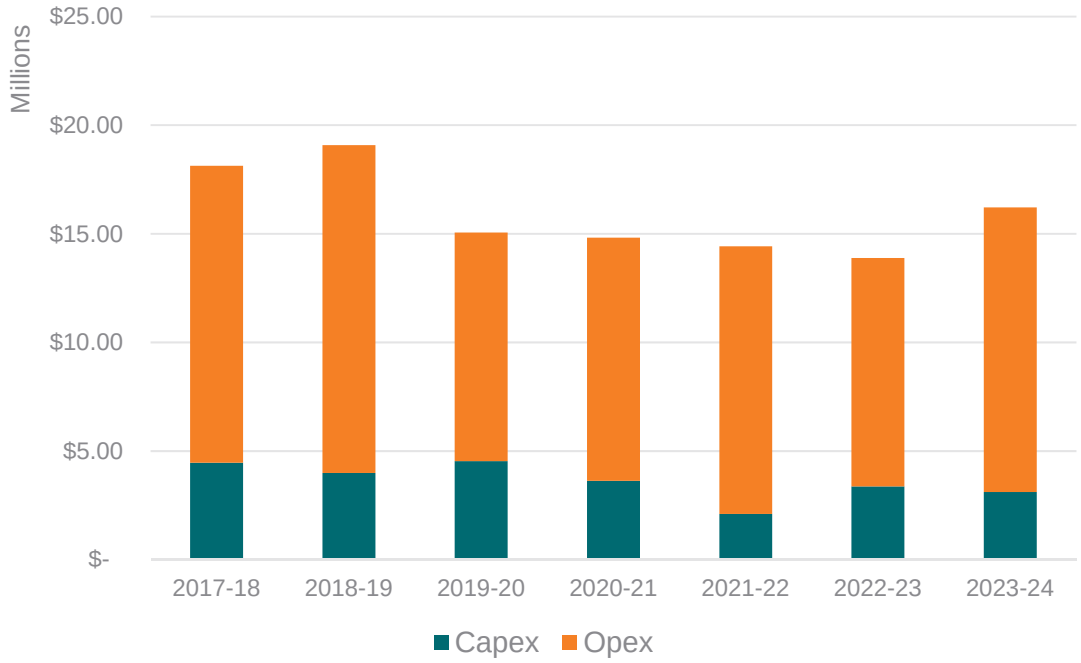
  When replaced due to structural corrosion / mechanical issues, pot belly / triangular columns will be replaced with a separate pillar for ACS services and a standalone column for public lighting assets. This may have tariff implications for customers.

Investment Program Summary

Expenditure ($ millions 2018/19)

	17/18	18/19	19/20	20/21	21/22	22/23	23/24
Total Opex	$13.67	$15.09	$10.52	$11.20	$12.33	$10.51	$13.10
Total Capex	$4.46	$3.99	$4.54	$3.63	$2.10	$3.38	$3.12

- Volatility in operating costs are predominantly driven by the cyclical nature of luminaire and pole maintenance programs, with volumes affected by the density of lighting in specific Local Government Areas.
- Increased penetration of LED lighting technology will drive down maintenance costs over time, with this technology not affected by lamp degradation.
- LED installations will be completed in conjunction with Public Lighting Customers. Any upgrades completed prior to the end of the useful life of the existing installed luminaire will be funded by the customer.



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:

LED Technology

> Essential Energy is committed to the implementation of new technology where both commercially and technically viable.

> LED luminaires is an area that requires constant monitoring for technological advancements. These technologies are inclusive but not limited to:

> Changes in LED technology to more efficient and more reliable luminaires as they come onto the market.

> Category V LED implementation as a standard offering for use on Essential Energy's network.

Smart Controls

> The implementation of LED luminaires has opened avenues for increased control of illumination. "Smart controls" is a very broad term that includes a large variation in technology ranging from basic with minimal infrastructure augmentation to complex requiring significant electrical network augmentation and data bandwidth. Smart controls in general are devices that can:

> Control the luminaire; i.e. switching and dimming.

> Monitor the luminaire; i.e. metering and asset performance monitoring.

> Monitor the surroundings; i.e. environmental sensors, CCTV, vehicle and pedestrian movements.

Performance reporting

> Essential Energy will continually research better internal practices that minimise the cost of dispatch and completion of the work as well as comparing ourselves with external baselines to ensure Essential Energy is moving towards best practice in the maintenance of Street Lights.

> Metrics will be incorporated into Essential Energy's monthly performance reporting to show that the measures outlined in this asset management plan are continuing to put downward pressure on Essential Energy's callout costs.

Relevant Legislation , Policies, and Supporting Documents

Legislation

Document	Relevance to the AMP
National Electricity Rules	Used to set Asset Management Objective Targets
Electricity Supply Act 1995 and supporting Licence Conditions	
Electricity Supply (Safety and Network Management) Regulation 2014 (NSW)	
NSW Public Lighting Code, 2006	
Australian/New Zealand Standard: AS/NZS 1158 Lighting for Roads and Public Spaces	

Policies

Document	Relevance to the AMP
CEOM7004 Materials Inventory: Contestability	This document is intended to provide details of the objectives which Essential Energy has adopted in relation to the various system characteristics that influence the quality, reliability and security of electricity supply to its valued customers
CEOP8030 - Electrical Safety Rules	
CEOP8010 - Electricity Network Asset Inspection	
ISO 55000:2014 - Asset Management	Used to develop Asset Management System

Support Documents

Document	Relevance to the AMP
Australian/New Zealand Standard: AS/NZS 3000 Wiring Rules Australian/New Zealand Standard: AS/NZS 7000 Overhead line design – detailed procedures	Provides detailed specifications and requirements for the design and construction of overhead power lines

Essential Energy

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