

Lighting the way in South East Queensland – the Ipswich LED street lighting retrofit project

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ABSTRACT: Ipswich City Council (ICC), located within the high growth South East Queensland region, prides itself in being a forward thinking innovative council. In keeping with ICC's commitment to lead the transition towards 'A Sustainable Ipswich', Council undertook an iconic street light upgrade project in 2015. The project purpose was to trial the transition of existing street lighting service in Ipswich to a high-efficiency, environmentally friendly, low cost and superior amenity service (LED technology).

Currently there are approximately 21,500 street lights within the city, increasing at an average rate of 2.5% per year as the city is steadily growing. Over 60% of existing street lights in Ipswich are mercury vapour (MV) lamps, a very low performing street light type which is currently being phased out on an international scale due to environmental concerns. In the 2014/15 financial year, street lighting accounted for over 39% of ICC's energy usage and 65% of electricity costs. Street lighting is also considered the largest source of greenhouse gas emissions from local government in Australia, contributing 7,268 tonnes of CO₂-e in Ipswich over the last financial year.

The Ipswich LED Street Lighting Retrofit Project saw the conversion of 2,616 street lights into energy efficient LED technology, replacing all MV lights and older fluoro technology within eleven suburbs of the city. The outcomes of this project are a 74% reduction of energy usage across the project area and 428 tonnes less of CO₂-e entering the atmosphere. Measurements taken after implementation of the project indicated that there was very little difference in performance and luminance between the LED street lights and control lights, with the exception of LEDs showing higher road luminance.

This presentation will focus on sharing ICC's experiences, learnings and outcomes with implementing this project, the first of its kind in Queensland and currently one of the largest LED installation projects in Australia.

KEYWORDS: street lighting, LED, local government, retrofit, energy efficiency.

1 Introduction

The Ipswich local government area covers 1,090 km² and is located within the western corridor of South East Queensland. For many years, Ipswich has been one of the fastest growing local government areas in Queensland (having experienced an average annual growth rate of approximately 3% over the past 10 years [1]). This is expected to continue with the prediction of the city's population more than doubling over the next 15 years (from current population figure, March 2016, of 194 596 to 435 000 in 2031) [2].

Catering for high growth within a local government area provides a number of challenges for councils, as the needs of an

expanding population have to be given continued consideration in the planning and management of the city's resource consumption and associated assets.

The Ipswich LED Street Lighting Project is aligned with Ipswich City Council's (ICC) commitment to lead the transition towards 'A Sustainable Ipswich'. The project aim was to trial the transition of the street lighting service in Ipswich to a high-efficiency, environmentally friendly, low cost and superior amenity service.

1.1 Project Background

The City of Ipswich sits within the Energex electricity distribution network, which spans more than 25,000 km² throughout South East Queensland and includes over 300,000 street

lights. Approximately 6.8% of these street lights are located within the Ipswich local government area as there are currently just over 21,000 street lights across the City, increasing at an average rate of 2.5% per year as the City is steadily growing.

According to the Draft Street Lighting Strategy prepared for the Equipment Energy Efficiency Program [3], street lighting is considered the single largest source of greenhouse gas emissions from local government in Australia. In Ipswich, over the 2014/15 financial year, street lighting accounted for 39% of Council's greenhouse gas emissions, 45% of electricity usage and 65% of electricity costs.

The purpose of the Ipswich LED Street Lighting Retrofit Project was to reduce greenhouse gas emissions by increasing energy efficiency of the City's street lighting fleet.

2 Project Overview

In 2013, ICC was successful in their application for funding under the Australian Government's Community Energy Efficiency Program (CEEP) to undertake an iconic LED street lighting upgrade project within South East Queensland.

The key objectives of the program were to:

- Trial the LED street lighting technology to provide guidance for future retrofit projects within the area;
- Improve the energy efficiency of the existing street lighting network within the Ipswich City Council footprint;
- Reduce current greenhouse gas emissions, continuing Council on its way towards **A Sustainable Ipswich**, and contributing to Australia's climate change solutions; and,
- Provide leadership for LED retrofits within South East Queensland.

Approximately 12% (2,616) of the City's street lighting network was included in the project and was contained within a defined project area. The project area spans across eleven Ipswich suburbs (Figure 1) which were chosen

due to: a) low-socio economic status over parts of the area; b) being located within the same sub-catchment, and; c) being older aged suburbs with mainly over-head wiring.

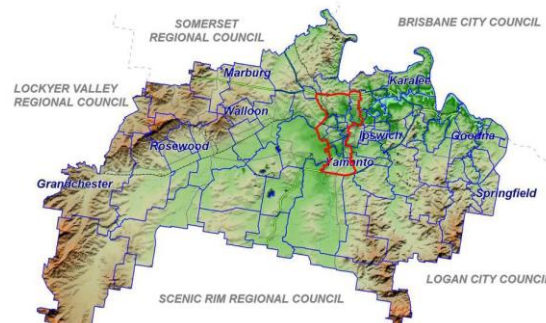


Figure 1: Ipswich local government and location of the project area

Table 1 outlines the total number of lights retrofitted plus baseline energy consumption and carbon emissions data.

Table 1: 2013 baseline energy usage and greenhouse gas emissions for project

	Number of luminaires	kWh/Year	Annual CO ₂ -e (tonnes)
TOTAL	2,616	738,332	583.28

2.1 LED Street Lighting Technology

The project focused on conducting a large scale trial using LED technology as a like for like replacement of street lights whilst maintaining existing lighting levels. A key focus of the project was to reduce current energy consumption relating to the street lighting fleet.

Majority of operating street lights in Ipswich are mercury vapour (MV) lights (61%) and are mainly used on minor roads in residential areas. Other operating street lights are predominately High Pressure Sodium (34%) with a small percentage of Fluoro, Metal Halide, Incandescent and Low Pressure Sodiums.

Not only in Ipswich, but also across Australia, the majority of minor street lights are of the MV type [3]. MV street lighting technology has been phased out in a number of countries due to its poor overall performance as well as

containing high quantities of mercury, which poses a potential threat to the environment.

LED technology is quickly becoming the preferred replacement for traditional street lights both internationally and nationally. In Australia, Victoria appears to be leading the way when it comes to swapping older street lighting technology to LEDs, with New South Wales following close behind. Queensland does not appear to have embraced the LED street lighting technology as swiftly; however, Ipswich is leading the way in South East Queensland.

Energex, in partnership with a number of local governments within their distribution area, conducted a trial of energy efficient street lighting in 2008 [4]. During this trial LED technology was deemed to perform poorly over the course of the trial, with Compact Fluorescents (CFLs) being considered the best option available as replacement for the MV lights (M50s) within residential areas. Tested LEDs were shown to perform poorly due to a number of reasons, but mainly poor light distribution and high failure rate. This has led to Energex not currently supporting the roll out of LED street lighting technology and many local governments within the distribution area are conducting large scale roll outs of CFLs.

The Ipswich LED Street Lighting Retrofit Project is therefore the first, and largest, LED street lighting bulk replacement project within Queensland. It is also one of the largest LED retrofits in Australia carried out by a single council. To be able to implement the project, Council conducted two years of negotiations with Energex for the development of an agreement which allowed the project to go ahead.

ICC progressed with the implementation of LED technology based on potential benefits of:

- Increased efficiency of street lights as LEDs emit more light per watt than most of the current street lighting technology;
- Reduction of energy consumption of approximately 60%;
- Reduced maintenance and replacement costs due to increased life span of up to 20 years;

- Reduced light pollution; and
- Reduced environmental footprint as a result of lower greenhouse gas emissions as well as the absence of mercury.

2.2 Tender Process

ICC underwent an open tender process to choose the manufacturer and contractor, where one principal contractor was engaged to manage both the supply and installation of LEDs for the project. Key requirements identified for the successful contractor were:

- Be an Energex approved contractor to undertake the installation works;
- Have the ability to comply with any relevant standards and regulations;
- Nominated luminaires would need to be tested, assessed and accepted by Energex;
- Successful luminaires would need to be included in the Australian Energy Market Operator (AEMO) load tables; and,
- Be able to provide an extended warranty and population failure clause.

There were ten proposals submitted to Council during this tender process. After an extensive evaluation process the contract was awarded to the Pensar Construction Group as the principal contractor.

2.3 Technical details

The successful tender nominate the supply LED lights to be done by Gerard Lighting.

Table 2 outlines the chosen replacement technology as well as the make-up of the trial population before the roll-out of the Project, including wattages. Figure 2 provides a visual presentation of the LED replacements chosen for the like-for-like replacement.

Table 2: LED technology used and technology replaced

LED technology	Wattage	Old technology	Wattage
Urban and Avenue LED 13W	16.4	M50 F18 F2x18 F32	61.7 28.6 43.8 36.5
Urban and Avenue LED 18W	21.9	M80	92.4
StreetLED 25W	29	M125	139.2
StreetLED 37W	42	S70	85.2
SL10 MIDI LED	107	M250	273.3

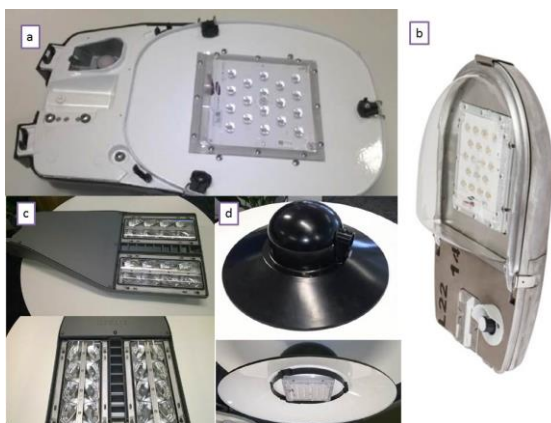


Figure 2: LED luminaires used in project: (a) Urban LED 13W; (b) StreetLED 25W; (c) SL10 Midi 107W; and (d) Urban LED 18W (Avenue)

The Urban LED and StreetLED luminaires have been specifically designed and developed for Australia's Category P public lighting requirements and in accordance with the requirements of the Australian Standard AS/NZS 1158-6 where appropriate. The Avenue LED provides similar aesthetics to the existing decorative luminaires whilst utilising the LED street light module. The luminaires were available in a range of wattages from 13W to 37W. The SL10 Midi luminaire is a high quality roadway luminaire which features a reflector type optical system to minimise glare.

2.3 Project Implementation

Installation works for the project commenced on the 3 August 2015. The contractor, Pensar,

had two mobile elevation working platforms (EWPs) on the job from the first week, with a third one brought on board in the second week. As at 28 August 2015, approximately 67% of the project had been completed. However, throughout the process it was identified that a number of street lights had been omitted from the contract schedule. In some instances, there was a single pole and sometimes several poles which were not scheduled for a LED replacement on a street located within the project area. These omissions were reported back to Council where it was discovered that the lights in question had been categorised wrongly within the initial baseline audit/data capture. This resulted in a variation being added to the existing work schedule.

Installation works of the original construction schedule was completed on 11 September 2015. Auditing of the local streets to check fixtures was then carried out over the following two weeks to identify any non-operating lights and conduct rectification works of faulty lights reported to ICC and Energex. The additional LED fittings that were identified as a variation were not able to be installed until early January 2016 as they had to be ordered, manufactured and delivered. Table 3 outlines the number of lights retrofitted.

Table 3: Number of lights retrofitted through the process on a per light type basis

Standard		High Powered			Decorative	
M	M	M	M	S	M	M
50	80	125	250	70	50	80
1808	72	40	14	6	465	201

3 Project Outcomes

The projected outcomes of this project were:

- Reduced energy usage
- Reduced greenhouse gas emissions
- Reduced maintenance requirements

Table 4 outlines the savings resulting from this project in relation to energy usage and carbon emissions. Reduced maintenance requirements have not been realised for ICC at this stage due to the need of further negotiations with the asset owner. Maintenance requirements of the LED luminaires are to be revisited once the LED technology has shown a demonstrated reduction of maintenance requirements.

Table 4: Outcomes resulting from the Ipswich LED Street Lighting Retrofit Project. Figures relate to project area only.

	Post-project	Savings	Reduction
Energy (kWh)	195,902	542,430	74%
CO ₂ -e (tonnes)	154.76	428.52	66%
Annual costs (\$)	31,167	86,297	73% (retail savings only)

3.1 Performance

Measurements of the newly installed LED lights were taken within the first three months of operation and were compared with the replaced street lighting technology of the same age. Results indicated that there was very little difference in performance and luminance between the LED street lights and mercury vapour street lights (control lights), with the exception where LED street lights showed slightly higher road luminance than the control lights. This indicates that LEDs increases the ability of approaching drivers to detect objects on the road.

Figure 3 to 6 showcases some comparison before and after photos taken from the project area.

Also of note, is that during implementation of the project, 194 shields were removed from existing street lights. None of these were re-installed during conversion to LED and only seven requests for shields have been requested by community members since the installation of the new lights.

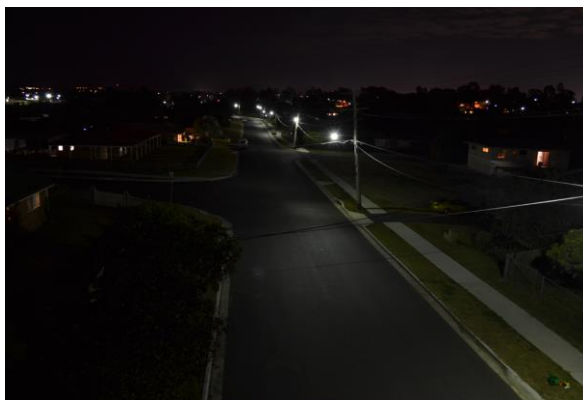


Figure 3: Before photo taken at Jacaranda Street, East Ipswich

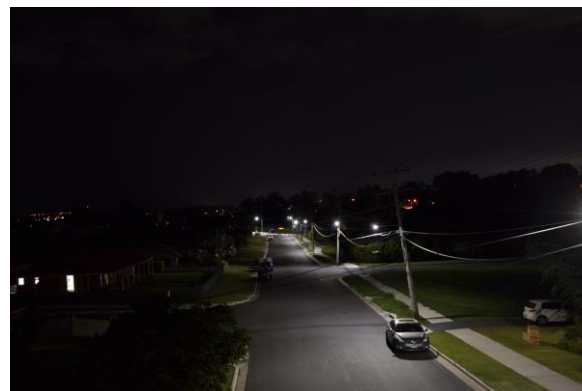


Figure 4: After photo taken at Jacaranda Street, East Ipswich

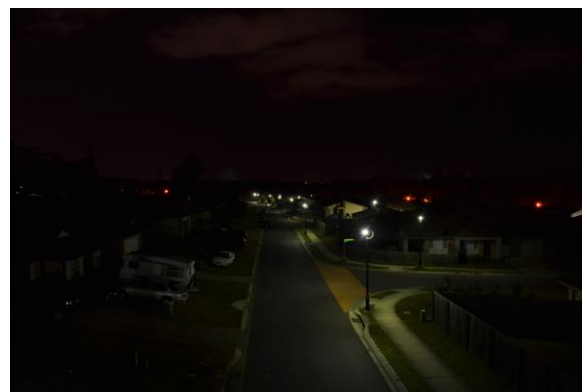


Figure 5: Before (left) photo taken at Aramac Street, Brassall



Figure 6: After photo taken at Aramac Street, Brassall

Since final installation of the lights, there has been 19 fittings repaired under warranty (0.7%), and an additional 29 lights repaired due to faulty PE cell or circuit breaker issues.

4 Project Observations

The following observations were made over the implementation of the project, leading to lessons learnt:

- Lengthy negotiations with Energex (the asset owner) to receive approval to implement the project, led to delays in project delivery.
- Approval process of the chosen LED product by Energex who underestimated the timeframes for product approval, led to further delays in project implementation.
- Miscommunications relating to the warranty and population failure clause of the contract with the supplier, led to some further negotiations required before the project could commence.
- Manufacturing lead times of LED lights was underestimated as they were made to order.
- Mislabelling of over 100 street lights in the audit process caused a variation in the contract as these lights had initially been incorrectly excluded from the project.
- Issues with some lights not being assembled correctly.
- There was an apparent lack of interest from the community in regards to receiving information in relation to the project.
- There was a huge interest from surrounding local governments relating to the project outcomes.

The key lesson learnt through these observations was to allow for more lead time if conducting a similar project in the future, taking into account manufacturing requirements and network owner negotiations.

In conclusion, project observations and outcomes has shown that LED technology brings a real cost saving. This has resulted in ICC looking at implementing LED when installing new public lighting in the future within areas not controlled by Energex.

5 Communication Activities

The project was planned with an extensive communications strategy designed to engage the local community and surrounding areas in relation to energy efficiency and improved energy management practices. In order to effectively communicate the message of energy efficiency and promote the project, ICC undertook a number of activities (Table 5).

Table 5: Communication activities undertaken in relation to project

Activity	Outcomes
Dedicated project page on the ICC website	A project webpage as well as a conserving energy webpage were established.
Media updates	Five media releases/articles posted within local media.
Information displays	One temporary LED display was available within the Ipswich Library for the 2014/15 Christmas school holiday. A permanent LED display is available at the Queens Park Environmental Education Centre.
Public surveys	Two surveys promoted via the project webpage and ICC Facebook.
Letterbox drops and community Information sessions	13,000 flyers delivered to residents within the project area.
Energy Efficiency Awareness Campaign	Household energy efficiency workshop and information sessions. Kids school holiday activity relating to energy efficiency awareness. Energy Superhero sessions delivered to create "energy efficiency heroes". Energy Efficiency Challenges via Facebook, reaching almost 5,000 people
Ipswich LED Public Lighting Forum	A half day forum attended by surrounding local government representatives, organisations and consultancies working within the field of public lighting.

During the public survey conducted after installation of the lights were finalised, community members were provided with the opportunity to give feedback to Council in relation to their personal experience with the newly installed LED street lights. On the whole, the feedback was overwhelmingly positive with comments such as:

- Great job! Love that ICC is becoming more forward thinking.
- Keeps the bug population down and saves money on electricity so dollars can be used on something else plus protect the earth.
- Great idea, do it all over.
- Put them everywhere. It brightens up the area and easier to see things. Plus looks better.
- These are great, well done!
- Great job! Leading the way in sustainability and saving energy costs for investment and maintenance in other areas. One happy rate payer among many!
- Lights are bright directly under the pole but do not shine as far as previous lights.
- I think it's a fantastic initiative!
- These lights are by far better as the old style light used to shine into our house and yard but was dull on the road. The new LED lights up the footpath and road very well and there is no light shining into our house or yard. Well done we are happy.
- Didn't know it was done until I just walked outside and looked at the light near my house.
- Great initiative!

Some of the negative comments were:

- I know a number of people who get headaches and dizzy spells from blue lights and LED lights, and I am concerned as to how this will affect their health and motoring.
- LED sucks, should go 42 CFL suburban Eco by Sylvania
- More light is on the pole than directed downwards. Causes sore eyes and distraction when driving.

Despite the project affecting a population of approximately 30,000 residents, only limited formal complaints have been received by Council since instalment of the lights. Seven

complaints were received for the lights being too bright and two complaints for the lights being too dull.

6 Conclusion

In 2013 Ipswich City Council went down the path of trialling LED technology as an alternative to traditional street lighting technology within the City. After lengthy negotiations with the area's network distributor, manufacturers and contractors, 2,616 street lights were finally upgraded to this energy efficient street lighting technology. As a result, the following outcomes are being realised:

- Reduced energy usage: The project is achieving an annual energy reduction of 542,430 kWh across the project area.
- Reduced greenhouse emissions: The project is achieving an annual greenhouse gas emissions reduction of 428.52 tonnes of CO₂ equivalent across the project area.
- Cost savings: The project is achieving an annual cost saving of approximately \$86,000 relating to energy consumption across the project area.

The project is considered a huge success, the first of its kind in Queensland and currently one of the largest LED street lighting retrofit projects in Australia.

The project also included a major community awareness and education component, aimed at raising general energy efficiency awareness across the City to lead a change towards a more energy conservation minded community.

Acknowledgements

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