CEEP2182 – City of Greater Dandenong
– “Light Up Greater Dandenong
Energy Efficient Street Lighting Bulk
Conversion” Project

FINAL PROJECT REVIEW REPORT

May 2016

This activity received funding from the Australian Government.
Prepared for
City of Greater Dandenong

<table>
<thead>
<tr>
<th>Version</th>
<th>Author/Reviewer</th>
<th>Date</th>
<th>Description of changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1a</td>
<td>Sean Lithgow/Keith Harwood</td>
<td>2/5/2016</td>
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<td>V1b</td>
<td>Jenny Frieden</td>
<td>27/5/2016</td>
<td>Addressed John’s comments</td>
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<td>V1c</td>
<td>Jenny Frieden</td>
<td>31/5/2016</td>
<td>Inserted the comms changes ES emailed through</td>
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<tr>
<td>V1d</td>
<td>Keith Harwood</td>
<td>22/6/2016</td>
<td>Updated financial figures</td>
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About Ironbark Sustainability

Ironbark Sustainability is a specialist local government consultancy that works with councils 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 decades of technical and financial analysis, maintenance and implementation experience in the areas of energy & water auditing, and public lighting technologies and management.

Ironbark provides public lighting support nationally including technology advice, technology approvals, business cases and project management. Ironbark delivers strategic and specific advice and support for the establishment of effective environmental management systems for government and business clients. We pride ourselves on supporting our clients to manage their operations more sustainably.
Contents

Executive Summary .............................................................................................................. 4
Project Objectives ............................................................................................................... 5
Project Energy Efficiency Activities .................................................................................... 8
Project Demonstration and Communications Activities ..................................................... 12
Outcomes and Benefits of the Project ................................................................................... 22
Budget .................................................................................................................................. 29
Project Operation, Mechanism and Processes ................................................................... 32
Conclusion ............................................................................................................................. 34
Attachment A: Project Energy Efficiency Improvement ....................................................... 36
Executive Summary

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.

The Light Up Greater Dandenong project is a community energy efficiency project on a giant scale that involved changing over 5,320 old and inefficient street lights to modern energy efficient LEDs. The total cost of the upgrade was $2,323,960 with $1,549,307 in grant funding received from the Australian Government.

Each light changed represents a 77% reduction in electricity costs. These are savings that have started to flow through to the council, ratepayers and broader community with a total of $7.43 million in energy and maintenance savings anticipated over the 20-year life of the new lights. The project has resulted in a reduction of energy use by 1,827,314 kWh a year, which will result in a reduction of greenhouse gas emissions by 39,484 tonnes over the next 20 years.

Indeed, this project has been – by a significant margin – the largest energy reduction project in Greater Dandenong’s history.

In addition to offering lower costs, lower energy consumption and lower greenhouse gas emissions, the new lights provide better lighting outcomes for the community, including a greater uniformity of light across and along Greater Dandenong’s streets; better colour rendering and visibility; and less depreciation of the light output over time.

Moreover, the flow-on benefits from the community promotion and education component of the project have been significant, particularly in terms of increased awareness of residential and commercial energy savings and links to other Council programs, networks and publications.

The project has been a great success and was delivered on time and on budget. However, the benefits are more than financial. As well as reducing costs to Council, which will result in improved services to all residents into the future, the installation of the LEDs has resulted in safer lighting, stimulated the Australian economy through the choice of Australian made and owned products and services where possible; and delivered great value for money for Council and the Australian Government.
Project Objectives

The Australian Government’s Community Energy Efficiency Program provided co-funding to local governing bodies and non-profit community organisations to implement energy efficiency measures. The objectives of the program were to:
1) increase the energy efficiency of different types of non-residential council and community-use buildings, facilities and lighting
2) demonstrate and encourage the adoption of improved energy management practices within councils, organisations and the broader community.

The City of Greater Dandenong’s CEEP project aimed to replace large numbers of inefficient street lights with more efficient lights. This directly addresses CEEP objective 1). It was managed with the following objectives in mind:

- maximisation of energy savings within project budget
- maximisation of greenhouse gas reduction
- reduction in council and ratepayers’ electricity costs
- sharing the learning and promoting energy efficiency with the community (CEEP objective 2).

The project was also guided by the following requirements, each of which were met:

- A proper procurement process was implemented as per the requirements of the Local Government Act and through partnership with the Municipal Association of Victoria’s (MAV) Street Lighting bulk procurement project
- Approved, safe and thoroughly assessed lighting technology was installed
- Safe and efficient work practices were undertaken
- Design was based on Australian Standards (AS/NZS 1158)
- The project considered above-standard lighting in areas of crime and public safety concern
- Community information was disseminated including information on the benefits of the project to residents, business and community organisations in saving energy and reducing greenhouse emissions
- Energy efficiency was promoted to resident and businesses by linking to residential and commercial programs
- Leadership around energy efficiency in the community was demonstrated (i.e. ‘practice what you preach’)
- Information on project outcomes and key milestones were successfully communicated to residents and businesses throughout the project reaching thousands of people. Engagement of local industry (in particular the Distribution Network Service Provider United Energy, lighting manufacturers and local installers).
Project Outcomes and Outputs

The following high-level outcomes of the project were met. More information on each of these is provided within this report:

1. Installation of the most energy efficient lights approved:
   a. 5,320 x 80 Watt Mercury Vapour (MV) lights were replaced by 18 Watt LEDs resulting in the financial and environmental savings listed below, as well as a range of community benefits through demonstrating the efficacy of energy efficiency programs.

2. Financial and environmental savings:
   a. Over 1,974 tonnes of greenhouse emissions saved per year
   b. Over 39,000 tonnes of greenhouse emissions saved during the life of the new assets (over 20 years).
   c. $7.43 million in energy and maintenance savings over 20 years.

3. Community education and promotion:
   a. A range of promotional activities were undertaken including:
      - a project launch with a promotional stand at Greater Dandenong Council’s Sustainability Festival on 22 March 2016 – a successful community engagement activity with Councillors and over 6,500 residents and key stakeholders in attendance
      - 50 A3 posters and 200 A5 promotional flyers were designed, printed in hard copy and distributed to Council’s key resident and business engagement outlets; both the promotional poster and flyer were also made available electronically via Council’s website; and distributed in resident show bags at the annual Dandenong Show, 15-16 November 2015
      - a Frequently Asked Questions (FAQs) document was prepared and posted on Council’s website; handed out in hard copy at the project launch event; provided to installation company ETS for distribution to interested residents while working in the field; provided to Council’s customer service team for informed response to customer enquiries
      - regular media releases were prepared and distributed to local media outlets, industry press, online forums/blogs, and local government magazines throughout the project
      - regular updates about progress and outcomes of the project appeared in Council’s the City resident publication
      - regular project updates were provided to Council staff via the Webstar e-newsletter and intranet updates. This has reached a target audience of over 700 staff and has resulted in increased awareness of sustainable practices and noticeable behavioral changes such as increased recycling and energy saving improvements (i.e. turning off monitors and lights at night).
   b. Local communication channels were used, including local papers, Council’s website, social media platforms and resident publications.
Lighting Up Greater Dandenong

The City of Greater Dandenong is committed to reducing its environmental footprint.

We will replace over 5000 mercury vapour street lights with LED lights, reducing our energy consumption by 77% and improving visibility.

Council will partner with United Energy to install and maintain the new lights.

New street lights will be installed from May 2015 – June 2016

Visit our greaterdandenong.com/lightup to see when we’ll be making the switch in your neighbourhood.
Project Energy Efficiency Activities

The project involved replacing 5,320 inefficient MV lamps in Category P (residential) streets throughout the City of Greater Dandenong. This included streets in the suburbs of Springvale, Springvale South, Keysborough, Noble Park, Noble Park North, Dandenong, Dandenong North, Dandenong South, Bangholme and Lyndhurst.

Fluorescent and LED Technology
When Council originally developed the funding application for the Community Energy Efficiency Program (CEEP), the only energy efficient technologies approved by the owners of the assets (United Energy) were fluorescent lights. The original project plan was therefore based on installing T5 fluorescent lights. These provided a clear improvement to MV lamps in terms of lumens per watt and light colour. United Energy subsequently approved an LED streetlight. The capital cost of the LED was higher than the fluorescent lighting, but the overall cost savings and environmental benefits are superior. In conjunction with the Australian Government, the decision was made by Council to purchase and install LEDs instead of T5s.

LED technology has developed rapidly over the last five years. From a position where the upfront costs were prohibitively expensive, costs have now reduced dramatically with the size and reliability of savings significantly improved. In their landmark 2012 report, Lighting the way: Perspectives on the global lighting market, McKinsey & Co predicted that the price of LEDs would reduce by around 14% per year between 2010 and 2015.

Indeed, over the last four years, costs have fallen even faster than expected and by 2020, LED streetlights are expected to reach cost parity with legacy technologies, making their benefits to costs immediately positive. Furthermore, with many countries rapidly urbanising and in need of improved street lighting infrastructure, this has created an enormous market opportunity. Between 2015 and 2025, LED street lighting investment is projected to cumulatively reach $57.8 billion of global investment pipelines which has already resulted in improved technology and cost reductions.

The key reasons for the decrease in prices are technology advancement and increased competition. Firstly, LED lighting is considerably more efficient than traditional lighting technology, which means that consumers can significantly reduce energy use. This is expected to continue with key international bodies stating that while it can be difficult to predict the speed at which the technology will develop, LEDs are predicted to increase in efficiency over the coming decade.

Prices are also falling through market forces. All large lighting manufacturers are spending significant money and resources on research and development and marketing of their LEDs. As competition increases, prices are decreasing.

Greater Dandenong Council is one of the 68 councils in Victoria that have joined together to reap the benefits of bulk procurement of LEDs across local government boundaries which has seen

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2 For example, the US Department of Energy.
increased competition and large reduction in capital costs as 256,000 lights will have been changed over to energy efficient alternatives by June 2016.

Finally, LED technology is also considerably better from an on-going maintenance perspective. The life of LED luminaires (10-20 years) are substantially longer than MV (3-4 years)

**Implementation**

The lights were installed by Eastern Tree Services (ETS), a contractor accredited to work on the United Energy network. Installation was uncomplicated with the exception of minor disruptions (see below). From a technological point of view this is one of the most straightforward projects a council, funding organisation or distributor can implement. It is simply changing one type of light to another 5,820 times. It’s as easy as 1-2-3:

1. **Find this:**
   ![](An old inefficient 80W MV)

2. **Replace with this:**
   ![](The efficient 18W LED alternative)

3. **Repeat 5,820 times:**
   ![](A new lighting design)

**Site and technology specific problems**

Overall the installation was a success and the project was implemented very smoothly. There were however minor issues, which are to be expected in a project of this size and scale:

- The project was initially planned prior to LEDs being approved for installation in the United Energy distribution areas. Therefore, the initial intention was to use fluorescent lights to replace the inefficient MV lamps. Once LEDs became available for the distribution areas, the project plan

[3] Note that High-Intensity Discharge (HID) sources such as MV have readily replaceable lamps while the luminaires can last 20 years or longer. For LEDs, typically the entire luminaire is replaced (at 10 to 20 years).
was amended to allow for the use of LEDs lights rather than their less efficient fluorescent counterparts. This meant that fewer lights could be replaced, but more energy could be saved per light.

- Stage 1 design only had 1,420 lights suitable for replacement due to decoratives and ‘not on map’ lights being found. ETS took 84 lights from the Stage 2 design to make up these numbers, resulting a reconfiguration of stage boundaries.

- Downer Tenix, who manage street lighting on behalf of United Energy, had multiple staff members leave or change position over the course of the project. This left a number of items including the Letter of Offer (CWA) outstanding during the middle of 2015. This required further follow up from Ironbark staff to Downer Tenix’s upper management to urgently prepare an offer and respond to other requests.

- Downer Tenix staff members leaving, which left a number of items including the submission of installation data and billing updating outstanding. This required further follow up from Ironbark staff to Downer Tenix’s management to ensure installation data and billing was updated.

- Delays in commencement of Stage 2 due to the ETS temporarily losing their United Energy accreditation. ETS made efforts to increase installation teams involved to make up for lost time.

- In Stage 2, 44 lights were noted that were unable to be replaced as they were either HPS lights, required repair, did not exist or had access issues. A further 44 lights were therefore required to be added to an amended design file to ensure the installation target was reached.

- There were some inaccuracies in the GIS data that was provided by United Energy. This meant that on 26th February 2016, crews found that lights scheduled for replacement were all T5 Fluorescents and not 80W mercury vapour lights as expected. Because of this, additional lights were added to an amended design file to ensure the installation target was reached.

The before and after photos below show the improved light spill in Grace Park Avenue, Springvale post installation of new LED technology.

![Before](image1.jpg)

![After](image2.jpg)
Project Demonstration and Communications Activities

Communication Objectives and Strategies

The project was communicated broadly and frequently. It was a major project for Council, as it represents the single greatest available reduction in Council’s greenhouse gas emissions.

The key communication objectives were:

- Inform the wider community about the benefits of the project
- Promote energy efficiency to residents and businesses by linking to residential and commercial programs
- Demonstrate leadership around energy efficiency in the community (“practice what you preach”)
- Provide information on the project outcomes.

Communication strategies included:

- Project launch event with photo opportunities for Councillors and to engage residents and key stakeholders
- Media releases to local newspapers, articles in relevant journals, industry publications and online blogs, and local government magazines
- Promotional posters and flyers available electronically and with hard copies at Council facilities and key business and community outlets and distributed at the annual Dandenong Show
- Information on Council’s website and social media platforms
- Frequently Asked Questions (FAQs) document posted on Council’s website; handed out in hard copy at the project launch event; provided to installation company ETS for distribution to interested residents while working in the field; provided to Council’s customer service team for informed response to customer enquiries
- Project updates in Council’s the City resident publication
- Internal staff updates in Council’s Webstar e-newsletter and online via staff intranet.

Target Audience and Stakeholders

Before the project, Council mapped out key stakeholders and audiences, including internal project partners and stakeholders. The following key stakeholders were involved in project delivery:

- United Energy
- Downer Tenix
- MAV Procurement
- Gerard Lighting (manufacturers)
- ETS (installers)
- Council staff and Councillors
- Ironbark Sustainability.
Council also maintains close engagement with local groups about a range of Council and community environmental initiatives.

This project was a great opportunity to build on these close relationships and build the capacity of the broader community. Target community groups included:

- Greater Dandenong residents
- Greater Dandenong businesses (both commercial and industrial)
- Other Local Government bodies
- Local environmental groups
- Local commercial and industrial businesses
- Local media outlets
- Other government departments and agencies.

The table below outlines the communications implementation plan to inform the local community and all internal/external stakeholders about the project. All of the communication tools and techniques implemented were successful and effective and can be executed again in a timely manner and within budget.

<table>
<thead>
<tr>
<th>Communications Action</th>
<th>Purpose</th>
<th>Target Audience/ s</th>
<th>Timeframe</th>
<th>Activity Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Launch Event – Sustainability Festival</strong> * (22 March 2015)</td>
<td>Soft launch of program with stall at Sustainability Festival. Emma Smith to be present on day.</td>
<td>Community/Media</td>
<td>22 March 2015 (10am – 3pm)</td>
<td>Successful &amp; we would do it again – effective in reaching thousands of local residents and key stakeholders – great awareness/engagement activity.</td>
</tr>
<tr>
<td><strong>Flyer / Poster</strong> <em>(can be printed to suit various sizes/formats)</em></td>
<td>To disseminate information to local residents about energy efficiency and what council is doing about climate change at Council offices/retail outlets etc. To have ready for first light installation and then ongoing during project.</td>
<td>Community</td>
<td>25 May 2015</td>
<td>Successful &amp; we would do it again – effective in reaching residents/businesses that may be time poor and don’t usually engage directly with Council.</td>
</tr>
<tr>
<td><strong>Media Release - official launch and photo opportunity</strong> with Mayor, interested Councillors, ETS,</td>
<td>To announce the project and launch it officially via the media. Photo opportunity to occur in residential</td>
<td>Community/Media</td>
<td>18 May 2015</td>
<td>Successful &amp; we would do it again – effective tool to reach local paper</td>
</tr>
<tr>
<td>Communications Action</td>
<td>Purpose</td>
<td>Target Audience/s</td>
<td>Timeframe</td>
<td>Activity Outcome</td>
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</tr>
<tr>
<td>Ironbark, local media</td>
<td>street in Springvale with ETS installation truck and workers.</td>
<td></td>
<td></td>
<td>readership – often elderly and CALD communities – great Councillor engagement.</td>
</tr>
<tr>
<td><strong>Council website</strong> (landing page on Council website)</td>
<td>Content describing project and FAQs.</td>
<td>Community</td>
<td>18 May 2015</td>
<td>Successful &amp; we would do it again – effective online engagement and ongoing portal of information for highly engaged residents and industry stakeholders.</td>
</tr>
<tr>
<td><strong>Frequently Asked Questions</strong></td>
<td>For use by Council customer service staff and installation contractors. Upload onto website.</td>
<td>Community</td>
<td>18 May 2015</td>
<td>Successful &amp; we would do it again – effective means of consistent messaging for all stakeholders, particularly for customer service staff and Councillors.</td>
</tr>
<tr>
<td><strong>Communications newsletter template</strong> – local government and environment industry press</td>
<td>An article was distributed to local government media and environment industry press to raise awareness of the project and to seek further media coverage, featuring a project update and relevant photos upon request. Article secured in SECCCA e-newsletter on 11 August 2015. Follow up with local government editors will continue.</td>
<td>Local government media and environment industry press.</td>
<td>July 2015</td>
<td>Successful &amp; we would do it again – effective technique to inform and engage the sector and key industry stakeholders.</td>
</tr>
<tr>
<td><strong>Council newsletter</strong></td>
<td>To inform the</td>
<td>Community</td>
<td>July 2015</td>
<td>Successful &amp; we</td>
</tr>
<tr>
<td>Communications Action</td>
<td>Purpose</td>
<td>Target Audience/ s</td>
<td>Timeframe</td>
<td>Activity Outcome</td>
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<tr>
<td>(Monthly resident publication the City)</td>
<td>community with a project update – article was secured in the July 2015 edition.</td>
<td></td>
<td></td>
<td>would do it again – broad reach and effective engagement activity to reach all rate-payers.</td>
</tr>
<tr>
<td><strong>A3 posters/ A5 flyers</strong></td>
<td>To inform the community about the project, and continue to display posters and flyers in ‘high traffic flow’ locations throughout Greater Dandenong. The A3 poster was also emailed to all primary and secondary schools, and all contacts in the Greater Dandenong Family and Children’s Services Directory, as a jpeg image for proposed publication in their newsletters and for display on their noticeboards.</td>
<td>Community</td>
<td>June-August 2015</td>
<td>Successful &amp; we would do it again - effective in reaching residents/busines sses that may be time poor and don’t usually engage directly with Council.</td>
</tr>
<tr>
<td><strong>Council website</strong></td>
<td>To inform the community of project progress and to answer any questions the community may have regarding the LED street light installation process.</td>
<td>Community</td>
<td>July 2015</td>
<td>Successful &amp; we would do it again – effective online engagement and ongoing portal of information for highly engaged residents and industry stakeholders.</td>
</tr>
</tbody>
</table>
| **Article in internal newsletter**  
(staff intranet Webstar – weekly e-newsletter sent each Mondays) | To inform all Council staff, many of whom are local residents, with a project update, including photographs of results. | Council staff | July 2015 | Successful & we would do it again – effective tool to inform all 700+ staff, they became ambassadors for the project with key messages |
<table>
<thead>
<tr>
<th>Communications Action</th>
<th>Purpose</th>
<th>Target Audience/s</th>
<th>Timeframe</th>
<th>Activity Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dandenong Show</strong></td>
<td>Direct engagement with local community and key stakeholders – A5 flyers</td>
<td>Community</td>
<td>November 2015</td>
<td>Successful &amp; we would do it again – effective way to reach families in particularly and people who do not usually engage directly with Council.</td>
</tr>
<tr>
<td><em>(15-16 November 2015)</em></td>
<td>distributed via Council show bags.</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>Final milestone activities</strong></td>
<td>Project completion - final outcome to be communicated to all stakeholders with relevant photos.</td>
<td>Community, media, resident, businesses, Council staff</td>
<td>April 2016</td>
<td>Successful &amp; we would do it again – effective communications to inform our audiences of final milestone outcomes.</td>
</tr>
<tr>
<td><strong>YouTube video</strong></td>
<td>Project completion – video to show installation of lights, outcomes of</td>
<td>All stakeholders</td>
<td>April 2016</td>
<td>Successful &amp; we would do it again – effective tool to continue sharing the story of the project, can reach all audiences and be an informative tool for the industry – best practice example.</td>
</tr>
<tr>
<td><em>(linked to Council’s website and shared via all social media platforms)</em></td>
<td>improved light spill, partnership delivery, and key messages communicated. This video will appear online for the following year as summary celebration of the completed project works.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Council newsletters</strong></td>
<td>To inform the community/businesses of final project outcomes, an article has been secured for the May 2016 editions.</td>
<td>Community, Businesses</td>
<td>April 2015</td>
<td>Successful &amp; we would do it again – effective communications to inform our audiences of final milestone outcomes.</td>
</tr>
<tr>
<td><em>(Monthly resident publication the City and business publication the Stakeholder)</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Industry publications</strong></td>
<td>To inform the professional industry of final project</td>
<td>Industry, local government associations</td>
<td>April 2015</td>
<td>Successful &amp; we would do it again – effective</td>
</tr>
<tr>
<td>Communications Action</td>
<td>Purpose</td>
<td>Target Audience/ s</td>
<td>Timeframe</td>
<td>Activity Outcome</td>
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<tr>
<td>Magazine; Roads &amp; Civil Works Australia Magazine</td>
<td>outcomes, an article has been sought for future editions.</td>
<td></td>
<td></td>
<td>tool to inform industry stakeholders of our Council’s best practice achievements.</td>
</tr>
</tbody>
</table>
The key messages throughout the project were:

- Energy efficiency is the best way to save money and reduce greenhouse emissions - reducing the street lighting energy consumption by 77 per cent
- Greater Dandenong Council is committed to reducing its environmental footprint
- Over 5,000 mercury vapour street lights will be switched over to new LED technology throughout the municipality over the next 12 months
- Works to occur in partnership with the Australian Government’s Community Energy Efficiency Program and United Energy, with local installer ETS (based in Hallam)
- The new LED street lights will improve visibility which in turn, will give the community the renewed perception of safety.

The community was educated about energy efficiency using the following methods:

- Presence at annual Council Sustainability Festival (market stand) and Dandenong Show (Council show bags)
- Posters and flyers
- Articles in local papers
- Articles in Council’s resident and local business publications
- Online communications – website and social media platforms
- Project animation – via YouTube video.

Communication and demonstration of information about the project and energy efficiency took place throughout the life of the project.

Please refer to images below from the Project Launch event at the Greater Dandenong Council Sustainability Festival on 22 March 2015.
Please refer to photographs below highlighting the successful display of posters and brochures in key engagement outlets throughout Greater Dandenong.

*Photo above:* A5 brochure display at Greater Dandenong Council Springvale Customer Service Centre (see second row on left for project brochure)

*Photo above:* A3 poster display at Noble Park Aquatic Centre
**Photo above:** A3 poster display at Dandenong Plaza Shopping Centre

**Photos above:** A3 poster display at Southern Migrant and Refugee Centre, Dandenong (close up on window and reception area)
LIGHTING UP DANDENONG

The City of Greater Dandenong is looking to address the rising cost of electricity by replacing street lights across the municipality.

In partnership with the Australian Government's Community Energy Efficiency Program and United Energy, Council will replace more than 5000 inefficient mercury vapour lights with LED (light emitting diodes) lights in residential streets.

The energy efficient lights are expected to reduce energy consumption by 77 per cent, in turn cutting operating costs and greenhouse emissions. LED lights can last up to 20 years, which also cuts maintenance costs.

Mayor Sean O’Reilly said the lights would improve visibility and the perception of safety across the city.

“Greater Dandenong Council is committed to reducing its footprint on the environment,” Cr O’Reilly said.

Works to replace lights started in May, and are expected to be completed by June 2016.

Disruptions to street accessibility are expected to be minimal, but visit www.greaterdandenong.com/lightup to keep up to date on when the crews will be in your neighbourhood.

_the CITY_ 3
Outcomes and Benefits of the Project

The observed project outcomes were different than expected in the initial planning phase, as indicated in the table below:

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Expected</th>
<th>Observed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of lights changed to LED</td>
<td>0*</td>
<td>5,320</td>
</tr>
<tr>
<td>Number of lights changed to fluorescent</td>
<td>6,819*</td>
<td>0*</td>
</tr>
<tr>
<td>Energy reduction (kWh)</td>
<td>1,462,437*</td>
<td>1,827,314</td>
</tr>
<tr>
<td>GHG emissions saved per year (tonnes)</td>
<td>1,744*</td>
<td>1,974</td>
</tr>
<tr>
<td>GHG emissions saved over life of assets (tonnes)</td>
<td>34,889*</td>
<td>39,484</td>
</tr>
<tr>
<td>Financial savings over life of assets</td>
<td>$4.78 million*</td>
<td>$7.43 million</td>
</tr>
</tbody>
</table>

*Note that the expected outcome figures reflect those provided in the original project plan. This plan was subsequently amended to use LED technology rather than fluorescent technology, with approval from the Commonwealth Government. See text for discussion of the benefits of this change.

These differences arose because when the project was being planned there were no LED luminaires approved in the United Energy network. Council therefore intended to use fluorescent lights to replace the existing 80W MV lights.

In November 2014, LED luminaires were approved for use in the United Energy distribution areas.

Council assessed the relative luminaires offered by fluorescent and LED technologies and determined that while LED luminaires incurred a higher initial capital cost, there were sufficient whole-of-life operational benefits to justify using LED luminaires for the bulk conversion project. For example, the LED has 20% energy efficiency over the current fluorescent lighting options (T5 or CFL).

The project plan was therefore amended to allow for a smaller number of lights to be changed to LEDs, and Council received approval to amend the CEEP funding agreement. Following a competitive tendering process, which resulted in underspends during each of the two implementation stages of the project, remaining funds were able to used to change additional street lights to LEDs. This led to a total of 5,320 lights being changed from 80W Mercury Vapour to 18W LED.

The number of lights changed is lower than the initially planned number of lights because the cost of each LED light is higher than the cost of the fluorescent alternative. However, as stated above, each LED light is more energy efficient than the originally planned for fluorescent technology. Therefore, Council was able to achieve higher than expected long-term financial and environmental savings by changing to LEDs rather than fluorescents, even though fewer lights were changed.

Note that the assumptions used to calculate the expected financial savings and greenhouse gas emission reductions have also changed since the original project plan was created. In particular, electricity prices have not been growing at the rates anticipated in 2014 and the model has been updated to reflect this. The model also uses an updated emissions factor.

Energy Efficiency Outcomes

Determining the energy efficiency and cost savings for street lighting projects is straightforward. Street lighting is an “unmetered load” with energy usage managed by the Australian Energy Market Operator (AEMO). The lights are all “standard”, all the same model and wattage, and all un-metered.
So the procedure for determining the energy consumption is specified in Parts A and B of the National Electricity Market (NEM) Metrology Procedures. This means that the electricity use of the old and new technology and the energy efficiency savings are known in advance and guaranteed.

**Methodology**

The methodology for the calculation of energy volumes for such unmetered supplies is set out in the National Energy Market (NEM) Metrology Procedures, which are managed by the AEMO. The methodology relies upon knowledge of the energy consumption of each type of approved load at an unmetered connection point. The values for assumed energy consumption are obtained from power consumption tests.

The outcomes of these tests are agreed upon by AEMO, responsible persons, Registered Participants and other relevant parties. The results are then presented and published in “load tables” managed by AEMO. The load tables must be updated whenever a new unmetered device comes into use. It is from these load tables that retailers and network service providers are able to calculate energy use from unmetered supplies. This is undertaken by maintaining an inventory of lights for each council so that costs can be appropriately allocated.

AEMO provides a list of unmetered loads for each state under its jurisdiction. These loads are then used by the electricity distribution business to calculate energy usage for each load type. United Energy multiply the load by the sunset to sunrise hours in that region over the relevant time in order to calculate total kWh.

**Baseline energy usage**

Greater Dandenong Council has been working with Ironbark Sustainability on energy efficient street lighting planning and development since 2013, including the development of the CEEP funding proposal in 2014. Over the last 2 years this has also involved liaison with the Municipal Association of Victoria (MAV) to assist with changing street lights, in particular procurement of materials.

Baseline energy usage and efficiency outcomes have been calculated using the same methods and factors used by United Energy and by Ironbark Sustainability. These were reality checked against power and maintenance bills.

Inputs are very straight-forward – the number of lights (from council electricity bills) multiplied by wattage of each light. To calculate baseline energy use the calculation is:

\[
\text{Number of Lights} \times \text{Wattage} \times 365 \text{ (days/year)} \times 11.94 \text{ (hours operational per day based on the regulations cited above)} / 1000 \text{ (to get to kWh)}.
\]

To convert to MJ, multiply by 3.6.
Number of 80W MV Lights changed | 5,320  
Wattage of 80W MV | 95.6  
Operating hours of lights in Victoria | 11.94  
Baseline energy use per annum (kWh) | 2,368,832  
Baseline energy use per annum (MJ) | 8,527,795  

For full information and data please refer to Attachment A: Project Energy Efficiency Improvement Template.

Figures are based on real street light data – bills and number of lights. Council’s lighting stock primarily comprised of standard 80 Watt MV lights.

**Projected efficiency improvements**

Energy savings from street lighting are very easy to predict because the exact number and type of lights and their operating conditions are well known and do not change. The new lights are 18 Watt LEDs and to calculate new energy use the calculation is:

\[
\text{New energy use per annum (kWh)} = \frac{\text{Number of Lights} \times \text{Wattage} \times 365 \text{ (days/year)} \times 11.94 \text{ (hours operational per day based on the regulations cited above)}}{1000} \]

Multiply by 3.6 to convert to MJ

| Number of new LEDs | 5,320  
| Wattage of new LEDs | 21.9  
| Operating hours of lights in Victoria | 11.94  
| New energy use per annum (kWh) | 541,518  
| New energy use per annum (MJ) | 1,949,465  

This project will save 1,827,314 kWh per year (6,578,330 MJ), which amounts to a saving of 77% relative to old inefficient lights that have been replaced. This project will therefore save 6,578,330 MJ per annum, which amounts to a saving of 77% relative to the existing lights that would be replaced.

**Projected financial savings**

This project is the largest energy reduction project in Greater Dandenong Council’s history. The technology used is also one that will retain its efficiency potential for an extraordinary time period of 20 years. (This is because of the cost of replacing these assets is high so they are maintained rather than replaced frequently).

The savings are significant. A total of $7.43million will be saved over the 20-year period through reduced energy and maintenance costs. This amounts to an average expected saving of $371,497 per year. These funds will be reinvested into the community and will improve economic output for councils and the country. The payback period is around 7 years.
Community and Other Benefits

As the largest energy efficient project in Greater Dandenong’s history, the project attracted a high level of media attention, with the project demonstrating to the community the importance of energy efficient and reducing greenhouse emissions.

Media clip above: Dandenong Journal, 20 May 2015, page 16 and online

LED streetlights have begun transforming cities and municipalities across the globe and this will continue over the next decade. LED streetlights lead the way when combining factors such as lamp life, lamp life efficacy, reduced maintenance costs and the potential for smart lighting controls and remote monitoring systems. It is a mature technology ready for mass deployment as demonstrated by the growing number of jurisdictions around the world that have upgraded to LEDs – a list that now includes the City of Greater Dandenong.

As well as requiring less maintenance – and the obvious energy efficiency benefits – there are other critical benefits of LED that have been realised, especially around safety, social and environmental factors. Safe lighting can be considered as lighting that maintains a consistent level of light throughout a space. Safe lighting provides light that is spread evenly onto roads and public spaces, and avoids patches of dark and light, which are common with old lighting technologies such as MV.

Safe lighting should also allow objects (both moving and stationary) to be easily identified by the human eye. This property of lighting is measured via the Colour Rendering Index (CRI) and relates to the colour of the light emitted. Broadly speaking, a whiter or “cooler” light improves facial recognition and helps motorists and pedestrians react quicker, thereby reducing the chances of accidents. In contrast, a more yellow or “warmer” light reduces the ability to accurately perceive objects.

This is also an important consideration where CCTV is deployed as a safety measure, again, to assist with facial recognition. This aspect of lighting is also linked to what is known as colour temperature (measured in degrees kelvin). Whiter or “cooler” lights are in the range 4,000-6,000°K (above 5,000°K start to appear bluish), whereas more yellow or “warmer” lights are generally below
3,000°K. There is also balance to be struck between energy efficiency (i.e. higher temperatures in the blue range (above 5,000°K are more efficient) and the ability of drivers to see pedestrians (too blue or too yellow (below 3,000°K) results in lighting where it is hard to see colour and contrast). International trends are towards a mid-range colour temperature of 4,000°K (neutral white).

In Image 1 we can again see “before” (HPS) and “after” (LED) images of an LED retrofit in Los Angeles. Results from the LED changeover in Los Angeles demonstrated a measurable reduction in street crime and vandalism after LED street lighting was introduced.

LEDs also minimise glare, thereby increasing visual comfort for people with certain kinds of vision impairment. Reduced glare also assists Victorian police and other law enforcement agencies, because less glare is clearer for cameras that require clear contrast.

Image 1: Mary Street, Springvale, before and after LED deployment on Local road.

The light output the old MV lights were maintained by a process of periodic visor cleaning and lamp replacements throughout their service life. While the design of street lights will factor-in dirt build up on visors and reduction in light output of the primary light source over time, the light output from the old MV would drop off very quickly, resulting in a big difference in light output at the start of its service life compared to the end of its service life.

This resulted in significant differences in light output between lights at the beginning and end of their service life, and from light to light in a given street. The City of Greater Dandenong’s new LED lights maintain a more consistent light output over time, which minimises fluctuation in illumination from light to light, and street to street.

Along with the technical parameters outlined above, public perceptions of safety are also an important consideration, and are often directly linked to the lighting of public spaces. Even though improved lighting should not be viewed in isolation as the answer to all crime and accident-related issues, improved illumination can play a role in addressing public perceptions of a lack of security or safety.

LEDs can also reduce other environmental impacts. The old MV lights were manufactured using harmful substances like lead and mercury. These substances risk being introduced into the environment during a light’s service life, and must be carefully disposed of when a light is retired. Note that the City of Greater Dandenong street lighting project included stringent waste and recycling practices that were carried out by the installer. These processes were audited by Ironbark Sustainability.

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The project also contributed to a broader uptake of energy efficiency measures. For example, energy efficiency is a key consideration in the design and refurbishment of new municipal buildings, such as the 5 Star Green Star rated Greater Dandenong Civic Centre, the new home of Council’s municipal offices and the Dandenong Library.

**Demonstration and Communication Outcomes**

Our communication objectives were met successfully during this project as awareness of energy efficient lighting has increased throughout the community and Greater Dandenong’s Business networks as observed anecdotally at recent network and community events.

Multiple articles appeared in Greater Dandenong’s resident publication *the City* with a reach of over 54,000 households.

Extensive and successful community engagement occurred throughout the project with Council stands, Officer presence and informative communications collateral presented to over 20,000 people at the annual Dandenong Show (15-16 November 2016) and to over 6,500 people whom attended the Greater Dandenong Council’s Sustainability Festival (22 March 2016).

Information on Council’s website regarding the project has been viewed 390 times.

The success of the YouTube video communicating the final project outcomes has yet to be measured.

**Local Industry Opportunities**

Due to the size of the scale of the project, installation contractor ETS was able to justify setting up a local operations centre to run the project from.

On a broader geographical scale, the project used materials that were assembled in Australia as well as Melbourne-based consultants.

**Benefits to Low Socio-Economic or Disadvantaged Groups**

Around 150,000 people live in Greater Dandenong, one of the most culturally diverse localities in Victoria, with over half of its population born overseas, from 150 different birthplaces.

The number of overseas-born residents in Greater Dandenong has risen steadily in recent years, growing by 14,000, or nearly a fifth, in the five years to 2011. Each year, a further 2000 recently-arrived migrants settle in Greater Dandenong, the highest rate of settlement in any Victorian municipality. One-third of these settlers are refugees, largely from Afghanistan, Sri Lanka, Iran, Burma and Pakistan.

Nearly two-thirds of the residents of Greater Dandenong speak languages other than English – the largest proportion in Victoria and twice the metropolitan level. One in seven residents however has limited fluency in spoken English – four times the metropolitan level.
The project provides a direct benefit to all residents of Greater Dandenong via the delivery of an improved public lighting scheme.

Additionally, cost and energy savings from the project will result in improved service to the community, both in terms of energy efficiency and through Council’s services for libraries, health, and services to support recreation and socially disadvantaged groups.

This is particularly important for the City of Greater Dandenong, where there are recognised socio-economic challenges. These include having the lowest average income in metropolitan Melbourne and an extensive community with English as their second language.
Budget

The Light up Greater Dandenong project was completed on budget.

Council also provided a significant amount of in-kind support for this project, including project management and communications support.

The following table summarises the costs throughout the project. Total project costs exclude non-contestable written down value costs.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Predicted Costs</th>
<th>Actual costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply/Materials costs⁵</td>
<td>Cost of purchasing 5,001 x 18W LED lights through the MAV materials tender panel.</td>
<td>$1,540,308</td>
<td>$1,658,774</td>
</tr>
<tr>
<td>Installation/Labour costs⁶</td>
<td>Cost of installation of 5,001 x 18W LED lights (see Implementation Plan, Stage 4: Procure)</td>
<td>$450,090</td>
<td>$344,948</td>
</tr>
<tr>
<td>Administrative costs</td>
<td>Internal council staff and time to manage the project, write reports, prepare community consultation materials, attend meetings and manage grant funding</td>
<td>$100,000</td>
<td>$100,000</td>
</tr>
<tr>
<td>Communication and Promotions</td>
<td>Community education, promotion etc.</td>
<td>$150,000</td>
<td>$83,762</td>
</tr>
<tr>
<td>External consultancy services</td>
<td>External expert services through procurement and management - defining specifications, tender panel and review of procurement program, ensuring works completed; reporting back to council</td>
<td>$136,326</td>
<td>$136,476</td>
</tr>
<tr>
<td><strong>Total Project Cost</strong></td>
<td></td>
<td><strong>$2,394,404</strong></td>
<td><strong>$2,323,960</strong></td>
</tr>
</tbody>
</table>

⁵ Predicted costs based on MAV Procurement Materials Panel (i.e., real market prices), unit costs. See Implementation Plan, Stage 4: Procure for more information on this tender panel.

⁶ Predicted costs based on assuming installation unit cost of $137.48 per light, based on recent and updated projects in the United Energy distribution area.
## CEEP - Financial Report
### Operating Statement for the period ended 30 June 2016

#### Project Budget - EX GST
Australian Government – CEEP
$1,549,307
CEFC
$774,653
**Total** $2,323,960

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Amount</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>$387,327</td>
</tr>
<tr>
<td>2 and 3</td>
<td>$154,931</td>
</tr>
<tr>
<td>4</td>
<td>$538,033</td>
</tr>
<tr>
<td>5</td>
<td>$0</td>
</tr>
<tr>
<td>6</td>
<td>$0</td>
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<tr>
<td>7</td>
<td>$269,016</td>
</tr>
<tr>
<td>8</td>
<td>$0</td>
</tr>
<tr>
<td>10</td>
<td>$200,000</td>
</tr>
</tbody>
</table>

**Total Income**
$1,549,307

#### Expenses
*Milestone 1, 2 and 3*

$0

**sub- total**

*Milestone 4*

$937,803

**sub- total**

*Milestone 5*

0
Milestone 6

0

Milestone 7

$1,938,302

Milestone 8

$0

Milestone 10

$229,406
Project Operation, Mechanism and Processes

Council managed the project internally along with accredited United Energy project managers, Ironbark Sustainability and United Energy installer ETS. This was an effective and affordable way to management the project. Ironbark and Council held monthly meetings to track the progress and update the risks and issues registers, while ETS also provided daily data with updates on the number of lights installed and any minor issues (such as faulty parts). Dealing with the one hardware supplier (Gerard Lighting) also aided in ensuring a smooth ordering and delivery process.

The City of Greater Dandenong, with other Victorian councils, has been investigating options for a street lighting “bulk change” for nearly a decade and it has only been in the last few years that these projects have become mainstream. General processes have become more streamlined given the increased number of projects throughout the state and the fact that the asset owner (United Energy) have now been fully engaged and were familiar with how these projects are implemented. Nevertheless, there were still components that were complex mainly due to the project involving a large number of diverse stakeholders; the fact that Council did not own the assets they were seeking to change; multiple funding streams; and the relative size of the project.

Procurement

The City of Greater Dandenong selected Ironbark Sustainability to project manage this project, using a public tendering process. Ironbark Sustainability and the City of Greater Dandenong then worked together to prepare the documentation and designs for the program, and tendered for the installer. Council selected ETS from this public tender process and managed the contract with ETS, Ironbark and other stakeholders.
In procuring the hardware, Council accessed the MAV Procurement bulk procurement panel for street lighting materials. As the largest peak body representing councils in Victoria, MAV and street lighting experts Ironbark Sustainability went out to tender on behalf of all Victorian councils in 2012 to set up a standing panel of approved energy efficient hardware that all councils could access.

The panel contains all currently approved energy efficient street lights and is refreshed on a quarterly basis as new lighting becomes approved. Purchasing lights from this standing panel minimized Council’s compliance and procurement risks and ensured that Council was meeting the requirements of the Local Government Act 1986.

**Key Challenges and Learnings**

While the project was managed and implemented smoothly, there were some issues and learnings for the City of Greater Dandenong that can be shared with other councils and also assist Council into the future.

The biggest challenge was the inaccurate and inconsistent data from United Energy which meant that the installers regularly found that lights mapped for replacement did not actually need to be replaced as they already had energy efficient lights installed, were decorative or did not actually exist in the field. Council now has a greater understanding of the lighting assets it pays for in the areas completed.

The other major challenge was the departure of significant Downer personnel which left a number of items including the Letter of Offer (CWA), Submission of Installation Data and Billing outstanding. This required Ironbark to make significant follow up efforts to ensure these failures were addressed. Ironbark has acknowledged that concerted efforts must be undertaken immediately if potential issues arise.

Overall, the project will significantly impact on the efficiency of broader public lighting. Council also owns many outdoor lighting assets in parks, car parks and sports facilities. These assets can readily be replaced and upgraded in a similar manner to the standard street lights. Additionally, indoor lighting has a large greenhouse footprint in Council operations and with the increased technical knowledge and project management experience, Council will investigate changing over these lights. Council plans to assess and audit these other lighting installations and develop plans to actively refit these. The street light project can thus be readily used as a case study for many other energy efficiency projects.
Conclusion

The City of Greater Dandenong Street Lighting Energy Efficient Changeover Program has resulted in the successful replacement of 5,320 mercury vapour lights with modern and energy efficient LEDs.

This has been an extremely successful project and key staff throughout Council are thrilled with the outcome. More importantly, council and ratepayers are starting to witness the massive cost and energy savings that flows through with lights that require 77% less electricity and cost less to maintain. The flow-on benefits from the community promotion and education component of the project has been far and wide, particularly in terms of increased awareness of residential and commercial energy savings and links to other Council programs and networks.

A key learning has been around the importance of good data management in tracking types of streetlights in the municipality. Council, ETS and Ironbark Sustainability worked together with United Energy throughout the project to ensure that data on street lighting in the City of Greater Dandenong was improved.

The City of Greater Dandenong has also built on and improved partnerships and relationships internally and with the broader community – residents, local business and the electricity providers. The benefits of this project will flow into the future for the entire community.
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
City of Greater Dandenong. (Name of organisation)

☐ 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

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

Authorised Officer Signature: [Signature] Date: 28/4/16

Name: Oliver Uido

Position: Manager

Organisation: City of Greater Dandenong

Witness Signature: [Signature] Date: 28/4/16

Name: Benny Kong

Position: Road Planning

Organisation: Dandenong 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.
## Attachment A: Project Energy Efficiency Improvement

<table>
<thead>
<tr>
<th>PROJECT TITLE</th>
<th>Light Up Greater Dandenong</th>
<th>PROJECT ID</th>
<th>CEEP2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>FUNDING RECIPIENT</td>
<td>City of Greater Dandenong</td>
<td>DATE</td>
<td>4 April 2016</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Building, Facility or Site 1</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of Building, Facility or Site 1</td>
<td>Street lights</td>
</tr>
<tr>
<td>Location (address)</td>
<td>This included streets in the suburbs of Springvale, Springvale South, Keysborough, Noble Park, Noble Park North, Dandenong, Dandenong North, Dandenong South, Bangholme and Lyndhurst.</td>
</tr>
<tr>
<td>Type of building, facility or site</td>
<td>Street lights installation across all of Greater Dandenong region</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity Type and Measure</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Because street lights are an unmetered load, energy savings calculations are based on theoretical, but nonetheless regulated, on and off times.</td>
<td></td>
</tr>
<tr>
<td>Figures are based on real street light data – bills and number of lights. As there is essentially one technology change (80W Mercury Vapour to 18W LED lights*) it is very simple to calculate the savings. Inputs are very straightforward – the number of lights (from council electricity bills) multiplied by wattage of each light, and the hours of operation.</td>
<td></td>
</tr>
<tr>
<td>Because we know from the electricity bills how many lights were there before the changeover and after the changeover, we can calculate the energy usage before and after the changeover using the formula below. While the energy savings have not been measured directly, the calculations we use are the same as those used by the DNSPs to calculate energy charges for the lights.</td>
<td></td>
</tr>
<tr>
<td>The methodology used to calculate the energy usage is explained in more detail in the body of final CEEP report for this project. The methodology is set out in the National Energy Market (NEM) Metrology Procedures. The methodology relies on approved load tables that retailers and network service providers use to calculate energy use from unmetered supplies, based on the inventory of bulbs for each council.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Energy Efficiency Estimate Method</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>There were originally:</td>
<td></td>
</tr>
<tr>
<td>5,320 x 80W Mercury Vapour Lights</td>
<td></td>
</tr>
</tbody>
</table>
To calculate baseline energy use the calculation is:
Number of Lights x Wattage x 365 (days/year) x 11.64 (hours operational per day based on the regulations cited above) / 1000 (to get to kWh).

* Please note the difference between nominal and total wattage of a lamp. The nominal wattage includes only energy use of the lamp. The total wattage includes the energy consumed by the control gear, or ballast, of the luminaire. It is this total wattage that is more relevant. The 80W Mercury Vapours have a nominal wattage of 80W but total wattage of 95.8W. The 18W LEDs have a nominal wattage of 18W but a total wattage of 21.9W.

<table>
<thead>
<tr>
<th>Baseline Energy Usage</th>
<th>2,368,832 kWh (8,527,795 MJ) per annum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline Energy Efficiency</td>
<td>Council’s lighting stock primarily comprised standard 80 Watt mercury Vapour lights (80W MV), which uses around 77% more energy than more efficient technologies that are currently available and approved:</td>
</tr>
<tr>
<td>Kilometres of roads that are P category: 476 km</td>
<td></td>
</tr>
<tr>
<td>Number of P lights: 5,320</td>
<td></td>
</tr>
<tr>
<td>Energy consumption: 8,527,795 MJ</td>
<td></td>
</tr>
<tr>
<td>Energy consumption per km of road per year: 17,915 MJ/km/Year</td>
<td></td>
</tr>
<tr>
<td>Energy consumption per km of road per day: 49.1 MJ/km/Day</td>
<td></td>
</tr>
<tr>
<td>Note this project only refers to Pedestrian Category, or “P Category” roads. P Category roads are also known as minor roads. The objective of P Category lighting is to provide a lighted environment where due to the low vehicular traffic flow the visual requirements of pedestrians are dominant. To accomplish this, it is necessary to illuminate both the roadways and the surrounding verges to allow pedestrians to identify obstructions, and to aid motorists in recognising that pedestrians may be present. The lighting levels are far lower than for Major Road lighting (or “V Category” or “Vehicle Category”) and the design is based upon the amount of light falling on the road reserve (boundary to boundary). The above requirements are considered achieved if the lighting is designed and installed according to the requirements of the Australian/New Zealand Standard AS/NZS 1158 “Lighting for roads and public spaces” (Category P – sub-categories P1 – P5).</td>
<td></td>
</tr>
<tr>
<td>Energy Efficiency Improvement</td>
<td>Energy savings from street lighting can be predicted with a high degree of confidence because the exact number and type of lights and their operating conditions are well known, and do not change as it is regulated by AEMO (see above). However, because street lights are an unmetered load, energy savings calculations are still technically theoretical.</td>
</tr>
<tr>
<td>The new lights are 18W LEDs.</td>
<td></td>
</tr>
<tr>
<td>To calculate new energy use the calculation is: Number of Lights x Wattage x 365 (days/year) x 11.64 (hours operational per day based on the regulations cited above) / 1000 (to get to kWh).</td>
<td></td>
</tr>
</tbody>
</table>
The new energy use is 541,518 kWh (1,949,465) MJ per year.

This project will therefore save 6,578,330 MJ per annum, which amounts to a saving of 77% relative to the existing lights that would be replaced.

Energy savings per km of road per year are 13,820 MJ/km/Year. Energy savings per km of road per day are 37.9 MJ/km/Day.

<table>
<thead>
<tr>
<th>Reporting Data (Measuring Energy Efficiency and Additional Data)</th>
<th>Council has a total of 476 km of P-Category roads specific to this project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average hours of operation of lights per day: 11.94 hours</td>
<td>Percentage of the day lights are operational: 49.8%</td>
</tr>
<tr>
<td>Assumptions</td>
<td>• Energy price decreases by 0.7% per year from 2014 to 2021, then increases by 5.45% per year for 10 years, then increases by 2.86% per year subsequently.</td>
</tr>
<tr>
<td></td>
<td>• OMR prices are as stipulated in AER Determinations and data from United Energy</td>
</tr>
<tr>
<td></td>
<td>• All savings and cost figures are GST Exclusive;</td>
</tr>
<tr>
<td></td>
<td>• Operating hours of lights are 11.94 hours per day in Vic</td>
</tr>
</tbody>
</table>

| Cost of Activity | $3,105,511 with $1,549,307 provided by CEEP |
| Estimated Cost Savings | $7.43 million over 20 years or an average of $371,497 per year. |