goulburn broken greenhouse alliance

Watts Working Better Project

Street Lighting Energy Efficiency Program

FINAL PROJECT REVIEW REPORT

BENALLA RURAL CITY · SHIRE OF CAMPASPE · MANSFIELD SHIRE · MITCHELL SHIRE COUNCIL · MOIRA SHIRE · Murrindindi Shire Council · GREATER SHEPPARTON · Strathbogie Shire · RURAL CITY OF WANGARATTA

This project 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.

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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.

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Executive Summary

The Watts Working Better Street Lighting Energy Efficient Changeover Program is an award-winning, large scale, community energy efficiency project. It involved changing over 12,040 old and inefficient street lights to modern energy efficient LEDs and T5 lights across 100 communities in rural and regional Australia. The total cost of the upgrade was $4,494,555.35 (including forecast expenditure) with $2,959,628 in grant funding received from the Australian Government.

Each light changed represents up to 77% reduction in electricity costs. These are savings that have started to flow through to the councils, ratepayers and broader community – a total of $19.5 million in energy and maintenance savings over the 20-year life of the new lights. The project has resulted in a reduction of energy use by over 3,555 MWh a year which will result in a reduction of greenhouse gas emissions by over 89,000 tonnes over the next 20 years.

Indeed, this project has been – by a significant margin – the largest energy reduction project in the region'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 the streets of Benalla Rural City Council, Campaspe Shire Council, Mansfield Shire Council, Mitchell Shire Council, Moira Shire Council, Murrindindi Shire Council, Greater Shepparton City Council, Strathbogie Shire Council and Wangaratta Rural City Council; better colour rendering and visibility; less depreciation of the light output over time; and lower glare.

Moreover, 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. The project has been a great success, delivered on time and only 1.24% over budget (significantly under budget including non-reportable income and expense). Given improvements in energy efficient technology and procurement processes that have reduced capital costs, the project is set to deliver higher cost reductions than expected with an estimated 2.5 year pay-back period for council's investment.

This is the first project of this scale to have been completed in Australia and continues to break new ground.

In October 2015 the project won the Premier's Sustainability Awards for the category of Built Environment[1].

The Awards celebrate the best of sustainability in Victoria and 2015 saw not only the largest number of entries in the history of the awards, but the most diverse, innovative and inspiring entries from individuals, organisations and communities across Victoria.

Watts Working Better was able to draw in the broader community and also expand the project to include extra rural councils to ensure further savings, which was a key to winning the Sustainability Awards. The Shires of Indigo and Towong – not part of the original 9 councils – were able to join the project over the last 12 months, which has resulted in an extra 1,000 lights being changed over. Both are small councils that were able to benefit from the purchasing power of the Watts Working Better project. This work would not have been feasible for each to do it on their own.

Watts Working Better also achieved 98.5% recycling of the old lights through a partnership with Connect GV, a social enterprise in Shepparton that provides employment opportunities for people with a disability.

Finally, the benefits are more than financial. As well as reducing costs to councils which will result in improved services to all residents into the future, the installation of the T5s and LEDs has resulted in safer lighting; stimulated the Australian economy through the choice of Australian made and owned products and services; and delivered great value for money for councils and the Australian Government. The project has also improved residential amenity in the region by providing more uniform street lights that have improved colour rendering and visibility, less depreciation of light output over time, and lower glare.

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[1] See http://sustainabilityawards.vic.gov.au/2015-winners

Project Objectives

The project aimed to replace large numbers of inefficient street lights with more efficient lights and 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

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.
- 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.
- Engagement of local industry (in particular the Distribution Network Service Providers (DNSP's) Ausnet Services and Powercor, 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. 12,040 x 80 Watt Mercury Vapour (MV) lights were replaced by 18 Watt LEDs and 2x14W "T5s"[2].

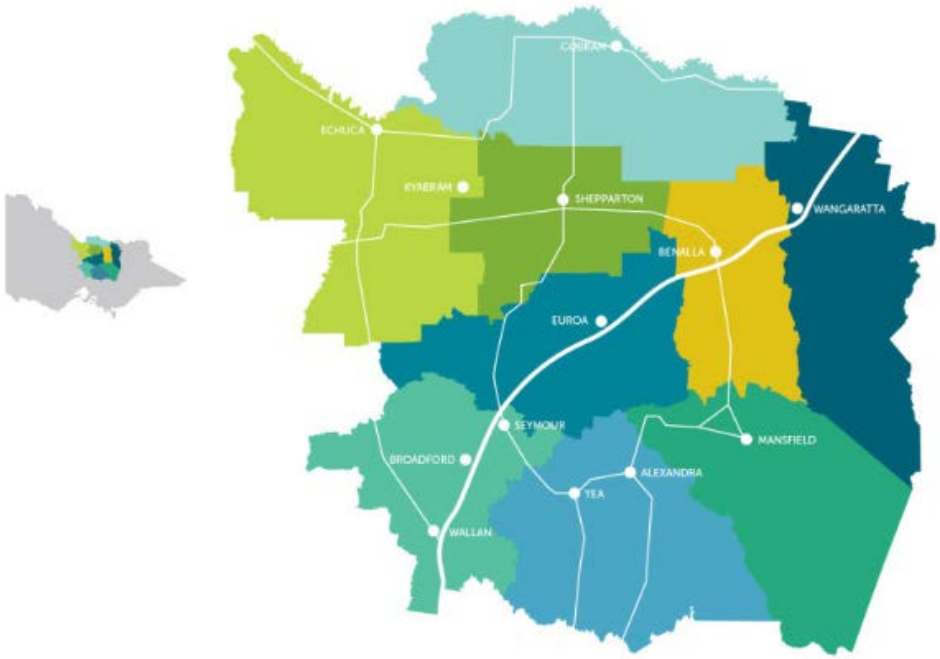
2. Financial and environmental savings:
    a. Over 80,000 tonnes of greenhouse emissions saved over 20 years
    b. $19.5 million in energy and maintenance savings over 20 years

3. Community education and promotional project:
    a. A raft of promotional activities were undertaken including distribution of fact sheets, regular updates about progress and outcomes of the project in local papers, and a launch that showcased the collaborative energy efficiency project between local and Federal Governments
    b. Local communication channels include dozens of media outlets, council network groups, community centres, schools, senior citizens clubs, sporting clubs and more.

[2] The project plan had originally outlined 12,661 lights to be changed over. Due to data inaccuracies on behalf of the asset owners, Ausnet Services and Powercor, 12,040 was the maximum number of lights that could be changed over. This is explained further in the report.

Project Energy Efficiency Activities

The project involved replacing 12,040 inefficient MV lamps in Category P (residential) streets throughout Benalla Rural City Council, Campaspe Shire Council, Mansfield Shire Council, Mitchell Shire Council, Moira Shire Council, Murrindindi Shire Council, Greater Shepparton City Council, Strathbogie Shire Council and Wangaratta Rural City Council.



LED Technology

Lighting technology and approval for installation on the Distribution Network Service Providers rapidly changed over the course of the project.

When the group originally developed the funding application for Community Energy Efficiency Program (CEEP) the only energy efficient technology approved by the owner of the assets (Ausnet Services and Powercor) were compact fluorescent (CFL) 2x14W "T5s" and 32W CFL lights. These were the only approved energy efficient replacement options for 80-Watt MV streetlights and provided a clear improvement to MV lamps in terms of lumens per watt and light colour.

Soon after the funding application had been finalised, T5 lights were approved by Ausnet and Powercor. This new technology gave higher energy efficiency than the CFL's and were longer lasting. All councils elected to invest in the T5 lights for their change over option. Then, just after the finding agreement had been signed, news came through that Powercor and Ausnet had approved one type of LED streetlight for installation on their assets.

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[3] 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[4] 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. Finally, LED is also considerably better from an on-going maintenance perspective. The life of LED luminaires (10-20 years) is substantially longer than MV (3-4 years)[5].

The improvement in efficiency and reduction in electricity and maintenance costs are two of the reasons that Powercor and Ausnet approved LEDs for use in early 2014[6].

[3] From *Global LED and Smart Street Lighting: Market Forecast (2015 - 2025)* summary, Northeast Group.
[4] For example, the US Department of Energy.
[5] 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).
[6] Other reasons include safety, as LEDs offer better lighting colour (in degrees Kelvin) and Colour Rendering Index (CRI) which are proven to provide better safety outcomes.

With support from the Australian Government, each of the Watts Working Better councils undertook further financial and technical analysis based on the changes to approved technology and in some regions LEDs were installed instead of T5s. The capital cost of the LED was higher than the "T5", but the overall cost savings and environmental benefits are superior. So the decision was made by some of the councils who could find extra budget to purchase and install LEDs instead.

The Watts Working Better councils are also part of the 68 councils in Victoria that have joined together to reap the benefits of bulk procurement of energy efficient lights across local government boundaries which has seen increased competition and large reduction in capital costs as 256,000 lights are in the process of being changed over to energy efficient alternatives.

Implementation

The lights were installed by ETS Electrical Services, a contractor accredited to work on both the Ausnet and Powercor networks. Installation was uncomplicated with the exception of minor incidents (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 12,040 times. It's as easy as 1-2-3:

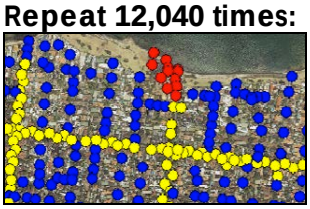
1. Find this:

An old inefficient 80W MV

2. Replace with this:

The efficient 18W LED alternative

3. Repeat 12,040 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 some minor issues, which are to be expected in a project of this size and scale:

- Ausnet and Powercor's GIS data was inaccurate. Although their GIS data (which is the basis of their billing of councils) had specified that there were 12,661 standard MV80 lights that could be replaced during the project, councils found while undertaking the project the data "on the ground" demonstrated there were only 12,040 MV80 lights. Councils will seek reimbursement from Ausnet and Powercor for being over-charged in the past.
- There were minor issues with a small number of lights (<0.05%) found to be faulty. These were returned to the manufacturer and replaced.
- There were a handful of complaints from residents. This was expected given the large numbers of lights – the participating councils were expecting some complaints from residents as the LED and T5 lights are newer and brighter, whereas the replaced MV80 lights were operating below the standard levels due to their age.
- These complaints were resolved by installing baffles to deflect the light from adjacent homes.

Project Demonstration and Communications Activities

Communication Objectives and Strategies

Watts Working Better was communicated broadly and frequently. It was a major project for the participating councils, as it represents the single greatest available reduction in each council's greenhouse gas emissions.

Mansfield Courier

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Award highlights success of street light upgrade

Wednesday, March 2, 2016
Categories: Community, Council, News
Tags: Mansfield Shire Council, street lighting

THE Goulburn Broken Greenhouse Alliance last week presented Mansfield Shire Council the Victorian Premier's Ancillary Sustainability Award in recognition of its involvement in the Watts Working Better street light upgrade.

Alliance executive officer Tom Brown presented the award and congratulated council on its commitment to sustainable practices.

The Watts Working Better street light upgrade project took out the prestigious Premier's Sustainability Awards in the built environment category at the end of 2015 at an award ceremony in Melbourne.

WATTS WORKING: Mansfield Shire Council mayor Paul Sladdin accepts the Victorian Premier's Ancillary Sustainability Award on behalf of the Mansfield Shire Council from Goulburn Broken

Figure 1: News Article promoting the successful Watts Working Better project from the Mansfield Courier

There were various reasons for the councils to communicate widely to the community and councils indeed used the opportunity to do so.

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:

- Media releases to local newspapers, articles in relevant journals.
- Photo opportunities for residents, council staff, councillors.
- Fact sheets available electronically with hard copies at each Council's facilities
- Information, video, updates, a "light-counter" on the www.wattsworkingbetter.com.au website.
- Video distributed through online media[7] and local television advertising.
- Distribution and information through dozens of media outlets including WIN New, South Cross 10 Weeknights, ABC Radio, OneFM, local newspapers and community newsletters.

[7] See for example https://www.youtube.com/watch?v=OKBIBpEuB4g

Target Audience and Stakeholders

Before the project, councils mapped out key stakeholders and audiences, including internal project partners and stakeholders (involved in the delivery of the project). The following key stakeholders were engaged throughout the project:

- Ausnet Services
- Powercor
- MAV Procurement
- Gerard Lighting (manufacturers)
- ETS Electrical (installers)
- Ironbark Sustainability (consultants and project managers)
- Council staff
- Department of Industry

External community groups were also identified, including:

- Residents of the 9 representative councils
- Local commercial and industrial businesses
- Police and community safety representatives (involved in mapping out areas of concern regarding safety and increased light levels)
- Network groups and community organisations
- Organisations supporting low socio economic and disadvantaged
- Media

Participating councils maintain close engagement with local environmental 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.

A project launch event was organised to coincide with the upgrade of the first streetlights and was held on Thursday 31 July, 2014 at The Eastbank Centre, Shepparton. The Member for Murray, the Hon. Dr Sharman Stone officially launched the project by switching on the new streetlights in front of a crowd of 90 people.

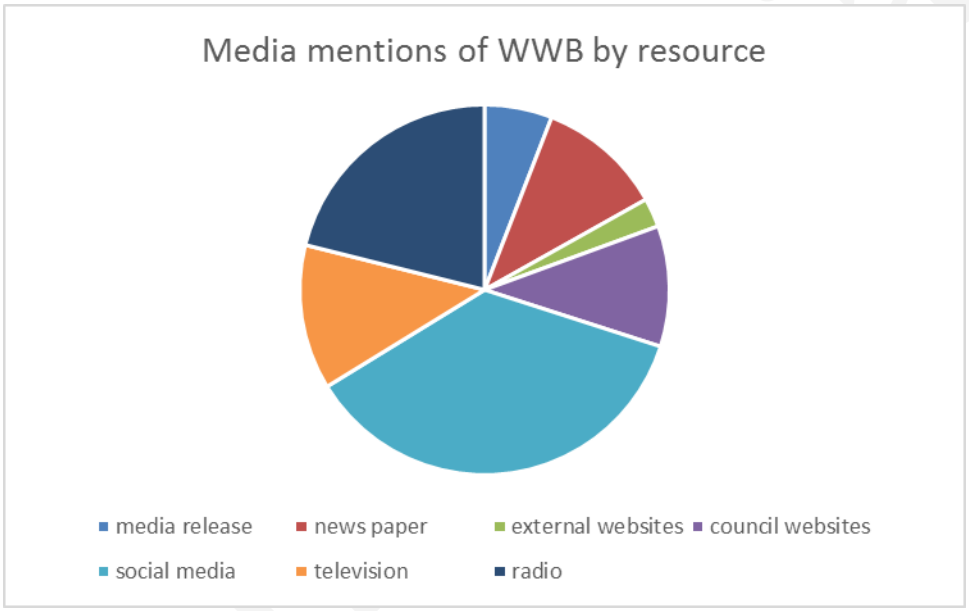
The launch attracted broad-scale media interest emphasising the community and environmental benefits of the project. Councils communicated updates to the project development via website, social media, community newsletters, key contacts within existing groups and in local newspapers for further community engagement. Project demonstration was completed through a range of communications, media, channels and forums. The

development of case studies, project reports, and attendance at forums with residents was delivered through media releases, fliers, articles and web content.

Below is a list of all media releases, media enquiries and media mentions that councils recorded since the beginning of the project.

Media Mentions

Over 14 media releases were produced over the life of the project with all 14 resulting in a hit from a media outlet. There were over 26 newspaper articles, 86 social media uploads, 30 television stories and over 50 radio mentions of the Watts Working Better project. The chart below shows the media mentions of Watts Working Better by medium.



Media Releases

- 30th October 2015 Media Release WWB takes out top award honour
- 15th October 2015 Media Release Indigo and Towong join street light upgrade
- 14th October 2015 Media Release Premier's Sustainability Award finalist
- 17th July 2015 Media Release Stage 1 Complete
- 10th July 2015 Media Release Energy Efficiency Workshops
- 15th July 2014 Media Release Victorian Councils light years ahead

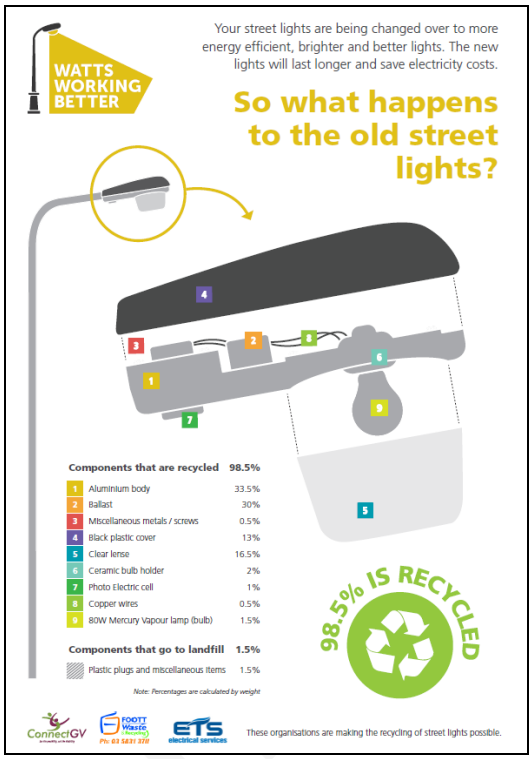


Figure 2: Watts Working Better infograph

Key Messages

The key messages throughout the project were kept clear and simple:

- Watts Working Better will reduce councils' impact on the environment on behalf of their communities.
- Watts Working Better will save councils money, and therefore enhance services to their communities.
- Watts Working Better will provide communities with the best available technology in street lighting.
- Watts Working Better will improve amenity for communities.
- Watts Working Better project coordinators will consult with stakeholders to keep them informed, share outcomes and lessons from the project, and obtain feedback.
- By collaborating on projects like Watts Working Better, councils demonstrate leadership and achieve significant benefits for their communities.

Councils provided monthly reports and gave presentations to dozens of community groups such as the Shepparton Community Safety Committee, U3A, and environment groups. A number of methods were also employed to keep the council staff engaged with the project such as internal newsletters, presentation to team meetings and all staff meetings and energy efficiency workshops.

Each of the 9 partner councils held energy efficiency workshops for the general community and for internal council staff. Over 110 people attended these workshops throughout the region.

Outcomes and Benefits

The following project outcomes were exceeded:

Outcome	Expected	Observed	Met?
Number of lights changed	At least 12,000	12,040	Exceeded
Financial savings over life of assets	$15.7 million	$19.5 million	Exceeded

Financial savings were higher than expected because some councils ended up installing LED lights which are more energy efficient than the originally planned "2 x 14W T5" compact fluorescent lights. Overall, 12,040 lights were installed. Further lights could not be installed due to inaccuracies in the data provided by Ausnet and Powercor. The data originally established that there were 12,661 standard MV80 lights to be replaced. The nine participant councils undertook business cases, a project plan, detailed designs and then began installation all based on these numbers.

The following project outcome was not met:

Outcome	Expected	Installed
Energy reduction	3,644 MWh	3,555 MWh

As councils completed the installations it became apparent that Ausnet and Powercor's data was inaccurate. There are only 12,040 lights that could indeed be changed over. This is consistent with other CEEP street lighting projects (for example, Baw Baw Shire, South Gippsland Shire Council, Bass Coast Shire Council, Casey City Council) whereby these councils reduced the number of lights to be changed[8].

Councils and the DNSPs organised extensive audits to finalise and reconcile the number of 80-Watt MV Lights including shared, decorative and standard luminaire under the program. It has now been established the total number of lights in the project is 12,040. While the project was expected to replace "at least 12,000" lights, this was still less than the estimate of 12,661 which resulted in the expected energy reduction being lower.

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

[8] CEEP funding arrangements were not affected with these councils. Instead there were variations - in the example of South Gippsland decorative lights were changed over and for Casey the number of lights were reduced significantly (by a few thousand) but more advanced and expensive technology (LEDs instead of T5s) were installed with no change to the funding amount.

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. Ausnet Services and Powercor then 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

Since 2009, councils in the Goulburn Broken region have been working with Ironbark Sustainability on energy efficient street lighting planning and development, including the development of the CEEP funding proposal in 2013. Over the last 3 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 Ausnet Services, Powercor 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:

Number of Lights x Wattage x 365 (days/year) x 11.94 (hours operational per day based on the regulations cited above) / 1000 (to get to kWh).

Number of 80W MV Lights to be changed	12,040
Total Wattage of 80W MV[9]	95.6
Operating hours of lights in Victoria	11.94
Baseline energy use per annum (kWh)	5,026,772
Baseline energy use per annum (MJ)	18,096,379

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. Councils' lighting stock primarily comprised of standard 80 Watt MV lights, which used up to 4.37 times more energy than the most efficient LEDs that some participant councils replaced them with.

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 or 2x14W "T5s" and to calculate new energy use the calculation is:

Number of Lights x Wattage x 365 (days/year) x 11.94 (hours operational per day based on the regulations cited above) / 1000 (to get to kWh).

Number of new T5s	8,911
Wattage of new T5s	30.5
Number of new LEDs	3,129
Wattage of new LEDs	21.9
Operating hours of lights in Victoria	11.94
New energy use per annum (kWh)	1,471,457
New energy use per annum (MJ)	5,297,246

This project will save 3,555,315 kWh per year (12,799,134 MJ), which amounts to a saving of 71% relative to old inefficient lights that have been replaced.

Projected financial savings

This project is the largest energy reduction project in the region'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).

[9] 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. The 2x14W "T5s" have a nominal wattage of 28W but a total wattage of 30.5

The savings for councils are significant. A total $19.465 million will be saved over the 20-year period through reduced energy and maintenance costs. These funds will be reinvested into the community and will improve economic output for councils and the country. This is higher than the $16.658 million savings predicted before the project started.

Community and Other Benefits

As the largest energy efficient project in the region'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. As well as requiring less maintenance – and the obvious energy efficiency benefits – there are other critical benefits of the new lights 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[10].

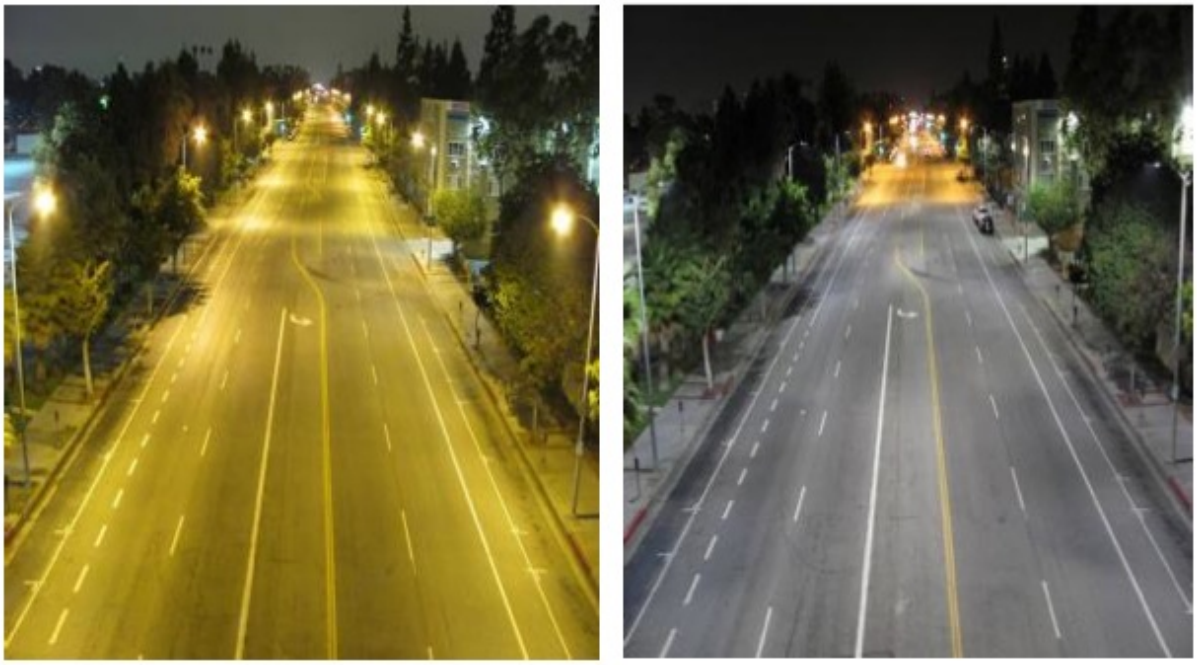


Image 1: Hoover Street, Los Angeles, before and after LED deployment on main road.

LEDs also minimises glare, thereby increasing visual comfort for people with certain kinds of vision impairment. Because the light is clearer for cameras that require clear contrast, reduced glare also assists Victorian police and other law enforcement agencies.

The light output of the old MV lights was 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. All of the new energy efficient lighting technology installed in the Watts Working Better project will

[10] *Towards More Sustainable Street Lighting Practice Note*, Institute of Public Works Engineering Australasia (IPWEA), July 2014.

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.

The new lights 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[11].

An unexpected but particularly positive outcome of the Watts Working Better project was the partnership developed with Connect GV. Connect GV is a not-for-profit social enterprise organisation that aims to provide development and employment opportunities for people with a disability.

Connect GV and Watts Working Better signed an MOU to govern the recycling of the old street lights. The lights were disassembled by clients of Connect GV and the parts sold to recycling companies. All funds generated from the sale of the parts were income for Connect GV.

There was a strong desire by council partners to recycle as much of the lights as possible. This partnership enabled 98.5% of each light to be diverted from landfill and sold on, generating income for Connect GV and viable and meaningful employment for their clients (Please see figure 2).

In addition, the delivery of the lights to Connect GV has been a service provided free of charge by a local waste company Foott Waste.

The other major benefit from the project relates to organisation learnings from a technologically simple but practically complex project. This project was at a scale that hadn't been attempted before in our region, at least in the last 20 years. There were many lessons learnt that we hope will assist other councils and make the implementation of their bulk street lighting changeover projects just a little easier.

As lead council, Greater Shepparton invested significant time into the project. At the beginning, it was unclear how much time that would be. As a conservative estimate, this has equated to over 233 hours in kind and $11,650 (@$50 per hour). The contribution from the other councils will make this figure higher again. A better understanding of the resources required to undertake this project in the future will ease pressure on council officers with responsibilities for other projects.

One of the key items that made Watts Working Better such a success was the Governance Participation Agreement (GPA) that was developed very early on in the project.

[11] The Watts Working Better project included stringent waste and recycling practices that were carried out by the installer, ETS Electrical.

A steering committee was established with representatives from all partner councils, the Goulburn Broken Greenhouse Alliance Executive Officer and Ironbark Sustainability. This committee developed the GPA that clearly outlined each partner's roles and responsibilities, the delegation power of the representatives and the financial contribution and timing for each council's installation. This arrangement allowed the officers present flexibility to make decisions in response to opportunities that arose during steering committee meetings. This document was amended after LED's were approved to reflect the updated contribution for the affected councils. This also gave a definitive guide for reporting and procurement for each stage.

The budget management was complex for this project as Greater Shepparton City Council has their own accounting management system with established ledgers which didn't match with the Watts Working Better project plan, the GBGA budget system or Ironbark budget system. So effectively we were managing 4 different budgets. In hindsight, this should have been managed more efficiently, ideally through a spreadsheet with line items to meet the project plan budget and a column to identify Greater Shepparton City Council line items. This would have saved officer time for reporting.

Likewise, reporting against the Watts Working Better Communication Plan was complicated by the items in the plan not matching the GBGA activity items. This resulted in time being spent at the end of the project matching items.

Early discussions regarding reporting with the Department may have prevented some of this. In addition, it would also be useful for the Department to provide funding recipients with a financial reporting template.

Budget

The Watts Working Better project budget reports a small overspend at project completion, representing 1.24% of the total reportable income and expenditure. This overspend can be attributed to the purchase of more expensive LED lights by some councils after Powercor introduced the first standard LED light to be approved for installation. The councils concerned contributed extra contribution to the income stream however this is considered non-reportable income for the CEEP budget and has not been included in the calculations below. Likewise, there are non-reportable expenses that have not been included in the budget below. The final reported overspend figure is expected to change as the remaining 361 lights are purchased and installed. The accompanying financial report will be adjusted and reported to the Department once the project is finalised.

As can be seen below, Watts Working Better achieved significant savings on the projected installation costs. This is a result of a number of factors including a number of tenderers were in the process of completing large scale lighting installation projects around the nation at the time contracts were sent out and the same installer was contracted for both DSNP's.

Project Expenditure	CEEP eligible expenditure (ex GST) incl forecast	CEEP budget (Project Plan) (ex GST)	Spending Variation (ex GST)		Comments
Lighting Supply/Materials	$2,452,749.74	$2,153,370.00	-$299,379.74	-13.9%	Lighting costs increased due to Wangaratta and Moira choosing LED's
Installation/Labour	$1,528,536.39	$1,795,923.00	$267,386.61	14.89%	Significant savings were achieved through bulk buying installation services
Communication and Promotion	$137,567.66	$140,724.00	$3,156.34	2.24%	Under budget
Project Management	$67,066.00	$133,133.00	$67,067.00	49.62%	Original budget included costs allocated to preparation and design
Administrative Cost	$100,686.00	$100,000.00	-$686.00	-0.69%	Over budget < 1%
Consultation Support - Preparation and Design	$47,229.00	$5,000.00	-$42,229.00	-844.58%	Stage 3 installation required design and preparation costs originally budgeted in Project Management.
Consultation Support - Procurement	$67,628.00	$44,650.00	-$22,978.00	-51.46%	Original budget included costs that were expended in installation costs
Consultation Support - Oversight and Management	$90,731.00	$41,642.00	-$49,089.00	-117.88%	Original budget included costs allocated to DNSP project costs
Project Costs from Distribution Network Providers (DNSP)	$271.59	$25,000.00	$24,728.41	98.91%	Original budget included costs reallocated to Consultation support - oversight and management
TOTAL EXPENDITURE	**$4,492,465.38**	**$4,439,442.00**	**-$53,023.38**	-1.19%	

Project Income	CEEP eligible expenditure (ex GST) incl forecast	CEEP budget (Project Plan) (ex GST)	Income Variation
CEEP2019 Grant	$2,959,628.00	$2,959,628.00	$0
WWB Councils Contribution	$1,479,814.00	$1,479,814.00	$0
TOTAL INCOME	**$4,439,442.00**	**$4,439,442.00**	**$0**
TOTAL OVERSPEND OF FUNDS	**-$53,023.38**	**$ 0**	**-$53,023.38**

Project Operation, Mechanism and Processes

Grater Shepparton City Council managed the overall project, while a steering committee was established to ensure clear and proper governance. The steering committee met monthly at the beginning of the project but then quarterly as installation began.

In the Powercor region, the project management of the installation was undertaken by Powercor. In Ausnet, where project management and installation services are fully contestable, project management was undertaken by Ironbark Sustainability.

For both projects, the installation contractor was ETS Electrical. The steering committee and respective project managers held regular meetings to track the progress and update the risks and issues registers, while ETS Electrical also provided weekly 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 nine participating councils – along with other Victorian councils – had been investing 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. While Watts Working Better is the first regional project of this scale to be completed, general processes have become more streamlined given the increased number of projects throughout the state and the fact that the asset owners (Ausnet and Powercor) 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 number of councils involved, the fact that councils did not own the assets they were seeking to change; and multiple funding streams.

Procurement

The steering committee prepared all of the documentation and design work for the program in conjunction with Ironbark Sustainability and tendered for the installer in the Ausnet area. A sub-committee selected ETS from this public tender process.

In procuring the hardware, councils 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 the councils' compliance and procurement risks and ensured that every 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 that can be shared with other stakeholders and also assist participation of councils into the future.

The biggest challenge was dealing with inaccurate and inconsistent data from Ausnet and Powercor. As mentioned previously Ausnet and Powercor's data (which forms the basis of electricity and maintenance costs to councils) proved to be inaccurate. It has been challenging to undertake a final audit and reconciliation of all lights because the information provided to councils by the DNSPs was different to what was found "on the ground".

Similarly, it was also difficult to identify "decorative" or non-standard lights and lights that were "cost-shared" with Vic Roads. Councils now have a greater understanding of the lighting assets it pays for. However, in the future when undertaking a changeover of the remaining lights (higher wattage lights), more extensive audits will be carried out to identify types and locations of lights[12]. Councils will also try to engage with Vic Roads before undertaking any project on the cost-shared lights to seek a contribution.

Overall the project will significantly impact on the efficiency of broader public lighting. Participating councils also own 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 the operations of most councils and with the increased technical knowledge and project management experience, councils will investigate changing over these lights. The street light project can thus be readily used as a case study for many other energy efficiency projects.

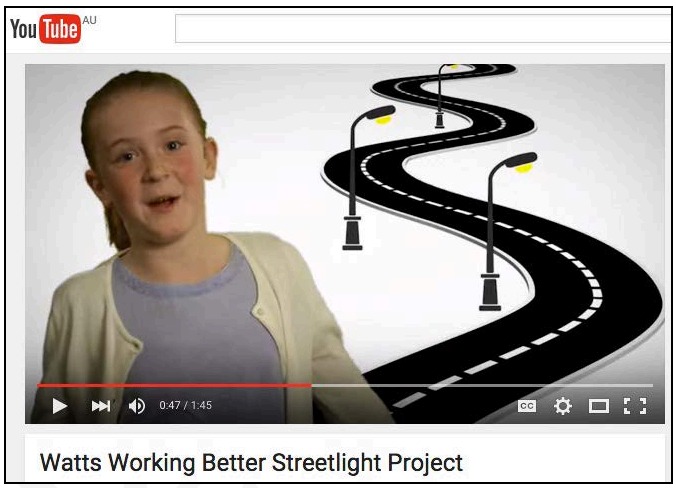
[12] Note despite the data inaccuracies it would **not** be recommended to undertake a physical audit before undertaking a standard "bulk changeover". Quite simply, it would be a waste of resources to send crews out to audit lights to confirm data only to duplicate the process a few months later with crews "on the ground" changing those lights. It is more cost effective for the crews to note data irregularities while installing the new lights.

Conclusion

Watts Working Better has resulted in the successful implementation of 12,040 modern and energy efficient LEDs and T5 lights.

This has been one of the most successful energy efficiency and greenhouse reduction projects undertaken in the region and indeed Victoria, demonstrated by the success in winning the Victorian Premier's Sustainability Award.

More importantly, councils 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 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.

Watts Working Better has built on and improved partnerships and relationships internally and with the broader community – residents, local business and DNSPs. The benefits of this project will flow into the future for the entire region.

Attachment A: Project Energy Efficiency Improvement

PROJECT TITLE	Watts Working Better	**PROJECT ID**	CEEP2019
FUNDING RECIPIENT	Greater Shepparton City Council	**DATE**	15/6/2016

Building, Facility or Site 1	
Name of Building, Facility or Site 1	Street Lights
Location (address)	Street lights throughout the municipalities of: Benalla Rural City Council (3671), Campaspe Shire Council (3564), Mansfield Shire Council (3722), Mitchell Shire Council (3660), Moira Shire Council (3643), Murrindindi Shire Council (3714), Greater Shepparton City Council (3630), Strathbogie Shire Council (3666) and Wangaratta Rural City Council (3676).
Type of building, facility or site	Street lights
Activity Type and Measure	Street lighting replacement
Energy Efficiency Estimate Method	Figures are based on real street light data – bills and number of lights. As there is essentially one technology change (80W Mercury Vapour to either 18W LED or 2x14W "T5s" lights*) it is very simple to determine savings. Inputs are very straightforward – the number of lights (from council electricity bills) multiplied by wattage of each light. 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 Australian Energy Market Operator (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 bulbs for each council so that costs can be appropriately allocated. They were: 12,040 x 80W Mercury Vapour Lights (wattage 95.8w) To calculate baseline energy use the calculation is: Number of Lights x Wattage x 365 (days/year) x 11.94 (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. The 2x14W "T5s" have a nominal wattage of 28W but a total wattage of 30.5
Baseline Energy Usage	Baseline energy use 18,096,379 MJ per annum
Baseline Energy Efficiency	Councils' lighting stock primarily comprised standard 80 Watt mercury Vapour lights (80W MV), which uses around 4.3 times more energy than more efficient technologies that are currently available and approved: KMs of roads that are P category: 1,400 km Number of P lights: 12,040 Energy consumption: 18,096,379 MJ Energy consumption per KM of road per year: 12,926 MJ/KM/Year Energy consumption per KM of road per day: 35 MJ/KM/Day 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).
Energy Efficiency Improvement	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 as it is regulated by AEMO (see above). The new lights are 18W LEDs and 2x14W "T5s". 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). The new energy use is 5,297,246 MJ per year. This project will save 12,799,134 MJ, which amounts to a saving of 71% relative to the existing lights that would be replaced.
Reporting Data (Measuring Energy Efficiency and Additional Data)	Council has a total of 1400KM of P-Category specific to this project Average hours of operation of lights per day: 11.94 hours Percentage of the day lights are operational: 49.8% Assumptions • Energy price increases at 5% per year. • OMR prices are as stipulated in AER Determinations and data from Ausnet Services and Powercor • All savings and cost figures are GST Exclusive; • Operating hours of lights are 11.94 hours per day in Vic
Cost of Activity	$4,468,380.18 (includes forecast expenditure)
Estimated Cost Savings	$19,465,423 over 20 years or an average of $973,271 per year.

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 …… *(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 an offence under the *Criminal Code Act 1995*.

☐ 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: ...../...../.....

Name: .....

Position: ..... Organisation: .....

Witness Signature: ..... Date: ...../...../.....

Name: .....

Position: ..... Organisation: .....

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.