Brisbane City Council

25,000 Street Lights Retrofit project

Final report
This activity received funding from the Australian Government

The views expressed herein are not necessarily the views of the Commonwealth of Australia, and the Commonwealth does not accept responsibility for any information or advice contained herein.
1. **EXECUTIVE SUMMARY**

The 25,000 Street Lights Retrofit project was a project to retrofit mercury vapour 50 Watt (M50), mercury vapour 80 Watt (M80), and twin 18 Watt fluorescent lights (2xF18) lights with more energy efficient technology.

In residential areas, 32 Watt compact fluorescent (32CFL) lights were installed. In commercial and industrial areas twin 14 Watt fluorescent (2xF14) lights were installed. The product selection was based on extensive trials of a range of options which was undertaken in a partnership between the Australian Government, Energex, South East Queensland Councils and the Queensland Government.

The project rollout occurred between April 2013 and November 2015. All retrofits were located within the Brisbane City Council local government area.

The objectives and outcomes of the project are summarised below:

<table>
<thead>
<tr>
<th>Objective</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Retrofit at least 25,000 street lights in the Brisbane area with more efficient light fittings - focussing on residential and industrial minor roads in 9 of Brisbane’s street lighting areas. Total project budget $10m</td>
<td>25,906 retrofits completed for $8,955,560</td>
</tr>
<tr>
<td>2. Improve energy management practices by introducing the use of two energy efficient technologies into the Energex network</td>
<td>Achieved</td>
</tr>
<tr>
<td>3. Reduce electricity costs (including energy and network costs) by approximately $500,000 in the first year</td>
<td>Savings of $530k per annum</td>
</tr>
<tr>
<td>4. Achieve at least the same lighting levels as existing lights</td>
<td>Lighting levels are brighter and have a better distribution pattern</td>
</tr>
<tr>
<td>5. Improve knowledge of energy efficient street lighting and capacity to deliver it within South East Queensland</td>
<td>Council, Energex and the Energex subcontractor all improved their knowledge of and capacity to deliver energy efficient street lighting in South East Queensland</td>
</tr>
<tr>
<td>6. Demonstrate sound energy management to the Brisbane community (through community education, information and media opportunities)</td>
<td>Achieved</td>
</tr>
<tr>
<td>7. Provide early action in relation to the removal of mercury vapour lighting ahead of potential future regulatory changes</td>
<td>Achieved</td>
</tr>
</tbody>
</table>
The project encountered a small number of implementation issues, however these were easily managed without changing project schedule, scope or budget. Examples of issues encountered include cars parked in locations that made cherry picker access for retrofits difficult, and some database errors which meant that certain sites which were targeted for a retrofit could not be retrofitted.

Some of the success factors were:

- Careful project design made delivery much easier
- Strong relationships and good communication
- Excellent partnership with Energex
- Rigorous monitoring and verification of energy savings.

2. PROJECT OBJECTIVES

The objectives of the project were to:

- Retrofit at least 25,000 street lights in the Brisbane area with more efficient light fittings - focusing on residential and industrial minor roads in 9 of Brisbane’s street lighting areas (National Metering Identifier Areas)
- Improve energy management practices by introducing the use of two energy efficient technologies into the Energex network
- Reduce electricity costs (including energy and network costs) by approximately $500,000 in the first year
- Achieve at least the same lighting levels as existing lights
- Improve knowledge of energy efficient street lighting and capacity to deliver it within South East Queensland
- Demonstrate sound energy management to the Brisbane community (through community education, information and media opportunities)
- Achieve early action in relation to the removal of mercury vapour lighting ahead of potential future regulatory changes.

It should be noted that the maintenance costs of the retrofitted lights (CFL32 and 2xF14) are charged to Brisbane City Council at the same rate as the maintenance costs for mercury vapour technology. This means that the project did not have the objective of reducing maintenance costs for Council.

3. PROJECT ENERGY EFFICIENCY ACTIVITIES

3.1 Location of works

Council’s streetlights are billed in blocks based on location. There are 14 different areas known as National Metering Identifier (NMI) areas for streetlights within the Brisbane City Council local government area. A NMI area for streetlights is designated using a 10 digit code followed by a checksum value. Each NMI area also has a 4 letter code. The following 9 NMIs were targeted for retrofitting lights:

- 31950010046 / QCBW
- 31950010079 / QBMH
- 31950000285 / QRBS
These particular NMIIs were chosen based on Energex analysis to determine the most efficient process for project rollout. Specifically, NMIIs with higher densities of M50 lights were chosen. Because nostalgia and avenue type M50 lights were more expensive per light, the number of nostalgia and avenue lights within the chosen NMIIs was also considered.

It is important to note that only M50, some M80, and 2xF18 lights on minor roads were retrofitted. Not every light in every street was retrofitted.

M80 lights were only retrofitted where streetscapes and lighting levels allowed, as the 32CFL light has a slightly lower light output when compared to an M80. About 1,200 M80 lights were retrofitted.

3.2 Technologies used

Suburban 32CFL compact fluorescent lights were deployed in residential areas. This was due to the more suitable light distribution pattern of the 32 Watt suburban fitting. A variation of the suburban 32CFL fitting is the aeroscreen 32CFL, which has a different light distribution pattern that can be more appropriate in certain glare sensitive installations. Some nostalgia and avenue type M50 fittings were also included in the retrofit project. These fittings had internal components replaced with 32CFL technology without changing the external appearance of the fitting. In commercial and industrial areas, 2xF14 fittings were chosen.
3.3 Technology choice

The South East Queensland Energy Efficient Streetlighting trial report contains detailed analysis and recommendations in relation to the technology options for retrofitting M50 lights on minor roads in South East Queensland.

The trial report recommends 32CFL lights for residential areas, and 2xF14 for commercial and industrial areas. This is the technology that was deployed through the project.

The trial report noted that the 32CFL lights provided higher lighting levels than the M50 lights they replace. There is a 26 Watt compact fluorescent light available which is more closely matched to the light output of the M50, however this light did not perform well enough in the trial.

3.4 Site specific implementation issues and solutions

The project was initially designed to retrofit all M50 lights within the targeted NMLs for the following reasons:

- inventory changes could be more easily monitored
- better maintenance and spares management in the areas where the retrofits were undertaken
- bulk retrofits were more cost effective than spot retrofits
- communication with residents and businesses in the areas where works were occurring could be delivered more effectively.

As the project rolled out, it transpired that it was more efficient not to retrofit every single M50 in an area. The reasons for this are outlined in the ‘difficulty completing some retrofits’ section below.

3.4.1 Difficulty completing some retrofits

Some sites were more difficult than others to retrofit. The reasons for certain sites being more difficult included encountering parked cars in locations that made cherry picker access a challenge, vegetation obstructions, and some terrain was not suitable for cherry pickers to set up.

The solution for sites that were difficult to retrofit was to undertake an equivalent retrofit in another location rather than spend additional time to retrofit the light originally targeted. This means that the overall outcome was still achieved without spending an inordinate amount of time to retrofit the more challenging sites and allowed the same number of retrofits to be completed without impacting significantly on the project cost.

Solutions which considered the overall project outcome rather than a more narrow focus on the immediate problem allowed overall project outcomes to be achieved despite challenges with specific sites.

3.4.2 Light spill

A small number of retrofits required followup investigation by Council officers to assess light spill onto private property. In limited instances the investigation found that a shield could be installed or the luminaire changed to reduce unwanted light spill. A shield or other similar intervention was required in less than 0.3% of all retrofits, which is a low rate and probably reflects the fact that light spill and glare were carefully considered as part of the product selection.

3.4.3 Database accuracy

Two types of database issues were encountered during the project.

1) When workers arrived on site to complete a retrofit they sometimes found that the light on a particular pole didn’t match the database information. For example some sites may have been listed in the database as M50, but on site there was a Sodium Vapour 70 Watt light. Sodium vapour lights were not targeted for retrofitting so
these sites did not receive a retrofit. Where database errors existed, they were rectified as part of the project.

2) As the project rolled out, some database updates did not occur smoothly. Council carefully monitored the changes to the database so these discrepancies were identified and worked through. These discrepancies may have gone unnoticed if Council had not monitored the energy savings from the project so closely.

Careful monitoring and verification of savings was an important part of the project management process.

4. COMMUNICATIONS ACTIVITIES

4.1 Communications activities

As part of the project design, a communication strategy was developed. This strategy had the following structure:

- Objectives
- Issues
- Target audiences
- Key messages
- Strategies
- Tactics
- Timing

4.1.1 Target audience

The primary target audience was residents, businesses and industry in the streets being retrofitted.

The secondary target audience was the broader Brisbane community.

4.1.2 Key messages

The key messages from the communication strategy were as follows:

- Brisbane City Council has been awarded a $5 million grant from the Australian Government to install energy-efficient street lighting. Council will match this contribution so that 25,000 street lights can be retrofitted.
- Council will work with Energex to deliver the 25,000 street lights program.
- The project will achieve the following:
  o The new lamps will use 40% less electricity than the ones they replace
  o Reduce Council’s overall electricity consumption by 2.5%
  o Save $500k per annum in energy and maintenance costs to Council
  o The new lights will improve light levels, which has safety benefits.
- The retrofitting works will start late March 2013 and are expected to be completed by late 2014.
- Installing energy-efficient street lighting reduces Council’s energy consumption and greenhouse gas contribution, and is another way Council is growing a clean, green Brisbane.
For more information on Council’s 25,000 Street Lights project visit www.brisbane.qld.gov.au

4.1.3 Tactics

The tactics used included the following:

- Green Heart Fair stalls showcasing the project and providing an opportunity for residents to speak with Council officers about the project
- Project details on Council website
- Flyers were distributed to residents in the areas where works were occurring.
- Project specific press advertisements were published in local papers in the parts of the city where the project was rolling out
- Translation of communication materials into languages other than English for certain parts of the city
- Media releases
- Social media announcements
- Living in Brisbane articles
- Green Heart Life articles
- Magnets on trucks undertaking the works
- Banner displays in libraries
- Reference the project in Council’s annual report.

5. OUTCOMES AND BENEFITS OF THE PROJECT

The project met or exceeded all of its objectives. It exceeded the minimum number of retrofits, achieved the rollout for about $1m less than the allocated budget and achieved energy savings that exceeded the forecast both in terms of energy saved (kWh) and value ($). The retrofitted lights resulted in brighter lighting levels and improved light distribution patterns. The project also laid the foundation for future installations of white light on minor roads to be compact fluorescent rather than mercury vapour technology.

5.1 Contribution to the Community Energy Efficiency Program objectives

The CEEP objectives as identified in the funding agreement between Brisbane City Council and the Australian Government were:

- Support a range of local councils and community organisations increase the energy efficiency of different types of non-residential council and community-use buildings, facilities and lighting; and
- Demonstrate and encourage the adoption of improved energy management practices within Councils, organisations and the broader community.
These objectives were met in the following ways:

The energy efficiency of Brisbane City Council’s streetlighting was improved.

The project provided the foundation for future lighting installations on minor roads to use compact fluorescent technology rather than mercury vapour.

5.2 Energy efficiency outcomes

5.2.1 Forecast savings

Prior to project commencement, the forecasted energy savings were about 2,491 MWh and $500k per annum.

5.2.2 Savings achieved

Using some conservative assumptions, the project achieved annualised energy savings of 2,781 MWh, and cost savings of $530k per annum. For the portfolio of lights retrofitted, the baseline energy consumption was reduced by 40%.

The Brisbane City Council contribution to the project was about $4,465,000. This means that the project achieved a simple payback of about 8.4 years for Council.

5.2.3 Measurement issues

The savings reported are based on the electricity consumption of the portfolio of lights before and after the project. During the period that the project was rolled out, there was some growth in the number of lights in the 9 NMI areas targeted for retrofits. The savings are therefore slightly understated.

5.3 Other outcomes and benefits

Countries that ratify the Minamata convention agree to phase out mercury vapour technology by 2020. Australia is a signatory to the convention, but has not ratified it at the time of writing. The retrofit project brought forward the removal of a significant proportion of lamps with high mercury content from Council’s inventory.

Although there was a small number of cases where residents noticed a change in the light distribution and requested a Council officer investigate, the outcome of the retrofit project was that the in-built shielding in the suburban and aeroscreen light design means that overall a better light distribution pattern was achieved. In addition to an improved light distribution pattern, the lighting levels achieved are also slightly brighter.

Although it was not an intended outcome of the project, another benefit of the project is that it allowed the accuracy of the Energex database to be verified and provided a clear process to update the database where necessary. A more accurate database supports improved asset management efficiency as well as billing accuracy.

For the street lights targeted as part of this project, Council pays Energex a monthly maintenance charge for each streetlight. Council pays the same maintenance charge per
light regardless of whether it is a mercury vapour or compact fluorescent light. The retrofit project therefore did not involve any change in maintenance costs for Council.

5.4 Communication outcomes

5.4.1 Flyers

More than 200,000 flyers were distributed to residents and businesses in the areas where the project was rolled out.

5.4.2 Community feedback

The stalls held at Council’s Green Heart Fair events provided an opportunity for the Lord Mayor of Brisbane to promote the benefits of the project to residents, and also gave residents the opportunity to discuss energy efficient streetlighting in general and the project specifically with Council officers.

The most commonly asked question was “why did the project use compact fluorescent technology rather the LED?” The answer is that the technology selection process was based on a rigorous trial of different technologies. The trial determined that 32CFL was the most appropriate technology for residential areas and 2xF14 was the most appropriate for commercial and industrial areas.

5.5 Contribution to broader uptake of energy efficient streetlighting

Since the rollout of the project Energex no longer deploys new rate 1 M50 lights on minor roads. Energex continues to hold spare parts to maintain existing M50 lights, but does not deploy new M50 lights any more. Council has also changed its requirements so that new rate 2 lights do not use M50 technology either. This means that the more efficient technology has now become business as usual for rate 1 and 2 street lighting in the Brisbane local government area.

5.6 What opportunities has the project provided for local industry?

The lights were manufactured in Australia.

The subcontractor who installed the lights was a local company based in South East Queensland.

6. BUDGET

The allocated budget for the project was $10,000,000.

The target number of retrofits under the funding agreement was ‘at least 25,000’.

The target number of retrofits under the contract between Council and Energex was ‘at least 25,114’.

The project was completed for $8,955,560 and 25,906 retrofits were completed.
The budget breakdown was as follows:

<table>
<thead>
<tr>
<th>Item</th>
<th>Total allocated (based on funding agreement for $10m project)</th>
<th>Total spent</th>
<th>Council contribution spent</th>
<th>Australian Government contribution spent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project management, contract management, audits and reporting</td>
<td>290,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communications (flyers, press advertisements etc)</td>
<td>130,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contract with Energex</td>
<td>9,580,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$10,000,000</strong></td>
<td><strong>$8,955,560</strong></td>
<td><strong>$4,477,780</strong></td>
<td><strong>$4,477,780</strong></td>
</tr>
</tbody>
</table>

6.1 **Unexpected costs and unexpected savings**

The contract between Council and Energex was for $8,676,391.82 plus GST, representing a significant saving from the allocated budget. A small number of subsequent variations to the contract between Council and Energex amounted to less than 1% of the project value. These costs were easily covered within the allocated budget.

6.2 **Value for money**

The project achieved increased lighting levels, improved light distribution patterns, and reduced energy consumption. The project has a simple payback of about 8.4 years for Council.

7. **PROJECT OPERATION, MECHANISMS AND PROCESSES**

The project was managed by a project manager within the Energy and Carbon team of Brisbane City Council's Natural Environment, Water and Sustainability Branch. Paul Brisbane was the project manager. Michael Arens performed a project director function for Council.

On-ground works were completed under a contract between Energex and Council. Energex subcontracted the on-ground works to a subcontractor.

Council managed the communication aspects of the project in-house, with the assistance of contractors for printing and distributing flyers.

Council’s project manager reported on time, budget and scope issues to a project control group on a monthly basis in accordance with Council’s project governance requirements.
7.1 **Productive relationships**

The success of the project was partly due to the flexible and productive working relationship between Council, Energex and the Energex subcontractor. Regular communication by email and phone, as well as occasional face to face meetings meant that the working relationship was open and always with a focus on ensuring project success.

7.2 **Focussing on the overall outcome**

Whenever issues arose, Council’s project manager approached the challenges in terms of ensuring the overall project achieved its objectives, rather than focussing too closely on the specific issue at hand. Examples of this include allowing flexibility in the delivery schedule and location of individual retrofits, so long as milestones and overall numbers of retrofits were still achieved.

7.3 **What lessons has the organisation taken away from this project?**

When a project involves a large number of repetitions of the same or similar action, careful project planning upfront contributes to a successful outcome.

Regular and early monitoring of the project rollout to ensure any issues are resolved before they are repeated across significant numbers of retrofits helps keep a project like this on track.

Monitoring and verification of savings was an important part of the project management process.

8. **CONCLUSION**

As detailed in the table below, the project achieved or exceeded all of its objectives, delivering 25,900 retrofits at a total cost of $8,955,560.

<table>
<thead>
<tr>
<th>Objective</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Retrofit at least 25,000 street lights in the Brisbane area with more</td>
<td>25,900 retrofits completed for about $8,955,560</td>
</tr>
<tr>
<td>efficient light fittings - focussing on residential and industrial minor</td>
<td></td>
</tr>
<tr>
<td>roads in 9 of Brisbane’s street lighting areas.</td>
<td></td>
</tr>
<tr>
<td>Total project budget $10m</td>
<td></td>
</tr>
<tr>
<td>2. Improve energy management practices by introducing the use of two</td>
<td>Achieved</td>
</tr>
<tr>
<td>energy efficient technologies into the Energex network</td>
<td></td>
</tr>
<tr>
<td>3. Reduce electricity costs (including energy and network costs) by</td>
<td>Savings exceeded $500k per annum</td>
</tr>
<tr>
<td>approximately $500,000 in the first year</td>
<td></td>
</tr>
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<tr>
<td></td>
<td>distribution pattern</td>
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<tr>
<td>lighting and capacity to deliver it within South East Queensland</td>
<td>subcontractor all improved their knowledge of and capacity to deliver energy efficient street lighting in South East Queensland</td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------</td>
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<tr>
<td>7. Provide early action in relation to the removal of mercury vapour lighting ahead of potential future regulatory changes</td>
<td>Achieved</td>
</tr>
</tbody>
</table>

In addition to achieving the project objectives, the Community Energy Efficiency Program objectives were also achieved as follows:

- The energy efficiency of Brisbane City Council’s streetlighting was improved.
- The project provided the foundation for future lighting installations on minor roads to use compact fluorescent technology rather than mercury vapour.

Success factors included the following:

- careful project planning
- technology selection based on extensive trials
- strong and productive relationships between delivery partners
- early and regular monitoring of project rollout to avoid future issues and identify opportunities for improvement
- rigorous monitoring and verification of energy savings.

The success of the project demonstrates the capacity of Brisbane City Council and Energex to deliver large projects to improve the energy efficiency of streetlights.

Given that energy efficient streetlighting technology is developing rapidly, the most valuable learnings from this project probably lie in the principles and project processes applied rather than the specific technology that was deployed in this instance.
DECLARATION

The Authorised Officer of the organisation makes the following declarations:

☑ I declare that I am authorised to submit this Final Report (including any attachments) on behalf of
   BRISBANE CITY COUNCIL

☑ I declare that the information provided in this Final Report is true and accurate.

☑ I understand, and acknowledge that giving false or misleading information in this Final Report is an offence

☑ I understand that final payment will only be made in accordance with the Funding Agreement including on
   satisfactory completion of Milestones.

Authorised Officer Signature: ___________________________ Date: 16/12/2015

Name: HAMISH BELL
Position: ACTING SERVICE DELIVERY MANAGER, ENERGY AND CARBON
Organisation: BRISBANE CITY COUNCIL

Witness Signature: ___________________________ Date: 16/12/2015

Name: VICKY PETTERSON
Position: SENIOR PROGRAM OFFICER, CARBON POLICY AND ADMINISTRATION
Organisation: BRISBANE CITY COUNCIL

The use and disclosure of information provided in this Final Report is regulated by the relevant provisions and penalties of the Public
Service Act 1999, the Privacy Act 1988, the Freedom of Information Act 1982, the Crimes Act 1914 and the general laws of the
Commonwealth of Australia.

Information contained in the Final Report may be disclosed by the Department for purposes such as promoting the program and reporting
on its operation and policy development. This information may also be used in answering questions in Parliament and its committees. In
addition, the selected project information will be made publicly available. Public announcements may include the name of the grant
recipient and of any project partners; title and description of the project and its outcomes; and amount of funding awarded.
# Project Energy Efficiency Improvement Report

<table>
<thead>
<tr>
<th>PROJECT TITLE</th>
<th>25,000 Street Lights Retrofit Project</th>
<th>PROJECT ID</th>
<th>CEEP1175</th>
</tr>
</thead>
<tbody>
<tr>
<td>FUNDING RECIPIENT</td>
<td>Brisbane City Council</td>
<td>DATE</td>
<td>13 May 2015</td>
</tr>
</tbody>
</table>

## Street Lighting Retrofit

**Brisbane street lighting network**

Council’s Street lighting network is divided into 14 main billing areas. Each billing area is identified by a unique National Meter Identifier (NMI) number as well as a designated 4 letter alpha code. The street lighting retrofit program targeted mercury vapour 50 Watt (M50) lamps in 9 identified NMI areas.

### Location (NMI areas)

- 31950010046 / QCBW
- 31950010079 / QBMH
- 31950000285 / QRBS
- 31950000252 / QRLE
- 31950010105 / QABM
- 31950000327 / QTNS
- 31950000244 / QSUM
- 31950000311 / QBBS
- 31950000260 / QRLD

### Type of plant

M50 lamps plus a small quantity of twin fluorescent 18 Watt lamps (F2x18) and mercury vapour 80 Watt (M80) lamps were replaced with twin 14 Watt fluorescent lamps (F2x14) or 32 Watt compact fluorescent lamps (CFL32) depending on the most appropriate technology for the location. Generally, CFL32 lights were installed in residential areas, and F2x14 lights were installed in industrial and commercial areas.

### Activity Type and Measure

The activity was a streetlight retrofit. The measure used is both the number of retrofits completed, and the energy savings achieved. Energy savings are measured in both kWh and dollars.

### Energy Efficiency Estimate Method

Street lights are unmetered and the electricity consumed is calculated using the deemed wattage of the individual lamp and the number of hours that they are operated in each period (typically 4,342 hours per year). The deemed wattage includes the light fitting and associated ballast losses.

*The Australian Energy market Organisation (AEMO) National Electricity Market Load Tables For Unmetered Connection*
Points lists the deemed wattage of various lamps types used in Queensland. Deemed wattages for the various light types are summarised below:

Lamps that were removed:
- M50 – 61.7 Watts
- F2x18 – 43.8 Watts
- M80 – 92.4 Watts

Lamps that were installed:
- CFL32 – 36.6 Watts
- F2x14 – 35.6 Watts

The annual savings attributable to the project are determined by the difference in deemed consumption (kWh) between the pre-retrofit portfolio of M50, 2Fx18 and M80 lights and the post retrofit portfolio of M50, M80, 2xF18, CFL32 and F2x14 lights.

Prior to commencement of the retrofit project, there were only 29 lights in the network that were either 32FCL or F2x14.

For the majority of lamp replacements the energy saving was 40.68% or (61.7 - 36.6) Watts x 4,342 hours per year = 108.5 kWh per retrofitted lamp per year.
Baseline Energy usage

The baseline energy usage was as follows:

<table>
<thead>
<tr>
<th>Technology</th>
<th>Number of lamps within the NMI areas where the CEEP project was implemented (March 2013 inventory)</th>
<th>Deemed Wattage</th>
<th>Deemed annual consumption (kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M50</td>
<td>23897</td>
<td>61.7</td>
<td>6,402,040</td>
</tr>
<tr>
<td>M80</td>
<td>1542</td>
<td>92.4</td>
<td>618,652</td>
</tr>
<tr>
<td>2Fx18</td>
<td>4031</td>
<td>43.8</td>
<td>766,614</td>
</tr>
<tr>
<td>32CFL</td>
<td>2</td>
<td>36.6</td>
<td>318</td>
</tr>
<tr>
<td>2Fx14</td>
<td>27</td>
<td>35.6</td>
<td>4,174</td>
</tr>
<tr>
<td>TOTAL</td>
<td>29,499</td>
<td></td>
<td>7,791,797</td>
</tr>
</tbody>
</table>

In terms of watts per square metre illuminated to the Australian Standard, the baseline energy intensity is 0.0354076963821596 watts per square metre (61.7 watts illuminates 1742.559 square metres).
### Energy Efficiency Improvement

The post project energy usage is as follows:

<table>
<thead>
<tr>
<th>Technology</th>
<th>Number of lamps within the NMI areas where the CEEP project was implemented (February 2015 inventory)</th>
<th>Deemed Wattage</th>
<th>Deemed annual consumption (kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M50</td>
<td>2932</td>
<td>61.7</td>
<td>785,487</td>
</tr>
<tr>
<td>M80</td>
<td>306</td>
<td>92.4</td>
<td>122,767</td>
</tr>
<tr>
<td>2Fx18</td>
<td>386</td>
<td>43.8</td>
<td>73,409</td>
</tr>
<tr>
<td>32CFL</td>
<td>25860</td>
<td>36.6</td>
<td>4,109,599</td>
</tr>
<tr>
<td>2Fx14</td>
<td>473</td>
<td>35.6</td>
<td>73,114</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>29,957</strong></td>
<td></td>
<td><strong>5,164,377</strong></td>
</tr>
</tbody>
</table>

There were some changes to the portfolio of lights due to activities other than the CEEP project. This means that although the above numbers provide an approximate overview of the savings achieved, more detailed analysis was required to improve the level of confidence.

Based on the more detailed analysis, there were 26,305 32CFL or F2x14 lights installed in the NMI's where the CEEP project was implemented. Of these, 25,906 were due to the CEEP project. Across the 26,305 installations, a demand reduction of 650kW was achieved. This equates to an average of 24.7 Watts reduction per retrofit.

For the vast majority of lamp replacements (from M50 to 32CFL) the energy efficiency improvement was 40.7%.

In terms of annual energy savings, the more detailed analysis (attached) found that the savings directly attributable to the CEEP project are about 2,781,723 kWh per annum (using some conservative assumptions).

In dollar terms, the annual cost savings directly attributable to the CEEP project are $529,785.17 (based on current electricity tariffs and GreenPower costs).
<table>
<thead>
<tr>
<th>Reporting Data (Measuring Energy Efficiency and Additional Data)</th>
<th>In terms of watts per square metre illuminated to the Australian Standard, the post project energy intensity is 0.0186775193600653 watts per square metre (36.6 watts illuminates 1959.575 square metres).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of Activity</td>
<td>About $8,930,000</td>
</tr>
<tr>
<td>Estimated Cost Savings</td>
<td>$530,000 per annum based on current electricity tariffs and GreenPower costs.</td>
</tr>
</tbody>
</table>