Ironbark Sustainability

Energy Queensland

Smart Lighting Strategy

ERGON ENERGY NETWORK | energex

Part of Energy Queensland

Prepared for
Energy Queensland

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Ironbark Sustainability is a specialist consultancy that works with government and business around Australia by assisting them to reduce energy and water usage through sustainable asset and data management and on-the-ground implementation.

Ironbark has been operating since 2005 and brings together a wealth of technical and financial analysis, maintenance and implementation experience in the areas of building energy and water efficiency, public lighting and data management. We pride ourselves on supporting our clients to achieve real action regarding the sustainable management of their operations.

Our Mission
The Ironbark mission is to achieve real action on sustainability for councils and their communities.

Ironbark are a certified B Corporation. We have been independently assessed as meeting the highest standards of verified social and environmental performance, public transparency, and legal accountability to balance profit and purpose.

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1. Executive Summary

Energy Queensland (EQL) has developed this Smart Lighting Strategy in response to the evolving needs of our stakeholders and customers. The purpose of this Strategy is to enhance the quality of the public lighting services we provide to our customers through the provision of a best practice smart lighting system. This not only includes the delivery of the technology required for smart lighting to function, but also the development of a management and governance framework that ensures there is clarity on the responsibilities of stakeholders, safeguards for the implementation of adaptive lighting and clear processes in place that allow customers and EQL to harness the features of smart lighting.

Approach

EQL considered three approaches for smart lighting in the context of its inclusion into, or exclusion from, the 2025-30 determination period. Ultimately a measured transitional approach has been chosen by EQL that will see customers pay for smart cells and installation upfront on an "as requested" basis. Figure 1 below provides a high-level overview of how this approach would operate.

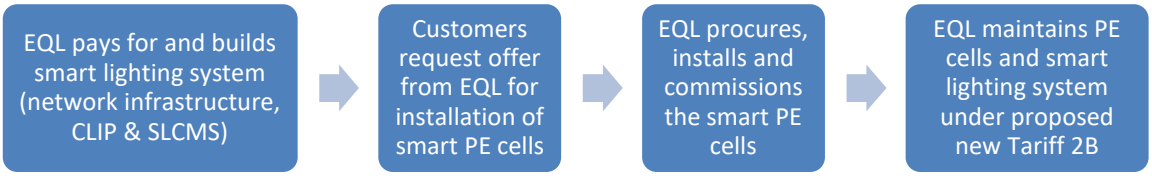


Figure 1: Overview of how a measured transitional approach would work in practice

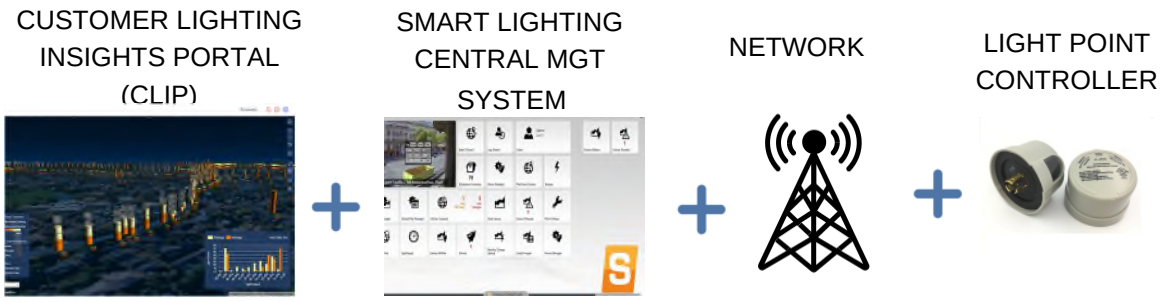
Smart Lighting System

EQL is planning a system architecture with a frontend Customer Lighting Interface Portal (CLIP) to enable users to understand and manage the smart lighting system (see Figure 2). The CLIP will be integrated with the smart lighting system to streamline the process of managing smart public lighting assets while providing a user-friendly experience for customers, offering intuitive tools for lighting design and compliance management.

This will be supported by the development of an operating protocol. This protocol will serve as a guiding document, outlining the rules, responsibilities, and procedures governing the operation and management of EQL's smart lighting system. It will ensure that the potential of smart lighting is harnessed effectively and responsibly. Core questions which will be discussed with customers in the development of the operating protocols include:

- Who can control the smart lighting settings?
- Who is responsible for smart lighting design and road safety outcomes?
- What are the management and maintenance requirements and who will carry out what activity?

Figure 2: Smart Lighting System Elements[1]



Front end for customers and lighting managers	**Backend system connector and advanced mgt.**	**Data transmission**	**Local control and comms devices**
• Integrates multiple backend systems • Simple visualisations & asset mapping • Customer requests • Project initiation, design and smart programming tools	• Connects network & LPCs to Insights Portal • Fault reporting to DNSP • Real-time data monitoring	• Facilitates comms between LPCs and SLCMS	• Connect streetlight • Local control • Transmit streetlight specific data • Connect to other assets (e.g. traffic counters)

Cost Benefit Analysis

EQL has completed a market assessment as part of the delivery of its smart lighting strategy. A cost benefit analysis of smart lighting for EQL's customers and the wider community was undertaken as part of this work. Scenarios were considered whereby smart lighting is installed and commissioned on major roads, minor road lights and for all lights across the EQL network.

The costs assume savings from energy reduction and over lighting reduce electricity bills and are weighed against the costs of additional control devices and systems.

Community wide benefits include improvements in road safety outcomes from reduced over lighting as well as improved fault rectification from automatic monitoring.

The detailed cost benefit analysis indicates the following:

- Smart lighting has greater economic benefits for customers when deployed on major roads and results in an average payback of 4 years. The average model demonstrates a potential lifetime net value of $75m for EQL customers for major road light types and a loss of up to $130m for minor roads. In residential areas there is no payback for customers as costs outweigh savings
- The additional financial benefits of road safety improvements range between $200m and $900m over 20 years if deployed across all street lighting in Queensland and is a significant benefit for the Queensland health and insurance sectors, but not the customers who fund public lighting. When including road safety benefits there is a 4-

[1] Images courtesy Opticity and Streetlight.vision

year payback for installing smart lighting on all lights across the EQL networks or an ROI of over 20%.

- Greenhouse emissions savings can reach over 500,000 tCO2-e over the 20 year asset life across Queensland.
- Overall benefits vary considerably depending on the assumptions (See Appendix 1 for details on the assumptions).

The outcomes from the cost benefit analysis are not clear cut in support for the use of smart lighting in all situations, and considering these inconclusive results a customer-led demand for smart lighting is the best option for EQL and customers. This provides customer choice while acknowledging that the economic benefits are uncertain.

Next Steps

The successful delivery of EQL's Smart Lighting Strategy requires the following key next steps:

1. Finalisation and formalisation of its management and governance framework via the development of a draft Operating Protocol
2. Completion of market research and procurement processes to select preferred smart lighting vendors. This will firm up smart lighting system costs and needs to be completed by December 2024 in time for final price submissions to the AER for the 2025-30 regulatory period.
3. Carry out the system build and use pilots and/or first deployments to test and iterate the Operating Protocol where required.

Customer Engagement

EQL will continue to consult and inform its customers via the Talking Energy/Public Lighting Forum webpage, and through its ongoing public lighting customer engagement process. This engagement vehicle is part of EQL's Regulatory Proposal activities for the 2025-30 regulatory period. Customers will be informed of the progress of key elements of this Strategy. This includes procurement updates, management model finalisation, operating protocol development (where input from customers will be sought), system build updates, pilot outcomes, smart metering updates and smart lighting tariff determinations.

It should be noted that an abridged, customer-friendly version of the Smart Public Lighting Strategy has already been published on EQL's Talking Energy webpage.[2]

Key recommendations

- Use the Sylvania Schreder Standing Offer Arrangement (SOA), utilised by DTMR
- Deliver the Implementation Plan as outlined in Section 10 including:
    - Deploy a system as outlined in Section 2.2

[2] https://www.talkingenergy.com.au/35806/widgets/200811/documents/271565

- Create an Operating Protocol in conjunction with customers to define the rules under which the smart lighting system is controlled and managed.
- Test these systems and protocols in 2024 and 2025 prior to the widespread use from July 2026

- Offer the system as an opt-in user-pays approach. EQL can consider funding smart lighting in isolated locations where the business case for removal of patrols delivers the cost of the system for that location.
- Under this model EQL will have a smart lighting system ready for deployment for customers. Depending on future potential changes to the regulatory arrangements, EQL will work collaboratively with metering providers to ensure customers can access metering services for smart lighting and will consider the merits of providing smart metering services to customers during the 2025-230 regulatory period.

Part 1: Introduction and Background

2. Introduction

2.1 About this Strategy

Understanding Our Mission:

This Smart Lighting Strategy (the Strategy) has been developed in response to the evolving needs of EQL's stakeholders and customers. The purpose of our Strategy is to enhance the quality and choice of the public lighting services we provide to our customers - both local governments and ultimately the residents and road users of Queensland. While smart lighting solutions offer innovation and potential benefits beyond those related to just lighting, our primary goal is to address tangible challenges related to lighting and deliver practical value. These are:

- Improved maintenance processes that ultimately lead to less down time.
- The provision of a framework for customers to adjust lighting levels for the purposes of improving road safety and reducing energy consumption.
- Improved transparency and access to data.

A Customer-Centric Approach:

We acknowledge that our customers (local government authorities and Department of Transport and Main Roads) have specific requirements and expectations. Smart lighting is not an end but a means to better meet these needs, which include improved road safety, reduced energy consumption and better control of environmental light spill. This strategy is grounded in our commitment to providing responsive, cost-effective, reliable and intelligent public lighting services. The development of a smart lighting strategy is in response to customer feedback received during our engagement for the 2025-2030 regulatory period.

Our Strategy at a Glance:

This strategy is a focused, step-by-step plan that outlines our approach to adopting smart lighting technologies. It aims to improve lighting quality, reduce operational costs, streamline information exchange, and enhance our ability to respond to maintenance issues promptly. Broadly speaking, the documents is separated into two parts:

- Part 1: Introduction and Background
- Part 2: Strategy and Implementation

In the sections that follow, EQL will outline the specifics of our smart lighting strategy. We will discuss the technologies we intend to deploy, the timeline for implementation, and the financial considerations. Our approach is grounded in feasibility and adaptability, reflecting this strategy's objective to deliver tangible results.

Collaborative Partnership:

This Strategy is based on a shared interest with our customers in improving EQL's service delivery in relation to public lighting. This strategy represents a joint effort with EQL's partners and customers to leverage technology while maintaining a practical and customer-centric/end-user perspective.

Engagement of Ironbark Sustainability:

EQL engaged specialist public lighting consultancy, Ironbark Sustainability to support the development of this Strategy. This work included:

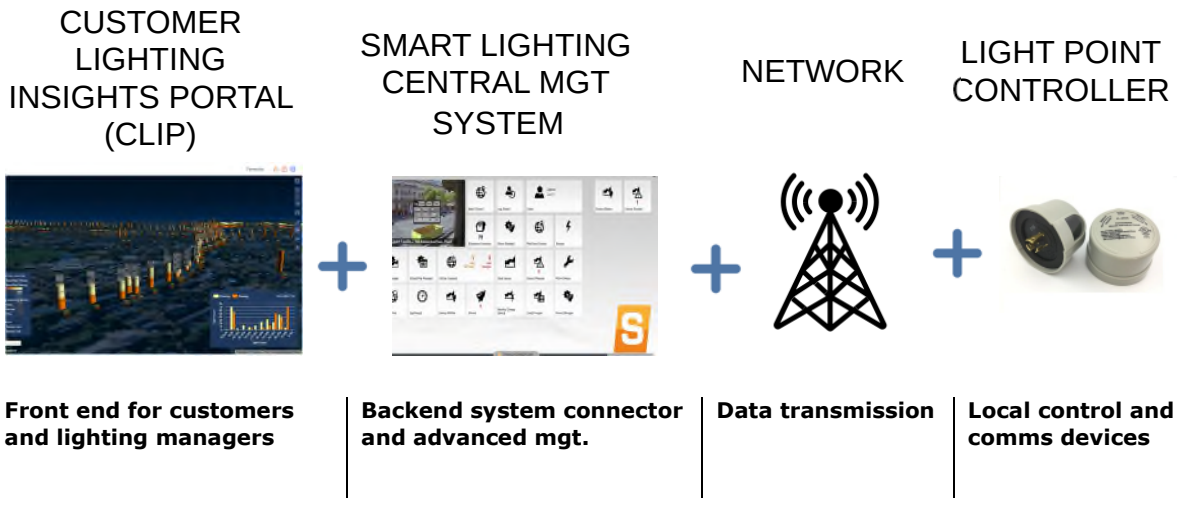
- Strategy development
- Market research and cost benefit analysis
- Engagement with EQL customers
- Engagement with internal EQL stakeholders
- Support in developing high level smart lighting system architecture

2.2 Smart Lighting at a Glance

2.2.1 Components

For the purposes of this Strategy, a smart lighting control system is considered to comprise of a set of four interacting component levels which are shown in Figure 3.

Figure 3: Smart Lighting System Elements[3]



[3] Images courtesy Opticity and Public light.vision

• Integrates multiple backend systems • Simple visualisations & asset mapping • Customer requests • Project initiation and tracking tools • Lighting design tools • Smart light programming	• Connects network & LPCs to Insights Portal • Fault reporting to DNSP • Real-time data monitoring	• Facilitates comms between LPCs and SLCMS	• Connect light • Local control • Transmit light specific data • Connect to other assets (e.g. traffic counters)

Further detail on each is outlined below:

1. **Customer Lighting Insights Portal (CLIP):** The CLIP serves as the frontend customer-facing interface. The CLIP, DNSP asset management system and SLCMS work together to streamline the process of managing smart public lighting assets while providing a more user-friendly experience for customers. The CLIP includes a standard customer interface including login, user access and reporting features. Targeted lighting tools assist with lighting design, task/project communications, smart lighting commissioning and complaints management.
2. **Smart Lighting Central Management System (SLCMS):** The SLCMS functions as the backend system used for sophisticated understanding and control of the smart system. It provides centralised control and monitoring of all connected public lights. It allows administrators and users to set schedules, configure lighting profiles, and receive real-time data from the LPCs/smart PE cells.
3. **Network Communications Infrastructure:** Comprises of the digital framework that interconnects all smart lighting components, including public lights, sensors, and controllers. It serves as the data transmission medium that facilitates communication between smart PE cells and the CMS. A key physical component of network communications infrastructure are gateways. They are akin to a wireless router, serving as intermediaries or bridges between individual smart PE cells and the communication network.
4. **Light Point Controllers (LPCs):** LPCs, most often in the form of smart PE cells in the Australian public lighting context, are essential components that sit within or attached to individual public lights. They enable local control and collect data from the public light as well as any sensors connected to the public light. LPCs are responsible for adjusting light levels and communicating with the central management system.

Public lights themselves must be smart enabled to allow them to be connected to a smart lighting system. For unmetered public lighting applications in Australia, this requires the street light luminaire to have a 7-PIN NEMA receptable (or less typically a Zhaga Book 18 receptacle) to plug the smart PE Cell into and a dimmable driver that allows power to the LED chips to be modulated and thus light levels to be decreased and increased.

A DNSP will have existing systems to manage workflow and knowledge management for its lighting system. Both the SLCMS and the CLIP will need to be integrated with these systems.

This document does not further explore the DSNP asset management processes beyond the functions of the CLIP and SLCMS.

2.2.2 Key Features

Some of the key features of a smart lighting system for public lighting are as follows:

- **Remote Monitoring and Control:** Smart lighting systems allow for real-time monitoring and remote control of individual public lights or groups of lights. This enables efficient management, reducing energy consumption and maintenance costs.
- **Metering of Street Lighting:** Smart lighting can allow for metering of street lighting such that the energy savings from dimming, trimming and other adaptive lighting approaches are reflected in customer electricity bills. Metering arrangements are subject to proposed rule changes by the Australian Energy Market Commission (AEMC).
- **Adaptive Lighting:** These systems can adjust brightness levels based on environmental conditions, traffic patterns, and time of day, providing optimal lighting while conserving energy.
- **Data Analytics:** Smart lighting systems collect data on energy usage, operational performance, and environmental factors. This data can be analyzed to make informed decisions and optimize lighting strategies.
- **Maintenance Alerts:** The system can proactively detect issues and send maintenance alerts, reducing downtime and ensuring that faulty lights are repaired promptly.
- **Integration with IoT:** Smart public lighting can be integrated into broader Internet of Things (IoT) networks, facilitating other smart city initiatives such as traffic management and environmental monitoring.

3. The Journey So Far

3.1 Customer Engagement to-date

In October 2022, EQL launched its engagement plan for Energex and Ergon Energy's 2025-30 regulatory proposals. This engagement plan was the product of a customer and stakeholder forum held in September 2022 to develop a genuine and authentic co-designed engagement process. In the engagement plan, EQL committed to consult with its customers on, among other things, smart lighting with a view to seek feedback and understand customer needs and views.

In March 2023, EQL held a shared learnings session to provide customers with an overview of the status and learnings of EQL-managed smart lighting trials as well as relevant adjacent trials and projects carried out by Queensland local governments and the Department of Transport and Main Roads (TMR). At this same session, EQL outlined three approaches for smart lighting in the context of its inclusion into, or exclusion from, its 2025-30public lighting proposals. These are outlined in Table 1 below.

Table 1: Overview of deployment options presented to customers in March 2023

	Option 1: Measured Transitional Approach	**Option 2: Full Deployment Approach**	**Option 3: Delayed Approach**
Funding arrangements	User Pays	EQL funded with costs shared across all users	Not applicable
Overview	Use of smart public lighting devices on an "as requested" basis.	Full deployment of smart public lighting devices on all LED public lights across both networks.	Energex and Ergon Energy will not offer smart public lighting devices as a public lighting service as part of the forthcoming 2025-30 public lighting strategy
Outline	• Customers will pay upfront for the assets. • Customers will pay for installation of the assets. • Energex and Ergon Energy will operate maintain the assets under a proposed new Rate 2B tariff.	All public lighting customers with LED lights will ultimately pay through their Rate 1, Rate 2 and Rate 4 public lighting tariffs.	No change to current practices

These three approaches were subsequently circulated as a part of a Public Lighting Issues Paper where customers were invited to provide feedback on their preferences. Based on customer responses, there was overwhelming support for Option 1: Measured Transitional Approach.

3.2 Research and Trials

EQL has conducted a trial of 40 devices using two alternate suppliers and network types. The trial provided several encouraging outcomes including the use of key smart lighting features such as fault reporting, adaptive lighting control and constant light output as well as consideration of the positive impact that faults data, voltage and current data, and burn hours data could have on operational and maintenance processes.

Overall, however, the trial identified that limited immediate benefits exist for EQL in terms of elimination of physical inspections, difficulty in interpreting faults/errors, lengthy commissioning and troubleshooting processes, limited value of voltage/current data and economic barriers for integrating key smart lighting data streams such as faults into EQL's existing asset management systems.

In addition to EQL's trial, Sunshine Coast Council is conducting an ongoing trial of 128 devices across a mixture of major road and minor road lights. To date, no data or outcomes from the trial have been shared by Sunshine Coast.

The mixed and inconclusive results of EQL's trials to date may be due to insufficient volumes, limited internal expertise of smart lighting systems, and resource constraints during the trials. The mixed results of the trials supports the measured transitional approach that has been chosen by EQL that will see customers pay for smart cells and installation upfront on an "as requested" basis.

Moving forward, EQL sees benefits in conducting further trials and pilots during the delivery of its smart lighting strategy. This will allow further interrogation into the potential benefits of smart lighting to EQL and play a key role in ensuring that processes and systems are functioning correctly by the time smart lighting is offered to customers in July 2026.

4. What does Smart Lighting Offer?

One of the first steps of a smart lighting strategy is to understand the features that have the potential to benefit customers, residents, road users and EQL – in essence this step is about developing a hypothesis upon which to justify further investigation.

In this section, a comprehensive examination of "What does smart lighting offer?" is carried out. The analysis extends beyond just customer needs, encompassing the broader spectrum of benefits that extend to those affecting EQL, maintenance processes, energy management, safety enhancement, and the natural environment.

Importantly, this section also includes a review of the potential limitations and challenges of rolling out a smart lighting system. Recognizing these challenges is an important step in understanding that not everything is going to work perfectly out of the box and that the roll out of a smart lighting system is a process that will take many years to perfect.

4.1 Customer Requirements and Expectations

In April 2023, EQL sought input from customers about what they want from smart lighting as well as whether smart lighting is something that they would consider in the first place. Some of the key points that highlight typical customer requirements and expectations around smart lighting are as follows:

- EQL customers have a desire to see a clear business case before committing to a roll out of smarts – some have already carried out business cases themselves, whilst other have yet to do this.
- Energy savings via adaptive lighting is a major driving factor for most customers considering the use of smart lighting.
- The cost savings associated with energy savings are a concern for some customers given that smart small-load metering is not yet approved. It would be a requirement of these customers that smart small-load metering is recognised before they invest in smart lighting roll outs.
- Environmental light pollution into residential and native habitats also factors as a major reason for wanting to install smart lighting.
- Improved asset management and maintenance processes was acknowledged as an additional benefit to those listed above by some customers.

Overall, a relatively small number of EQL's customers have indicated that they would be able to adopt smart lighting in the short term. Many customers have not yet considered smart lighting at all. However, in time as business cases are confirmed, awareness of smart lighting's benefits increases and smart small-load metering is brought on-line, it is not unreasonable to suggest that multiple tens of thousands of smart lights could be rolled out in the first couple of years of the 2025-30 regulatory period. EQL is currently seeking feedback from customers in terms of the volumes of lights they would consider taking up in the 2025-30 period. This is an attempt to gauge the level of interest. Responses are expected by 3 November.

4.2 EQL Requirements and Expectations

Based on EQL's research and trials to-date, there are limited expectations in terms of the benefits of smart lighting for EQL. Mooted benefits such as the elimination of physical inspections, faults data improving maintenance processes and voltage/current data assisting to identify electricity network issues would all rely on mass-uptake of smarts – something that is very unlikely within the next 10 years.

As such, EQL's requirements for smart lighting are primarily related to whether it can serve customer needs, whilst at the same time minimising any additional administrative or procedural burden for EQL. This would include activities associated with commissioning, programming, and maintaining the smart lighting system as well as any future activities associated with smart metering.

Key amongst EQL's effort to minimise smart lighting's impact on its processes is to ensure that one smart lighting system is used across the entire Energex and Ergon network. A fragmented approach to system choice between network or individual customer areas would greatly increase the complexity associated with managing smart lighting. In addition, an agreed approach to the management and control of smart lighting between EQL and customers is proposed (See Section 9.2).

Lastly, EQL expects that it will bear no responsibility to lighting level changes initiated by the customer. It is the Road Controlling Authority's decision on what lighting levels to apply in what areas and whether to comply with Australian public lighting standards.

4.3 Maintenance Benefits

The maintenance of a public lighting network, as vast as that of EQL's, is a substantial undertaking, requiring both time and resources. Smart lighting introduces features to streamline maintenance operations and potentially reduce associated costs. With real-time monitoring and diagnostics capabilities, smart lighting enables users to proactively identify issues such as lamp failures or damaged fixtures. This means that maintenance crews can be dispatched precisely where and when needed, eliminating the need for routine patrols and allowing for a more efficient allocation of resources.

Furthermore, predictive maintenance is a hallmark of smart lighting. By analysing data trends and performance indicators, users can anticipate potential failures before they occur, allowing for pre-emptive action. This not only minimizes downtime but can also extends the lifespan of lighting infrastructure.

4.3.1 Limitations and Challenges

There are several challenges associated with achieving the full suite of benefits associated with maintenance. These include:

- **Integration Complexity**: Integrating smart lighting systems with existing infrastructure and asset management systems can be complex. Ensuring seamless communication and compatibility can be challenging and costly.
- **Reliability and Connectivity**: Smart lighting systems rely on continuous connectivity to function effectively. Any interruptions in communication networks can impact the real-time monitoring and control capabilities of the system. Whilst typically short lived, communication interruptions can have broader impacts if it occurs regularly enough to distort the way in which faults data is interpreted.
- **Maintenance Expertise and Buy-in**: Transitioning to smart lighting requires specialized expertise in the maintenance and operation of a central management system and the faults data it offers. Training personnel and acquiring the necessary skill sets can be time-consuming and costly. Buy-in from staff can also be difficult because the use of real time faults data to inform maintained scheduling represents a quantum leap in processes – something that may take multiple years to adapt to.
- **Maintenance Dependency**: Overreliance on smart lighting faults data can lead to false positives or false negatives, affecting maintenance schedules. Striking the right balance between automation and human intervention is crucial.
- **Widespread Uptake:** Mooted benefits such as the elimination of physical inspections, faults data improving maintenance processes and voltage/current data assisting to identify electricity network issues would all rely on mass-uptake of smarts – something that is very unlikely within the next 10 years.

4.4 Energy Efficiency Benefits

Smart lighting technology offer the potential to deliver a significant leap in energy efficiency, offering substantial reductions in energy consumption and operational costs associated with energy.

Through advanced features such as motion sensors, adaptive dimming, and real-time monitoring, smart lighting solutions intelligently adjust illumination levels based on real-time conditions. This means lights can be dimmed or turned off when not needed, minimising wasted energy and significantly lowering electricity bills.

4.4.1 Limitations and Challenges

There are several challenges associated with achieving the full suite of benefits associated with energy efficiency. These include:

- **Acceptance of Smart Metering:** Smart lighting systems rely on in-built metering to measure energy usage. Smart metering rules are being written by the AEMC (See Section 8). The final decision on these rules are expected in early 2024. Once these are finalised, clarity on ownership, retail and regulatory processes can be integrated into this strategy. Additional costs and system complexity to enable smart metering may also occur, this will need to be considered and planned for within the smart system design. While the focus is mainly on the savings associated with lower energy use, the cost associated with real time metering are often overlooked. Quantifying these costs is a key concern for EQL. As a result, customers may face challenges in recognizing immediate cost savings, impacting the return on investment.

- **Detailed Design Processes and Compliance**: Achieving energy efficiency with smart lighting systems requires appropriate levels of planning and design. The challenge lies in ensuring that the design aligns with Australian lighting standards and regulations. Any deviations from these standards risk breaching compliance requirements.
- **Research and Effort for Real-Time Control**: Real-time control, including features like adaptive dimming, requires research and effort to ensure it functions optimally and safely. The challenge here in guaranteeing that real-time control meets safety standards while delivering energy savings as intended.

4.5 Environmental Benefits

Smart lighting not only brings advancements in efficiency but also offers and more sophisticated method to respond to the growing demands for 'responsible illumination'. One of its most significant contributions is its potential to reduce light pollution, benefitting both human inhabitants and our natural environment.

By precisely controlling the intensity and switching times of public lights, users can ensure that an appropriate amount of light (which could mean no lighting at all) is delivered to match the changing needs of road users and the natural environment over the course of the night or in fact over the course of a season or year. This means less light spillage into the night sky, reducing the disruptive effects of light pollution on astronomical observations and minimising the impact on nocturnal ecosystems. The precise control of illumination prevents unnecessary disruption to wildlife behaviour, particularly for species that are sensitive to artificial light. By reducing light pollution, smart lighting can support the natural behaviours of animals, minimize disorientation, and help protect our ecosystems.

4.5.1 Limitations and Challenges

There are several challenges associated with achieving the full suite of benefits associated with the control of artificial light at night. These include:

- **Community Acceptance of Reduced Lighting**: Achieving environmental benefits often involves reducing light levels during certain periods. However, community acceptance of reduced lighting can be a potential issue. Some residents may be accustomed to well-lit areas and may raise concerns about safety or visibility.
- **Customer Involvement in Lighting Decisions**: For effective light reduction, customers need to proactively identify when lights should be turned off or dimmed. This requires additional effort and coordination on the part of the customer to strike a balance between environmental preservation and community expectations.
- **Complexity of Environmental Impact**: It's important to recognize that there is no one-size-fits-all solution to environmental benefits. What benefits one species may have unintended consequences for another. Balancing the needs of different species and ecosystems requires a nuanced approach and ongoing research.

4.6 Safety Benefits

Road safety is the primary purpose of public lighting, and smart lighting has the potential to provide transformative measures to enhance it. First and foremost, smart lighting solutions are designed to minimize the occurrence of light outages. Through proactive monitoring and predictive maintenance, the chances of darkened streets can be reduced, ensuring that residents and road users have a more reliable source of illumination.

Additionally, real-time adaptive lighting offers innovative methods for improving road safety. Smart lighting systems can be set up to instantly respond to varying conditions, increasing light levels during adverse weather, heavy traffic, or emergency situations. This adaptive approach ensures that roads are adequately illuminated at all times, improving visibility for drivers and pedestrians alike.

4.6.1 Limitations and Challenges

There are several challenges associated with achieving the full suite of benefits associated with safety. These include:

- **Timely Action on Faults Data**: While having access to faults data is valuable, the effectiveness of safety benefits hinges on how quickly and efficiently this data is used and acted upon. Delays in addressing issues identified via a smart lighting system can compromise safety outcomes.
- **Complexity of Dimming, Trimming, and Switching**: The implementation of features like dimming, trimming, and switching for energy efficiency and environmental purposes can introduce various issues that may potentially compromise safety. It's crucial to adopt a holistic approach to ensure that these actions do not inadvertently create hazards.
- **Research and Effort for Real-Time Control:** As with real-time control for energy efficiency benefits, for safety purposes, such as increasing light during adverse weather events, demands research and effort to ensure it operates optimally and, most importantly, safely. The challenge lies not only in technical development but also in guaranteeing that real-time control enhances safety without introducing unintended risks.

5. Costs of Smart Lighting

5.1 Cost Benefit Analysis

EQL is carrying out a separate market assessment as part of the delivery of its smart lighting strategy. This includes benchmarking for each of the cost groups outlined below:

- **System Establishment** - initial expenses incurred for purchasing the hardware and infrastructure needed for the smart lighting system, including the purchase of smart PE cells. Includes any consultancy and project management costs including to confirm Operating protocols with customers.
- **Installation and Commissioning** - encompasses the expenditures associated with deploying and configuring the smart lighting system. It includes expenses for labour, programming of adaptive lighting schedules, data integration and initial testing to ensure proper functionality of smart PE cells.
- **Subscription and Ongoing Data** - the fees or subscriptions paid for continuous access to data services, platforms and communication networks that enable remote monitoring and control of the smart lighting system. This includes expenses related to data transmission, cloud services, and network connectivity.
- **Maintenance and Operation** - attributed to the routine upkeep and operational activities required to maintain the smart lighting infrastructure. They encompass tasks such as system monitoring, troubleshooting, repairs, software updates, smart metering management, user training and ensuring the system's smooth operation over time.

These costs benchmarks will then be used to assist in guiding the smart lighting system procurement process and ultimately the charges for the tariff that is applied to smart lighting for the 2025-30 regulatory period.

The market assessment also includes a simple cost benefit analysis of smart lighting for EQLs customers and the wider community. For the analysis, a range of models (pessimistic through to optimistic which are outlined in Appendix 1) have been applied to three simple scenarios, whereby smart lighting is installed and commissioned on:

1. Major Road Lights
2. Minor Road Lights
3. All Lights

Table 2**Error! Reference source not found.** below summarises the costs and benefits for installing smart lighting across Queensland for customers. The average model demonstrates a potential lifetime net value of $75m for EQL customers for major road light types and a loss of up to $130m for minor roads. The costs assume savings from energy reduction and over lighting reduce electricity bills and are weighed against the costs of additional control devices and systems.

Community wide benefits include improvements in road safety outcomes from reduced over lighting as well as improved fault rectification from automatic monitoring. This is estimated to save between $200m and $900m from directly reducing accidents on Queensland roads. When

including road safety benefits there is a 4-year payback for installing smart lighting on all lights across the EQL networks.

The detailed cost benefit analysis indicates the following[4]:

- Smart lighting has greater economic benefits for customers when deployed on major roads and results in an average payback of 4 years.
- In residential areas there is no payback for customers as costs outweigh savings.
- The additional financial benefits of road safety improvements ranges between $200m and 900m over 20 years if deployed across all street lighting in Queensland and is a significant benefit for the Queensland health and insurance sectors, but not the customers who fund streetlighting.
- Greenhouse emissions savings can reach over 500,000 tCO2-e over the 20 year asset life across Queensland.
- Overall benefits vary considerably depending on the assumptions (See Appendix 1 for details on the assumptions).

Table 2: Queensland summary smart lighting cost-benefit analysis (average model)

Model	**Major Roads**	**Minor Roads**	**All Roads**
Number of lights (thousands)	140,000	360,000	500,000
Total Cumulative Project Cost ($M)	$33	$65	$98
Net lifetime cost-benefit (Road Controlling Authority (RCA), $M)	$75	-$130	-$55
Greenhouse savings (ktCO2-e, first year)	22	3	24
Payback period (for RCAs, yrs)	10	None	None
Additional road safety benefit ($M, 20 yrs)	$110	$365	$475
Community wide payback (inc. road safety benefit, emissions value and maintenance reductions, yrs)	4	5	4

The outcomes from the cost benefit analysis are not clear cut in support for the use of smart lighting in all situations, and considering these inconclusive results a customer-led demand for smart lighting is the best option for EQL and customers. This provides customer choice while acknowledging that the economic benefits are uncertain.

5.2 Next Steps

As part of the delivery of its smart lighting strategy, a key focus for EQL will be to firm up smart lighting system costs and ideally reduce costs to enhance the cost-benefit to customers. As it stands, the market analysis summarised above has not included a market testing process, nor a call for quotes from vendors. Relevant procurement processes are now required to confirm financial information for EQL to make final procurement decisions.

[4] See

Further to this, governance processes and regulatory requirements need to be established to ensure customers can maximise energy savings (through appropriate design and control, but to also manage quality and risk) and realise these energy savings via reduced electricity charges.

Part 2: Strategy and Implementation

6. Proposed Approach

As detailed in Section 3.1 of this document, EQL considered three approaches for smart lighting in the context of its inclusion into, or exclusion from, the 2025-30 determination period. Ultimately a measured transitional approach has been chosen by EQL that will see customers pay for smart cells and installation upfront on an "as requested" basis. Figure 4 below provides a high-level overview of how this approach would operate.

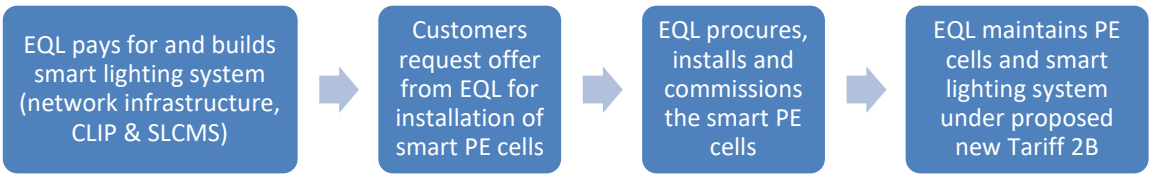


Figure 4: Overview of how a measured transitional approach would work in practice

This Strategy is designed to guide the implementation of a measured transitional approach. The sections of the Strategy that follow outline the key items to be considered and refined as well as a proposed implementation plan to deliver a functioning smart lighting system for customers by the beginning of the 2025-30 determination period.

These key items to be considered are:

- Technology options for the smart lighting system
- Regulatory requirements (tariffs and pricing, AS1158 and smart metering)
- Governance – in particular the choice of a management model and the development of an operating protocol

7. Technology Options

EQL will need to consider a number of technology options prior to and during the procurement phase.

This includes network technology types, Smart Lighting Central Management System (SLCMS) options and Customer Lighting Insights Platform (CLIP) options.

7.1 Network Technology Options

The choice of network type should align with the specific requirements and constraints of a smart lighting project. Factors to consider for EQL include geographic location/area, budget, scalability, data transfer requirements, and the need for future-proofing the system as technology evolves.

The network options to be explored by EQL include:

- Mobile 4G and 5G - Mobile/Cellular networks use 4G or 5G technology to connect public lights to a central control system via mobile/cellular towers.
- LoRaWAN - Low-Power Wide-Area Network (LoRaWAN) networks are not part of the cellular network and operate independently. LoRaWAN is based on the LoRa (Long Range) radio modulation technology. LoRaWAN uses a mesh network topology, where Internet of Things (IoT) devices (nodes) can communicate with each other, forming a self-healing and flexible network. Data can hop from node to node until it reaches a gateway, which connects to the internet.
- NB-IoT - a type of low-power wide-area network (LPWAN) that uses cellular/mobile technology. As with LoRaWAN, NB-IoT is perfect for devices that don't need to send lots of data but need to do it reliably and for a long time.
- Ultra-Narrow Band - a type of low-power wide-area network (LPWAN) that excels at isolating and filtering out unwanted noise beyond its exceptionally narrow bandwidth. Consequently, the network can transmit data with low transmitter power levels, making it energy-efficient. Moreover, its effective communication range can be greater compared to technologies that lack such precision and selectivity in filtering out unwanted signals.
- Wi-Sun - Wireless Smart Ubiquitous Network Field Area Networks (Wi-SUN) are based on the open IEEE 802.15.4g wireless specification which promotes compatibility with various devices. They are considered low-power and offer long-range communication for applications like smart meters, street lighting, and environmental monitoring in urban environments, making them a popular choice. They typically offer higher data bandwidths than LPWAN networks.

Based on initial considerations by EQL, the use of an NB-IoT network technology appears the most sensible given that infrastructure already exists via the mobile phone network (meaning capital costs are minimal) and network coverage is extensive, existing in most locations where public lighting is present. Further consideration will be carried out during the procurement phase of EQL's strategy delivery.

7.2 SLCMS Options

A Smart Lighting Central Management System (SLCMS) offers a range of features to monitor, control, and manage public lights. Broadly speaking, the commonly available SLCMSs in Australia offer very similar features and functions. Below are the main features commonly found in a SLCMS:

- Device Management:
    - Device Inventory: Maintains a comprehensive list of all connected devices, such as public lights, sensors, or controllers.
    - Device Registration: Allows for the seamless addition and registration of new devices to the network.
- Remote Monitoring:
    - Real-Time Data: Provides real-time status and performance data for each device, including power consumption and sensor readings.
    - Alerts and Notifications: Generates alerts and notifications for issues like device failures, maintenance requirements, or security breaches.
    - Dashboard: Offers a user-interface for at-a-glance monitoring of the entire network.
- Control and Configuration:
    - On/Off and Lighting Level Control: Allows for remote control of individual devices or groups, enabling turning lights on/off and adjusting brightness levels.
    - Scheduling: Supports scheduling of lighting profiles to optimize energy usage and adapt to changing conditions.
    - Event-Triggered Actions: Enables real-time responses to events such as motion detection or environmental changes.
- Access Control:
    - User Authentication: Enforces user authentication and authorization to ensure secure access to the CMS.
    - Role-Based Access Control: Assigns different levels of access and permissions to users based on their roles within the organization.
- Data Analytics and Reporting:
    - Data Collection: Gathers historical data from devices for performance analysis and trend identification.
    - Data Visualization: Presents data in graphical formats for interpretation by the user.
    - Custom Reports: Allows users to create custom reports for specific performance metrics or KPIs.
    - Energy Measurement: Meter grade measurement of energy consumption.
- Fault Detection and Management:
    - Automated Diagnostics: detects and diagnoses faults or anomalies in devices.
    - Fault Logging: Logs and tracks fault occurrences and resolutions for maintenance purposes.
- Scalability and Integration:

- Scalability: Supports the addition of new devices and expansion of the network including the segregation of geographic regions and/or asset classes to accommodate multiple council end-users
- APIs and Integration: Provides APIs (Application Programming Interfaces) for seamless integration with other smart city systems, IoT platforms, or third-party applications.

7.3 CLIP Options

A Customer Lighting Insights Platform (CLIP) serves as the customer-facing interface. The Customer Lighting Insights Platform (CLIP), DNSP asset management system and SLCMS work together to streamline and secure the process of managing smart public lighting assets while providing a more user-friendly experience for customers. The main features of a CLIP are outlined below:

- Login and user access control.
- Project or task communications (e.g. progress on a project).
- Smart lighting commissioning and programming.
- Requests to the DNSP (such as faults, adding lights, changing control settings etc.).
- Commands to the SLCMS.
- Customer facing reporting from the SLCMS, can include energy, faults, real time data, alerts, lighting levels, compliance.
- Data Visualization: Presents data in graphical formats for interpretation by the user.
- APIs and Integration.

EQL will consider the choice of an off-the-shelf CLIP or a bespoke solution that it develops itself. There are limited off-the-shelf products available to EQL for use as a CLIP, however what is in the market offers a good range of capabilities and functionalities to suite EQL and its customers' needs. The alternative direction of developing a bespoke solution is expected to be significantly more expensive and time consuming.

8. Regulations and Standards

The key regulatory elements directing smart lighting include:

1. Australian Road lighting Standards (predominantly the AS/NZS 1158 Series)
2. AEMC metering
3. AER pricing regulations

EQL's Strategy will aim to cater for each of these elements. Each of these are discussed below.

8.1 Australian Road Lighting Standards and Smart Lighting

The Australian Road lighting Standards (AS/NZS 1158 Series) covers technical standards for approval of lighting products (in particular luminaires) as well as lighting design requirements. This includes detail of approaches to deploy when designing road lighting for adaptive lighting.

Key approaches to smart lighting and design need to be considered in any agreement between EQL and customers, in particular Road Controlling Authority (RCA). Commonly these approaches are managed through the development of operating protocols or design policies. Broad principles that underpin the EQL approach include:

- The RCA is responsible for determining lighting standards.
- EQL is not responsible for risks when an RCA elects to change lighting levels, including when switching off lighting.
- Customers are required to consider and plan for the safety and amenity implications of any change including consideration of relevant Australia Standards and local conditions and risks.
- Design and safety consideration need to be included within any relevant smart lighting policies and procedures developed for Queensland by EQL

Smart lighting design considerations include the requirements for several specific features that alter lighting and energy levels for lights. These are discussed below.

8.1.1 Constant Lighting Output

Light sources slowly depreciate over time and lighting designers produce designs with lighting levels above compliance for the majority of a luminaire's life in order to ensure compliance at end of life. Constant Light Output (CLO) reduces energy at start of life and steadily increases the energy supplied to the light over 20 years to ensure lighting levels remain consistent and at, but not above, compliance.

Relevant management considerations include:

- The RMA can request the establishment of the CLO feature

- Best Practice dictates the CLO can be utilised for any lighting that meets or exceeds relevant Australian Standards compliance levels.
- By default, CLO will not be enabled by EQL upon installation of a new smart light.

8.1.2 Dimming and Trimming

Trimming involves the reduction of over lighting above standard until lighting levels meet standards.

Dimming reduces light output for a community benefit. This can include to reduce lighting where standards allow (e.g. where traffic volumes decrease over time and lighting categories can switch from a higher to a lower category (see AS/NZS 1158 Series)), to reduce energy usage or to limit environmental impact.

Relevant management considerations include:

- The RMA can determine the dimming and/or trimming levels in accordance with relevant design policies.
- EQL will implement any request from a RCA.
- Best Practice dictates trimming can (and should) be utilised for any lighting that meets or exceeds relevant Australian Standards compliance levels to reduce glare and the negative impacts of excess light.
- By default, dimming and/or trimming will not be enabled by EQL upon installation of a new smart light.

8.1.3 Switching

Switching involves turning luminaires on or off. When there is no lighting of a road the requirements of the Australian Road Lighting Standards do not apply (AS/NZS 1158 Series).

Relevant management considerations include:

- The RMA can determine which lights are controlled in accordance with relevant design policies.
- EQL will work with customers to develop smart lighting Operating Protocol/s to clarify the process and responsibilities for control setting and management.
- EQL is not responsible for risks when a public lighting customer elects to switch off lighting. Customers are required to consider and plan for the safety and amenity implications of any change including consideration of relevant Australia Standards and local conditions and risks.
- By default on/off switching based on dusk/dawn will be enabled by EQL upon installation of a new smart light.
- In addition to switching for other reasons, on/off switching at dusk and dawn can be changed by customers should the default ambient light level be deemed insufficient (e.g. light spill/reflection is causing a feedback loop and resulting in lights switching on and off).

8.2 Regulated Tariffs

The Australia Energy Regulator (AER) is the economic regulator responsible to review the appropriateness of EQL's proposed 2025-30 public lighting expenditure, tariffs and charges, including smart lighting. This Strategy is intended to inform and support EQL's proposed smart lighting expenditure and charges and will be used as key reference during our customer engagement.

8.3 Metering

Australian Energy Market Commission (AEMC) has released a Directions Paper[5] setting out its initial views on opportunities to improve how energy use is measured for public lighting and other street furniture (such as park BBQs). This outlines some key elements in how smart metering can be approved for use as a meter and customers can have cost reflective electricity bills as a result. The Draft Determination is expected to occur on February 29th 2024. The elements discussed are outlined below:

- The reform appears likely as the AEMC states: "Overall, stakeholders see value in capturing the energy flows of public lighting and public furniture through a new physical meter framework, with a stakeholder noting a trial implementation may be practical before any rule changes take effect."
- Operational requirements and market arrangements including the providers of relevant system roles including Metering Coordinators, Metering Providers, and Metering Data Providers. Initial indications are that the DNSP can provide this role or external metering providers.
- AEMO proposes that minor energy flow meters should be exempt from requirements to meet the minimum services specification in NER schedule 7.5.
- Proposes changed arrangements for the testing and inspection of metering devices/system to avoid undue cost. An option could include MCs proposing remote inspection and testing capabilities within their asset management Plans.
- The proposed framework is forward-looking only and switching to smart lighting non-mandatory.

EQL propose an approach whereby the smart lighting system is built by July 2026. Smart metering is likely to be provided by approved metering providers with which EQL will cooperate to ensure customers can access these services. EQL will consider the value in providing these services to customers once the AEMC ruling is released and during the 2025-230 regulatory period.

[5] https://www.aemc.gov.au/rule-changes/unlocking-CER-benefits-through-flexible-trading

9. Governance

It is important to consider not only the technical and functional aspects of a smart lighting system but also how EQL's customers will interact with and harness its capabilities. This Governance section explores the relational aspects of the management model and operating protocols, acknowledging that the success of EQL's smart lighting system hinges not only on the technology itself but how EQL and customers will interact and collectively work with the system.

Two critical elements for the governance of a smart lighting system are outlined. Determining the details of each of these elements form important steps in the delivery of EQL's smart lighting strategy.

- **Management Model** - refers to the specific approach adopted for overseeing, controlling, and administering a smart public lighting system. It encompasses the key principles, roles, responsibilities, and processes that govern how the system is managed and operated.
- **Operating Protocol** - An operating protocol outlines the specific procedures, rules, and operational details that govern the implementation and execution of a chosen management model within a smart lighting system. It serves as a practical guide for users, detailing how the management model is practically applied. This can be formalised into a series of policies and procedures.

The section explores a spectrum of customer access options, from limited read-only access to comprehensive access that would allow real time control of public lighting. Ultimately, by fostering a governance framework that balances security, usability, functionality and customer preferences, EQL aims to maximise the usability, value and impact of our smart lighting system for end-users while ensuring that keys risks are mitigated.

9.1 Management Model Options

There are three main management model options currently being employed by DNSPs in Australia for smart lighting systems. The approach taken by Energex and Ergon will need to be confirmed via the delivery of this Strategy and ratified within an Operating Protocol. Table 3 provides a summary of the key features of each of the three options to be explored by EQL. EQL's current preference is to pursue Option 1.

These approaches are relevant for any smart lighting framework, however Table 3 has been completed assuming that EQL owns and maintains the assets (as outlined in Section 6) whilst the customer (when the RCA) is responsible for establishing lighting levels. These options can be tailored to suit the specific needs of EQL and its customers. Each option should be considered as a guide to the main options that are available rather than a prescriptive framework.

Within the three management model options, two separate but integrated software platforms are discussed:

- **Customer Lighting Insights Platform (CLIP):** CLIP is a type of platform designed as a customer interface to the smart lighting system. It commonly will assist the customer address resident concerns, manage the design and commissioning of smart lighting, and ensure compliance with road safety standards. It seamlessly integrates with the Smart Lighting Control Management System (SLCMS) to access lighting data, issue commands, and generate reports. Whilst the primary user of a CLIP is EQL's customers, it is also valuable for customer service and support roles, such as lighting designers, bulk change coordinators, or audit project managers.
- **Smart Lighting Control Management System (SLCMS**): SLCMS is software designed for sophisticated asset managers. It connects the light point controllers and the network communications infrastructure to provide control, customization, and monitoring capabilities for individual public lights or groups of public lights within a smart lighting infrastructure. It is the default means through which asset managers are able to interact with smart public lights. It primarily serves sophisticated and regular users, particularly lighting asset owners responsible for maintenance and overseeing the smart lighting system.

Table 3: Management model options

	Option 1: Customer Lighting Insights Platform (CLIP)	**Option 2: Customer read only access to smart lighting CMS**	**Option 3: Full Customer Access and Control of CMS**
Access to Smart Lighting CMS	None	Read access	Read and write access
Customer Lighting Insights Platform	Required[6]	Optional[7]	Optional[5]
Commissioning/updating of lighting control settings	Automatic	Manual	Manual
Smart Metering	TBC	TBC	TBC
Maintenance and Replacement of Smart Cells	EQL	EQL	EQL
Determining adaptive lighting levels	RCA	RCA	RCA
Approval of change in lighting levels	RMA or EQL (TBC)	EQL	RCA

To implement these approaches, an authorisation process is necessary for both customers and third parties. Customers would need to nominate specific staff members who have the authority to request actions such as adding or removing users or changing the level of access for existing users. This process helps maintain security and control.

There are four potential tiers of users depending on the option chosen above:

1. Customer account manager – has the authority to request EQL to add/remove users or change the level of access an existing user has.
2. Read only user – has the ability to view and download data.

[6] Could consider read only access to CMS for sophisticated customers as well as CLIP.

[7] CLIP avoids manual processes for requests and scheduling changes. Without CLIP manual processes need to be used.

3. Read and write user (asset information) – has the ability to view and download data and edit asset information, this can be limited to particular data (like constant light output functions).
4. Read and write user (lighting programming) – as per 3. above, with the additional ability to program and control light levels and switching.

The three management model options are discussed in more detail below.

9.1.1 Option 1: Customer Lighting Insights Platform (CLIP)

In this option, which is EQL's preferred option, the CLIP and SLCMS work together to streamline the process of managing smart public lighting assets while providing a more user-friendly experience for customers.

Customers do not have direct access to the SLCMS, which remains the backend system for lighting asset owners. Instead, the CLIP serves as the customer-facing interface, offering intuitive and user-friendly tools for lighting design and compliance management. This makes it easier for customers to interact with and manage their smart public lighting system.

The integration of CLIP and SLCMS results in automated smart lighting programming and ongoing lighting level management. This automation reduces the need for manual intervention, making the system more efficient and responsive to changing needs.

While the initial establishment costs of the smart lighting system are lower with this option due to automation, operating costs from the software system are higher. However, these higher operating costs are offset by reduced manual resource requirements compared to other options. This can lead to long-term cost savings and improved efficiency in managing the smart lighting infrastructure.

Some sophisticated customers may also request read only access to the SLCMS for specialised viewing of individual light data.

9.1.2 Option 2: Customer read only access to smart lighting CMS

In this option, customers are granted read-only access to the SLCMS. This means they can view lighting data, asset details, and other information but cannot make changes or adjustments directly within the system. Any changes to lighting levels or asset details would need to be communicated manually by the customer to EQL.

The responsibility for implementing change requests from the customer lies with EQL. EQL would need to manually process and implement any changes requested by customers. This manual process can potentially lead to delays in addressing customer needs and could also expose EQL to risk associated with the incorrect application of customer requests.

Customers using this option are required to interact with the SLCMS, which may have a sophisticated interface. This could pose challenges for some customers who may not be familiar with the tools and systems involved. It may also require additional training or the engagement of contractors with expertise in the SLCMS.

Under this option customers are provided with access to the SLCMS as read only. Any changes to lighting levels or asset details needs to be provided manually by Council and are updated manually by EQL. Experience from other jurisdictions suggests that providing read-only access to customers may result in low usage rates. Customers may find it challenging to navigate the SLCMS or may be discouraged by the lack of direct control over lighting settings.

9.1.3 Option 3: Full Customer Access and Control of CMS

Under this option customers are provided with read and write access to the SLCMS. The customer is responsible for utilising and managing the control settings of the overall system using this sophisticated interface. This approach allows for maximum customer autonomy in managing their smart public lighting infrastructure.

This approach shifts the responsibility for the system from the service provider (EQL) to the customers. EQL's role becomes more limited to hardware-related tasks, such as replacing and installing smart nodes, and providing user access based on customer requests.

While this option offers maximum customer control, it also carries the highest risk, especially for unsophisticated users. The potential for programming errors or unintended road safety impacts exists, as users may not have the necessary expertise to manage the system effectively.

Option 3 prioritises customer autonomy and control but requires a robust authorisation process, clear user tiers, and careful consideration of the associated risks. It may be suitable for technically sophisticated customers who are willing to take on the responsibility of managing their smart public lighting system.

9.2 Operating Protocol Development

A key next step for EQL’s smart lighting strategy is the establishment of a comprehensive operating protocol. This protocol will serve as a guiding document, outlining the rules, responsibilities, and procedures governing the operation and management of our smart lighting system. It will ensure that the potential of smart lighting is harnessed effectively and responsibly.

The key items to address via the operating protocol include:

Transparency and Accountability:

At its core, the operating protocol will underscore the principles of transparency and accountability. It will define who can access the system, what they can access, and what actions they can perform.

Role-Based Access Control:

The protocol will implement role-based access control, ensuring that individuals and entities have the appropriate level of access and authority commensurate with their responsibilities. Whether it's local government staff, EQL personnel, third parts lighting designers or maintenance teams, each role will be defined and granted access accordingly.

Adaptive Lighting Guidelines:

Adaptive lighting, a hallmark of smart lighting, requires a structured approach. The protocol will delineate the conditions and criteria for adaptive lighting control. It will specify the triggers for modifying light levels and the processes that must be followed, ensuring that these adjustments align with safety, energy efficiency, and customer needs.

Data Security and Privacy:

Given the sensitive nature of data collected by smart lighting systems, the protocol will place a strong emphasis on data security and privacy. It will define data access, storage, and protection measures to safeguard against unauthorised use or disclosure.

Commissioning Responsibilities:

Smart lighting is sometimes assumed to be plug and play. However, there are key steps that should be followed during and immediately after installation of a smart PE cell to ensure the best outcomes for using a smart lighting system to its full potential. The protocol will outline the responsibilities of EQL, its customers and other stakeholders during the commissioning phase of a smart public light.

Metering Responsibilities:

We understand the importance of compliance with local regulations and industry standards. The operating protocol will address these requirements, in particular providing guidance on how to align with evolving regulations related to smart metering so that stakeholders are prepared to reap the economic benefits of adaptive lighting as soon a regulatory framework is announced by the AEMC.

Education and Training:

Explain how educations and training needs to be considered. How do councils access it? How do new staff members at councils access it. Is it paid for by EQL, built into the tariff or to be paid by councils on an as needs basis?

10. Implementation Plan

10.1 Introduction

EQL considered three approaches for smart lighting in the context of its inclusion into, or exclusion from, the 2025-30 determination period. Based on customer wishes as well as the needs of EQL, a measured transitional approach has been chosen by EQL that will see customers pay for smart cells and installation upfront on an "as requested" basis.

This section outlines the implementation plan for EQL to have a smart lighting system in place by 1 July 2026 that will allow customers to connect smart lights under this approach.

10.2 Implementation Stages

Table 4: Implementation timeline for EQL's smart lighting strategy

Stage	Element	Timing	Responsibilities
Strategy	Finalise Strategy	Late 2023	EQL – engage consultant and customers in drafting process Customers to provide input into drafting
Supplier Engagement		Mid 2024	EQL
Pilot	Identify customer/s	Early 2024	EQL and relevant customers
	Establish Project Plan	Mid 2024	EQL and relevant customers
	Design and Preparation (inc. Pilot, Management Models and Operating Protocols, consideration of integration of smart metering etc.)	Mid 2024	EQL
	Deployment	Second half 2024	EQL
	Reporting/learning	Early 2025	EQL and relevant customers
	Redrafting/edits to Strategic Approach	Mid 2025	EQL
System Establishment	Management model	Mid to late 2024	EQL
	Operating Protocol	Mid to late 2024	EQL
	System Build, digital integration	2025	EQL and smart systems providers
	Infrastructure Preparation	2025 onwards	EQL
	System testing, work instructions & training	Early 2026	EQL and smart systems providers
Customer materials & engagement	Stakeholder Engagement	Ongoing	EQL
	Training	First half 2026 onwards	EQL and smart systems providers

Transition to BaU	Established	July 2026	EQL
	Internal Stakeholder Upskilling	Early 2026 onwards	EQL and smart systems providers
	Monitoring and evaluation	July 2026 onwards	EQL

10.3 Pilots and First Deployments

Pilots and first deployments have the potential to play an important role in informing the management model and operating protocol adopted by EQL. In addition, if smart lighting system choice is not yet made, a pilot can act as a tool to explore shortlisted options in real-world applications. EQL will seek to partner with willing customer/s to deploy smart lighting at scale (over 500 smart PE cells) so as to better understand the practicalities of its smart lighting system of choice or shortlisted systems if a selection has not yet being made. Such pilots would seek to focus on gaining knowledge on user access requirements; deployment and commissioning requirements; adaptive lighting governance; maintenance; and if applicable, smart metering responsibilities.

No pilots are currently earmarked, although opportunities may emerge in late 2023 or early 2024 via Sunshine Coast Council.

10.4 System Establishment

10.4.1 Establish Preferred Management Model and Operating Protocol

In early 2024, EQL will confirm its preferred management model from the options outlined in Section 9.1 of this document as well as drafting an operating protocol. A management model and operating protocol may not be finalised until it is tested as part of a pilot and may be adjusted based on the outcomes of a pilot and/or the specific features offered by EQLs chosen smart lighting system.

It is the intention of EQL to seek input from its customers on the final makeup of its operating protocol prior to its adoption by July 2026. Input will be sought via the Public Lighting Forum (see Section 10.5.1 for further details)

10.4.2 Procurement/Vendor Choice

The procurement process plays a vital role in firming up smart lighting system costs. As such, finalization of procurement is desired prior to final price submissions to the AER for the 2025-30 regulatory period in December 2024. EQL acknowledges that a protracted procurement process presents a risk to meeting the timelines outlined in this strategy.

As a QLD Government Corporation, EQL can take up a Standing Offer Arrangement offered by Sylvania Schreder. This is a duplicate of the arrangement between TMR and Sylvania Schreder. Taking advantage of this already established arrangement could potentially save 24 months of

market engagement and/or negotiation and is potentially an 'off the shelf' option for providing a smart lighting system offering for our customers to pilot prior to the 2025-30 regulatory period.

10.4.3 System Build and Testing

Once EQL's preferred supplier/s for its smart lighting system is procured, EQL's 'instance' of its smart lighting system will need to be built. This will largely be the responsibility of the smart lighting system vendor/s and depending on the network technology chosen, could involve either the deployment of dedicated network infrastructure in the form of gateways or leverage existing network infrastructure. Because customer uptake of smart lighting is not expected to be widespread in the first five years, leveraging existing network infrastructure (mobile networks such as 4G or NB-IoT) is likely to provide a more suitable outcome than needing to try and pre-empt demand during the build of a dedicated network.

Once built, testing will occur via small, controlled roll-outs initiated by EQL. The need for such controlled roll-outs may be negated if a pilot has already acted as a test environment for the final system build.

10.4.4 Infrastructure Preparation

As it stands, there is limited preparation required to ensure that EQL's existing physical and digital infrastructure is ready for the adoption of a smart lighting offering to its customers.

In terms of existing physical infrastructure, there are two key items required for smart lighting to operate. Number one is a luminaire with a 7-pin NEMA base and a dimmable driver. Number two is 24-hour power to the luminaire. The luminaires themselves can be installed prior to or at the same time and the smart PE cells. Central switches – that result in power to the smart PE cell being switched off during daylight hours – are more often found after smart cells have been deployed, after which EQL crews will need to evaluate the work required to eliminate the central switch.

Consultation with other Australian DNSPs about the eradication of central switches indicates that this is expected to be a minor issue, but EQL will consider the potential impacts of eliminating central switching on costs as part of the delivery of this strategy.

In terms of digital infrastructure preparation, it is not the intention of EQL to integrate its chosen smart lighting system into its existing asset management platform during the delivery of this smart lighting strategy. The complexity of integrating a smart product like this into the business at scale is easily underestimated and would potentially require ground-up builds by smart lighting vendors and asset management software providers. Further to this, there is no indication that the scale of customer-uptake required to make systems-integration viable will occur during the 2025-30 regulatory period.

10.5 Customer Materials and Engagement

10.5.1 Customer Engagement

EQL will continue to consult and inform its customers via the Public Lighting Forum. This engagement vehicle is part of EQL's Regulatory Determination Project 2025. Customers will be informed of the progress of key elements of this Strategy. This includes procurement updates, management model finalisation, operating protocol development (where input from customers will be sought), system build updates, pilot outcomes, smart metering updates and smart lighting tariff determinations.

10.5.2 Customer Training

Training of customers on how to use the smart lighting system will be carried out largely by the smart lighting system provider/s. It is yet to be determined whether training would be provided to customers within a smart lighting tariff. Due to the likelihood of training being required at different frequencies by different customers, a user pays model, whereby customers pay a fee per training sessions is potentially more equitable than smearing the costs across all customers.

10.6 Transition to Business as Usual

A smart lighting system available to use by all customers is planned to be delivered in time for the commencement of the 2025-30 regulatory period on 1 July 2026. Once this occurs, several items need to be addressed to prepare for increased uptake of smart lighting by customers over time.

10.6.1 Internal Stakeholder Upskilling

There are several key areas and roles that may require upskilling as smart lighting is adopted in increasing numbers by EQL customers. Some of the items listed below can be addressed via training, whereas some will need to be addressed via real-world learnings before being converted to internal technical manuals for use by EQL staff.

- Field Technicians and Maintenance Staff:
    - Training on the installation, maintenance, and troubleshooting of smart devices, sensors, and communication equipment.
    - Fault identification and diagnostics, enabling them to respond to system alerts and issues promptly.
    - Familiarity with the central management system (CMS) for remote control and monitoring of assets if a management model that requires EQL to program lights manually is adopted.
- Operations and Control Centre Staff:
    - Training on the CMS for real-time monitoring and control of smart devices.
    - Understanding how to analyze system data, identify trends, and respond to anomalies.
    - Troubleshooting procedures for network connectivity and device malfunctions.
- Customer Service and Call Center Staff:

- Training to assist customers or end-users with inquiries related to the smart system.
- Understanding how to query the system to provide accurate information regarding outages, maintenance schedules, or issues reported by customers.

10.6.2 Monitoring and Evaluation

There are several items that EQL intends to monitor and evaluate once a smart lighting system is offered as business as usual. These are itemised below. Notably, EQL's evaluation will not include reviewing energy savings, environmental impacts and lighting level adherence to Standards. These features of the smart lighting system will be for the customers to have carriage over.

- **Smart Cell Performance and failure rate:** Monitor failure rates of smart cells and how this compared to modelling used to establish smart lighting tariffs for the 2025-30 regulatory period.
- **Customer Satisfaction:** Collect feedback from the council and the public regarding their satisfaction with the new smart lighting system.
- **Impact on maintenance and operational processes:** Collect data (quantitative and qualitative) on how the smart lighting system improves or adversely impacts EQL processes.
- **System performance:** Evaluate the network's performance, including data reliability, communication uptime, and data accuracy.
- **Budget Adherence:** Evaluate adherence to the allocated budget, including any cost overruns or unexpected expenses not factored for in the established smart lighting tariff.

10.6.3 Future integration of digital systems

It is not the intention of EQL to integrate its chosen smart lighting system into its existing asset management platform during the delivery of this smart lighting strategy. During the 2025-30 regulatory period, however, the uptake of smarts will likely increase steadily over time. This will present EQL with the opportunity to take learnings from its monitoring and evaluation process and consider the benefits of and requirements for system integration in time for the 2030-35 regulatory period.

EQL will have a smart lighting system ready for deployment for customers by July 2026. Depending on future potential changes to the regulatory arrangements, EQL will work collaboratively with metering providers to ensure customers can access metering services for smart lighting and will consider the merits of providing smart metering services to customers during the 2025-230 regulatory period.

11. Glossary

Acronym	Full name	Description
7-pin NEMA Cell	**7-pin National Electrical Manufacturers Association Cell**	The National Electrical Manufacturers Association is an organization developed to form the technical standards for the manufacturing of electrical equipment. 7-pin NEMA Cell refers to a specific type of electrical plug and receptacle used for various smart cities applications. These connectors are designed to provide a secure and standardized way to connect electrical devices, such as for power distribution, control, or communication and smart lighting. The "7-pin" designation indicates that the connector has seven pins or terminals, which can be used for different functions such as switching and dimming.
AER	**Australian Energy Regulator**	The Australia Energy Regulator (AER) is the economic regulator responsible to review the appropriateness of EQL's proposed 2025-30 public lighting expenditure, tariffs and charges, including smart lighting.
AS/NZS 1158 Series	**Australian Road lighting Standards**	Covers technical standards for approval of lighting products (in particular luminaires) as well as lighting design requirements that inform the lighting levels and other light technical parameters required in Australian and New Zealand.
CLIP	**Customer Lighting Insights Portal**	Serves as the customer-facing interface of a smart lighting system. The CLIP, DNSP asset management system and SLCMS work together to streamline and secure the process of managing smart public lighting assets while providing a more user-friendly experience for customers.
DNSP	**Distribution Network Service Provider**	Organisations that own and control the hardware of the distributed energy network such as power poles, wires, transformers and substations that move electricity around the grid.
EQL	**EQL**	Energy Queensland is Australia's largest, wholly government-owned electricity company. They service customers and communities through their distribution businesses Energex and Ergon Energy Network, their regional Queensland retailer Ergon Energy Retail, and their integrated energy solutions provider Yurika.
IOT	**Internet of Things**	Describes the network of physical objects—"things"—that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet.
LED	**Light Emitting Diode**	

LPC	**Light Point Controller**	Most often in the form of smart PE cells in the Australian public lighting context, LPCs are essential components that sit within or attached to individual public lights. They enable local control and collect data from the public light as well as any sensors connected to the public light. LPCs are responsible for adjusting light levels and communicating with the central management system.
RCA	**Road Controlling Authority**	For the purposes of this Strategy, the RCA refers to the entity responsible for determining: the need for public lighting within a road reserve; the level of lighting that is required; and the metrics for when a public light is switched on and off, dimmed or brightened.
SLCMS	**Smart Lighting Central Management System**	Functions as the backend system used for sophisticated understanding and control of the smart system. It provides centralised control and monitoring of all connected public lights. It allows administrators and users to set schedules, configure lighting profiles, and receive real-time data from the LPCs/smart PE cells.

Appendix 1: Cost-Benefit Analysis Assumptions

System Costs

Annual costs include network and SLCMS costs. Establishment costs include LPC, design and commissioning costs. Additional labour and project costs apply if delivered as part of a standalone project.

Energy

	Optimistic	Average	Pessimistic
Retail electricity price (c/kwh[8])	25	22	19
Electricity Growth rate	2%	1%	0%
Operating cost growth rate	2%	1%	0%

Emissions

Key emissions variables are outlined below.
Australian Carbon Credit unit (ACCU) spot pricing as of 18/10/2023:
https://coremarkets.co/resources/market-prices

Emissions factor	0.88	kg/kWh
Emissions price (ACCUs)	$31.25	$ per tonne

Road Patrols

Energex patrols all roads in SEQ to check for outages. By installing smart lights on sufficient scale these patrols can be avoided. The cost of patrols is around $1.4m annually[9]. Costs from savings in the Ergon region have not been included.

Road Safety

The provision of street lighting has a direct impact on road safety. According to the Australian Government's Street Lighting and Smart Control Roadmap completed in 2016 and the Australian Road Lighting Standards (AS/NZS 1158 series), the provision of lighting reduces both the amounts and severity of traffic accidents with accidents reduced by 30% when street lighting is present. Key references include:

- The calculations consider the volume and location of accidents by state. Cost of accidents are based on BITRE (low, 2013) and TfNSW (high, 2019) research from the Australasian Transport Research Forum 2022 Proceedings 28-30 September, Adelaide, Australia. Publication website: http://www.atrf.info 1 Sizing the road crash cost iceberg Neil Douglas.
- The impact of road lighting on accidents is based on AS/NZS 1158.6.1.2:2010 C4, ""average reduction in crashes is at least 30%"".

[8] As per Ironbark business case analysis of various Queensland local government public lighting retail electricity pricing (2020-2023)
[9] Energex DRAFT Issues Paper-2020-25.

- Road accident reductions are based on fault reporting and increasing the uptime of lighting. This varies by state and based on local maintenance practices. "
- Fatalities and serious injuries take into account the significantly higher chance of fatalities on major roads.
- Derived from the economic impact based on calculating the value of accident avoidance in Queensland because of improved lighting and maintenance practices. Automatic fault identification ensures that the lighting levels are maintained for a longer portion of the year, major roads have a lesser value because of regular patrols from EQL.

Qld. Road Safety Savings	**Optimistic**	**Average**	**Pessimistic**
Major Roads (per light, p.a.)	$53.3	$39.0	$26.2
Minor Roads (per light, p.a.)	$103.5	$50.5	$16.5