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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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## Definitions

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AER</td>
<td>Australian Energy Regulator</td>
</tr>
<tr>
<td>AS/NZS 1158</td>
<td>Australian and New Zealand standards for lighting for roads and public spaces.</td>
</tr>
<tr>
<td>Category P</td>
<td>Category P refers to Pedestrian Category Roads</td>
</tr>
<tr>
<td>Category V</td>
<td>Category V refers to Vehicle Category Roads</td>
</tr>
<tr>
<td>CFL</td>
<td>Compact fluorescent lamps are a fluorescent lamp designed to replace HID and incandescent lamps</td>
</tr>
<tr>
<td>Colour temperature</td>
<td>The measurement of light colour expressed in Kelvin (K). The lower the Kelvin rating the “warmer” or more yellow the light is. The higher the Kelvin rating the “cooler” or more blue the light is.</td>
</tr>
<tr>
<td>Control gear</td>
<td>An internal component of a street light that ignites the lamp and/or provides a regular flow of electric current to the lamp</td>
</tr>
<tr>
<td>HPS</td>
<td>High Pressure Sodium lamp</td>
</tr>
<tr>
<td>Lamp (globe)</td>
<td>The lamp emits light and is located within the luminaire (lantern).</td>
</tr>
<tr>
<td>LED</td>
<td>Light Emitting Diode</td>
</tr>
<tr>
<td>Luminaire</td>
<td>A device that distributes, filters or transforms the light emitted by a lamp or lamps and which includes all the items necessary for fixing and protecting these lamps.</td>
</tr>
<tr>
<td>MH</td>
<td>Metal Halide lamp</td>
</tr>
<tr>
<td>MV</td>
<td>Mercury Vapour lamp</td>
</tr>
<tr>
<td>OMR charges</td>
<td>Operation, Maintenance and Replacement service charges are charges attributed to each light covering management and repairs or replacements due to failures.</td>
</tr>
<tr>
<td>PE Cell</td>
<td>Photoelectric Cell. Common switching mechanism for street lighting that turns lights on at dusk when ambient light levels drop below a set point. Vice-versa for dawn.</td>
</tr>
<tr>
<td>Spacing</td>
<td>Spacing refers to the distance between two road lights</td>
</tr>
<tr>
<td>T5</td>
<td>A new tubular fluorescent lamp providing lower energy use than most current lamps.</td>
</tr>
<tr>
<td>WDV</td>
<td>Written Down Value. A regulated figure that relates to the book value of the existing assets. When the assets are replaced this figure must be paid out.</td>
</tr>
</tbody>
</table>
1. Summary

Monash City Council has engaged Ironbark Sustainability to produce a Street Lighting Bulk Change Business Case. This is a revision of a business case from 2012 using updated figures and taking into account Council comments.

In total, Monash City Council has approximately eight thousand, two hundred 80-Watt Mercury Vapour (MV) streetlights in Category P (residential) streets. In addition there are one hundred and seventy five 125-Watt MV as well as five 50-Watt MV streetlights that could also be changed in the same program. In almost all instances, these streetlights are owned and operated by local distribution business United Energy. (See Appendix 1 for details).

The majority of these streetlights¹ can be replaced by either T5, Compact Fluorescent or LED streetlights, which reduce energy usage by 68%, 62% and 70% respectively, compared to the existing 80-Watt Mercury Vapour streetlights. In addition to offering lower costs, energy consumption and greenhouse emissions, the new lights provide better lighting outcomes for the community, including:

- Greater uniformity of light across and along the street,
- Better color rendering and visibility,
- Less depreciation of the light output over time, and
- Lower glare.

The choice between these technologies as well as the method of procurement is up to the discretion of Council. The cost and greenhouse savings analysis of this report provides a guide as to which option may be most suitable. Councils typically have the option of direct procurement from the distributor, collective procurement (regionally or through the Municipal Association of Victoria), or as an individual Council procuring to the market.

In total, the projects considered in this analysis are expected to cost between $3.3 million and $6.1 million. Net cost savings to 2031 (after project costs) are projected to be between $5.8 million and $19.2 million. The project becomes cash flow positive in 6 to 9 years depending on which technology and implementation timeframe is adopted. An abridged overview of the project costs and savings is provided in the table below.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Optimistic</th>
<th>Average</th>
<th>Pessimistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total project cost</td>
<td>$ 3.3m</td>
<td>$ 6.1m</td>
<td>$ 3.3m</td>
</tr>
<tr>
<td>Simple net savings</td>
<td>$ 19.2m</td>
<td>$ 13.15m</td>
<td>$ 14.1m</td>
</tr>
<tr>
<td>Greenhouse reduction (tonnes over 20 years)</td>
<td>56,113</td>
<td>57,089</td>
<td>56,113</td>
</tr>
<tr>
<td>Year where cash flow is positive</td>
<td>6</td>
<td>9</td>
<td>6</td>
</tr>
</tbody>
</table>

¹ If on standard poles. Lights on non-standard poles can still be changed, but would require a separate project.
2. Background to Monash’s Street Lighting Assets

According to the latest street lighting billing data provided by Council, the City of Monash contains a total of 13,271 streetlights. Of these, the vast majority are either Mercury Vapour or High Pressure Sodium lights, with the remainder consisting of Metal Halide and Fluorescent lamp types. The majority of this lighting is owned and managed by distribution business United Energy, although a portion is cost shared with Vic Roads. Council pays a service charge to the distributor to maintain the light and pole over its life. The following table provides a summary of these lights.

<table>
<thead>
<tr>
<th>Light Type</th>
<th>Percentage</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mercury Vapour</td>
<td>64.8%</td>
<td>8,597</td>
</tr>
<tr>
<td>High Pressure Sodium</td>
<td>34.7%</td>
<td>4,606</td>
</tr>
<tr>
<td>Fluorescent</td>
<td>0.05%</td>
<td>6</td>
</tr>
<tr>
<td>Metal Halide</td>
<td>0.5%</td>
<td>62</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>13,271</td>
</tr>
</tbody>
</table>

Mercury Vapour Technology

High Intensity Discharge (HID) street lighting makes up the majority of Australia’s current street lighting inventory. There are three common varieties of HID lamps: High Pressure Sodium (HPS), Metal Halide (MH) and Mercury Vapour (MV). Of these, Mercury Vapour is the most inefficient.

Energy efficient alternatives to MV technology include High pressure Sodium for major roads and Fluorescent and LED technology for residential streets. The most common MV light is the 80-Watt Mercury Vapour street light (80W MV).

80W MV lights are the current standard for residential street lighting. In Australia they number in the hundreds of thousands. For Monash, they represent 65% of Council’s street lighting inventory. When considering that as much as 70% in energy savings can be realized for these lights they are obvious target for replacement.

B2224

<table>
<thead>
<tr>
<th>Description</th>
<th>Technical Data</th>
<th>Image</th>
</tr>
</thead>
<tbody>
<tr>
<td>The B2224 is the most common 80W MV in Australia, having been the category P light of choice for around two decades. It is expected that B2224a make up in excess of 90% of all 80W Mercury Vapour streetlights. Most B2224 currently in operation will be nearing or beyond their typical life-span of 20 years.</td>
<td>Manufacturer: Sylvania</td>
<td>Sylvania</td>
</tr>
</tbody>
</table>
Suburban

<table>
<thead>
<tr>
<th>Description</th>
<th>Technical Data</th>
<th>Image</th>
</tr>
</thead>
</table>
| By the late 1990s the Suburban replaced the B2224 for new installations. Better light distribution and spacing was achieved. Usually 5-10% of overhead power networks have these lights in Vic. In underground powered areas they | Manufacturer: Sylvania  
Lamp: 80W MV  
System Wattage: 96W  
Life Span: 20 Yrs  
Max P5 Spacing: 81.5m  
Max P4 Spacing: 58.8m | ![image](https://example.com/suburban-image.jpg) |

Energy Efficient Technologies - Luminaires

Standard luminaire replacement options are limited to a select range of approved technologies. This is due to the combined effects of limited competition, stringent Australian Standards and meticulous approvals processes. Alternate luminaires are added periodically to the approved lists.

The following tables provide an overview of the current ‘standard’ energy efficient replacement options for 80-watt mercury vapour streetlights, as well as an up-coming LED replacement.

### 32W/42W Suburban Eco HE CFL

<table>
<thead>
<tr>
<th>Description</th>
<th>Technical Data</th>
<th>Image</th>
</tr>
</thead>
</table>
| The 32W Suburban Eco HE is currently the CFL replacement of choice in Victoria. The 42W unit is used when higher light output is desired (for high profile locations). | Manufacturer: Sylvania  
Lamp: 32/42W CFL  
System Wattage: 36.6/46.4W  
Max P5 Spacing: 84.9/84.2m  
Max P4 Spacing: 61.4/60.7m | ![image](https://example.com/suburban-eco-he-cfl.jpg) |

### T5

<table>
<thead>
<tr>
<th>Description</th>
<th>Technical Data</th>
<th>Image</th>
</tr>
</thead>
</table>
| The T5 provides an alternative (and more energy efficient) option to the CFL. There are now 3 alternative T5 products. T5’s are currently the energy efficient replacement option of choice in Victoria (around 80-90% of installations over the past few years – or 30-40,000 units). | Manufacturer: Pierlite, Artcraft, Streetworx  
Lamp: 2x14W T5  
System Wattage: 30.5W  
Max P5 Spacing: 83.3m  
Max P4 Spacing: 60.0m | ![image](https://example.com/t5.jpg) |

### StreetLED 25W

<table>
<thead>
<tr>
<th>Description</th>
<th>Technical Data</th>
<th>Image</th>
</tr>
</thead>
</table>
| The StreetLED is a P Category LED which is the lowest Wattage option but also the highest cost. | Manufacturer: Sylvania  
Lamp: 25W LED  
System Wattage: 28.3W  
Max P5 Spacing: 90.1m  
Max P4 Spacing: 75.8m | ![image](https://example.com/streetled-25w.jpg) |
3. Bulk Change Business Case

Implementation Options

The bulk change business case itself involved modeling three scenarios:

1. Optimistic
2. Pessimistic
3. Average

The modeling of the different scenarios were varied in the following ways:

Table 3: Implementation scenarios

<table>
<thead>
<tr>
<th>Variable</th>
<th>Optimistic</th>
<th>Average</th>
<th>Pessimistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual maintenance price rises</td>
<td>6%</td>
<td>3%</td>
<td>0%</td>
</tr>
<tr>
<td>Energy price rises²</td>
<td>High</td>
<td>Average</td>
<td>0% increase over 20 years</td>
</tr>
<tr>
<td>Technology choice³</td>
<td>T5</td>
<td>T5</td>
<td>CFL</td>
</tr>
</tbody>
</table>

In addition to the scenarios assessed above, an analysis of the impact of different technology choice has been made. This assessment used the average scenario and then assessed the impact of choosing LED, T5 or CFL lighting. It should be noted that the Pessimistic scenario is highly unlikely (i.e. assuming energy prices and maintenance costs will not rise), however, it is useful in providing a boundary on the possible worst case.

Summary of Outcomes

Tables 4 and 5 below summarise the overall outcomes from the three scenarios (as outlined in Table 2 above) and the technology choice (outlined in Table 3).

Table 4: Outcomes of different implementation scenarios

<table>
<thead>
<tr>
<th>Measure</th>
<th>Optimistic</th>
<th>Average</th>
<th>Pessimistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total project cost</td>
<td>$3,271,803</td>
<td>$3,271,803</td>
<td>$3,325,665</td>
</tr>
<tr>
<td>Simple net savings</td>
<td>$19,145,483</td>
<td>$14,115,208</td>
<td>$5,820,788</td>
</tr>
<tr>
<td>Net present value</td>
<td>$6,926,016</td>
<td>$5,018,481</td>
<td>$1,739,915</td>
</tr>
<tr>
<td>Greenhouse reduction (tonnes over 20 years)</td>
<td>56,113</td>
<td>56,113</td>
<td>50,812</td>
</tr>
<tr>
<td>Year at which the project is cash flow positive</td>
<td>6</td>
<td>6</td>
<td>7</td>
</tr>
</tbody>
</table>

The three scenarios show that the year in which the investment from council is paid back is between 5 and 7 years. The overall savings range from nearly $20m (over 20 years) using the Optimistic scenario compared with $5.8m of savings in the Pessimistic model.

Table 5: Outcome of different technology choices

<table>
<thead>
<tr>
<th>Measure</th>
<th>LED</th>
<th>T5</th>
<th>CFL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total project cost</td>
<td>$6,066,716</td>
<td>$3,271,803</td>
<td>$3,325,665</td>
</tr>
<tr>
<td>Simple net savings</td>
<td>$13,149,534</td>
<td>$14,115,208</td>
<td>$13,012,942</td>
</tr>
<tr>
<td>Net present value</td>
<td>$3,310,193</td>
<td>$5,018,481</td>
<td>$4,499,160</td>
</tr>
<tr>
<td>Greenhouse reduction (tonnes over 20 years)</td>
<td>57,089</td>
<td>56,113</td>
<td>50,812</td>
</tr>
<tr>
<td>Year at which the project is cash flow positive</td>
<td>9</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 5 summarises the outcomes of different technology choices (based on the average scenario from Table 3). This table is useful in that it provides a summary of the current technology options. The modeling shows that the capital cost varies significantly if using the LED ($6.1m) and the Fluorescent options ($3.3m). The simple savings are similar for all options ($13-14m), however, the net present value for the LED is worse (at

² Energy price rises detailed in Appendix 1
³ The T5 is currently the technology that provides the best long term cost savings for Council
$3.3m) to the fluorescents ($4.5-5m). Greenhouse savings are highest with the LED and this is expected to improve over time.

**CAUTION:**
The LED light is not currently approved for use by Council distribution business and the assumptions used in building the cost model for this technology uses estimated values. The T5 and CFL costs have known costs attributed and as such the modeling is expected to be more accurate.

LED technology is progressing at a rapid rate. Australian suppliers of LED street lighting are updating their products in check with advancements in the technology. Over the past three years this has seen LED street lighting advance from a fledgling technology to a realistically viable option for street lighting.

It is recommended not to choose a technology of choice until Council is ready to procure the project (i.e. budget is allocated and the project planning has been largely completed). Technology costs and benefits change rapidly – so the best time to choose the technology choice is just before it is purchased.

Prices for these lights change often and without notice. This business case is based on the prices current at 01 May 2013. In the case of a multi-year program, it is important to reassess the costs and any approved comparison technologies before each phase of implementation. The cost of this assessment has not been included in the model.

**Cash Flow Analysis**

The following graphs illustrate the cumulative cash flow of the different project options (using the simple savings model). The far-left bar in the one-year scenarios represents the initial capital outlay. Maintenance and energy savings for each subsequent year results in a gradual erosion of the initial capital outlay until cash flow is positive. After this point ‘profit’ is accumulated. (See Appendix 2 for all numbers relating to the graphs).

As can been seen in the three following graphs, the Optimistic scenario becomes cash flow positive in it’s fifth year, the Average scenario in it’s sixth year and the Pessimistic scenario in the seventh year.
Average Scenario

Pessimistic Scenario
4. Social implications

The energy efficient options all perform comparably under a range of social criteria. All are a significant improvement on the existing 80W MV particularly in terms of evenness of light spread and reduced mercury content.

Most are manufactured in Australia and are Australian owned technologies.

Safety and amenity for pedestrians and cyclists

Generally it is undesirable to light residential streets above the minimum required standard. Doing so creates unnecessary cost and greenhouse emissions. In many areas, residents have a preference for low levels of lighting.

However in some areas, higher levels of lighting may be desirable to encourage walking, cycling and use of public transport. In areas where there are concerns about safety at night, it may improve perceptions of safety and residential amenity to exceed the Australian Standards for lighting levels. Council may also have specific policy objectives (such as pedestrian connectivity between transport nodes and shopping centres) that can be supported with higher levels of light in strategic locations.

The bulk change is an unprecedented opportunity to reassess the Category P (residential street) lighting design to address local needs. Higher lighting levels can be achieved in selected locations by installing higher output varieties of the main LED and fluorescent options. In certain circumstances, additional lights may also be installed.

Extra lights or higher than required wattage lights incur extra cost to purchase and to operate. Because consultation has not yet been undertaken to determine priority areas, Ironbark cannot accurately estimate the cost implications of this approach. However it is very likely that the cost of these brighter lights would be insignificant in the context of the wider changeover with significant opportunity to take advantage of improved social outcomes.

This can be planned for in the standard bulk replacement program.

Public Awareness

The majority of residents and visitors in Monash are unlikely to notice the outcomes of an energy efficient street lighting upgrade scheme.

Council may deem it appropriate to provide communications about the program to residents via mail-outs, local newspapers, the web and other media outlets. This will raise Council’s position as a leading player in the promotion of energy efficient practices in the community.
5. Project Procurement

Council is generally required by Local Government Act Section 186 to tender any projects of this scale. However, distributors have sometimes indicated concern about the risk implications of allowing contractors not under their direct supervision to undertake works on and around their assets. Some have been vocally opposed to contestability. This position runs contrary to the Australian Energy Regulator’s advice that "The upfront installation cost of a luminaire is negotiable between distributors and public lighting customers. Customers can obtain these services from a party other than the distributor and therefore the AER does not assess a charge for the initial installation cost of a luminaire."4

In the course of Ironbark’s work at six Victorian councils, these distributors have clarified their approach to Councils tendering for implementation of luminaire changeover programs. Council can now access a contestable procurement process through the MAV street lighting support program.

MAV Procurement

The procurement process and options described above provides a simplified summary of a complicated set of strategic and business decisions. To assist councils in managing the complex procurement landscape associated with the transition to energy efficient street lighting, MAV (Municipal Association of Victoria) Procurement, working in partnership with Ironbark Sustainability, will be offering procurement services to any councils seeking assistance with this process.

In facilitating the procurement process on behalf of councils, MAV Procurement and Ironbark seek to achieve better financial outcomes for members by leveraging economies of scale and a streamlined and efficient process, while simplifying the resource requirements and ensuring full compliance with the Act.

Procurement in the United Energy distribution area

Regardless of whether Council joins the MAV Procurement / Ironbark program or not, below is the recommended approach to procurement as of May 2013 for United Energy.

United Energy (UE)

- Council / Ironbark and MAV Procurement prepare all documentation and design work for the project
- Council / MAV Procurement tenders for the supply and installation of all materials for the project5
- Council / MAV Procurement requests quotes from independent project management companies
- Energy distribution business provides a quote for the non-contestable works
- Council selects and engages the labour contractor, project manager and supplier/s
- Council manages the contracts
- Project manager manages the delivery of the project
- Project manager works with distribution business during the project finalisation and provides project summary and sign off to council


5 The installation contractor needs to be approved by the DB for the works within their distribution region. The materials need to be approved standard materials by the DB.


6. **Recommended Next Steps**

Based on the information provided within this preliminary business case and Ironbark’s experience with bulk changes in Victoria. Ironbark and MAV Procurement are assisting many Victorian Councils to deliver the street lighting bulk replacement program. See [www.mav.asn.au/policy-services/procurement/energy-efficient-street-lighting/Pages/default.aspx](http://www.mav.asn.au/policy-services/procurement/energy-efficient-street-lighting/Pages/default.aspx) for more information.

The following steps are delivered in the MAV/Ironbark support program and are recommended to progress the bulk change further:

A. **Prepare financial analysis**
   - a. Develop clear business case *(completed)*
   - b. Present business case to Council to gauge interest in the program. This can also be the right time to check timeframes for the roll out (1yr vs. 4yrs for example);

B. **Apply for funding and or financing**
   - a. Investigate all internal and external avenues

C. **Define Council’s requirements for the program (allow 3 to 6 months)**
   - a. Develop Lighting Design Policy to drive the bulk change
   - b. Consult around the requirements for the new lights (in particular around safety and the treatment of public transport);
   - c. Assess current lighting treatment within this context and compile and final design and specification for Council’s required replacement program;

D. **Procure the bulk change (allow 2 to 4 months)**
   - a. Consider options for procurement including tendering or direct engagement with the relevant distribution authority (taking into consideration the Local Government Act and the best cost solution)
   - b. Procure based on this consideration;

E. **Manage the bulk change**
   - a. Ensure clear communication during the bulk change program occurs including consideration of media, complaints, timelines, variations, invoicing and incident provisions;

F. **Finalise and report to Council outcome**
   - a. Post-project follow-up

These costs are largely dependent on the amount of internal time and expertise able to be allocated to the project, the number of lights being replaced and the specific distribution business area involved.

If Council plans to proceed further in scoping the project then MAV and Ironbark can discuss the next steps with Council.
7. **Other opportunities for outdoor lighting energy efficiency**

**Off street public lighting audit and efficiency program**

There are many other lights within areas that are not covered by the standard road lighting network. These include:

- Sports ground lighting
- Car park lighting
- Park lighting
- Lighting around buildings and for amenity reasons

Energy efficient replacement options exist for many of these lighting types.

In order to plan a refit or replacement program for these assets further work is required to identify, map and assess the options for each asset. A project budget and project plan could then be developed. The costs for this investigative work varies (based on location and light numbers). The assessment and mapping process could cost between $25-60,000 and the resulting projects may result in projects that can save a further $50-100,000 per year.

**Recommendation:** This project can be considered if there is additional budget for the project. It is common for Councils to decide on whether to include off street lighting after completing the preparation phase of the project. After this stage a firmer idea of project costs can then be compared to the project budget. If there is scope for expansion within the budget this is a logical area to focus on. If not, this can be addressed in a future stage.

**Expand policy work to include guidelines for all outdoor lighting**

The standard project scope includes the development of a policy document to direct the works for the replacement project. For many Councils an expansion of this work to include guidelines around preferred lighting standards for all outdoor lighting can be easily included. This work would address standards for:

- New installations in streets
- Installations in car parks, parks, sports facilities, pathways etc.
- The use of timers and other control devices
- Specific performance criteria for poles and lights

This could easily be incorporated into the project preparation phase. The same staff and stakeholders will be consulted as part of the street lighting design consultation as would be for this part of the program. Typically if completed as a separate project this work would cost around $8-15,000, within the project it will cost less than $5,000.

**Recommendation:** We recommend this be included within the standard bulk change support program. It is outside the scope of a direct replacement program, however, the addition of this work provides significant benefit for all future projects and to support staff in delivering long term sustainable asset management outcomes for outdoor lighting. Appendix 1: Assumptions for modeling
Appendix 1: Assumptions for Modeling

Assumptions – Energy Price Projections
As with any long-term economic projections, the modelling of energy price increases over the next two to four decades is difficult. Any number and combination of factors can render projections obsolete within a number of years, if not months.

Ironbark relies on relatively conservative price modeling. The source of information used in this business case is as follows:

Energy Price increases are based on the data provided on Page 123 Australian Government 2011, Strong Growth, Low Pollution: Modelling a Carbon Price

Price increases are based upon no energy price rise (conservative) or the high price in the model above. An average of the two is also used. National averages has been used in all cases.

<table>
<thead>
<tr>
<th>Number of years</th>
<th>No Change</th>
<th>High price</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-2017</td>
<td>5</td>
<td>0%</td>
<td>78%</td>
</tr>
<tr>
<td>2018-2022</td>
<td>5</td>
<td>0%</td>
<td>94%</td>
</tr>
<tr>
<td>2022-2032</td>
<td>10</td>
<td>0%</td>
<td>80%</td>
</tr>
<tr>
<td>2032-2050</td>
<td>18</td>
<td>0%</td>
<td>86%</td>
</tr>
</tbody>
</table>

This assumes the change of the carbon price (i.e. 2c increase in July 2012) has already been included. i.e. the initial electricity price is based on invoice data post July 2012.

Technology Power Consumption

<table>
<thead>
<tr>
<th>Light</th>
<th>Wattage</th>
<th>% less than 80W</th>
<th>% difference to T5</th>
</tr>
</thead>
<tbody>
<tr>
<td>2x14W T5</td>
<td>30.2</td>
<td>68%</td>
<td>0%</td>
</tr>
<tr>
<td>32W CFL</td>
<td>36.6</td>
<td>62%</td>
<td>-21%</td>
</tr>
<tr>
<td>80W MV</td>
<td>95.8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The true power consumption wattage of a light is different to the nominal lamp rating. For example an 80W Mercury Vapour has a power consumption of 95.8 Watts. All data sourced from the AEMO Public Lighting Load Table.

Individual costs for replacement
OMR, AC and WDV Sourced from regulated pricing (Australian Energy Regulator). Removal and project costs sourced from typical project costs in the United Energy areas.

Lights to be replaced

<table>
<thead>
<tr>
<th>Light</th>
<th>Number</th>
<th>Replacement</th>
</tr>
</thead>
<tbody>
<tr>
<td>50W MV</td>
<td>5</td>
<td>2x14W T5 or 32W CFL</td>
</tr>
<tr>
<td>80W MV</td>
<td>8214</td>
<td>2x14W T5 or 32W CFL</td>
</tr>
<tr>
<td>125w MV</td>
<td>175</td>
<td>2x24W T5 or 42W CFL</td>
</tr>
</tbody>
</table>

*Lighting numbers to be replaced include non-cost shared lights as well as percentage ownership of lights cost shared by council

Assumptions – Other

- OMR (maintenance) prices are for 2013 as stipulated in the United Energy 2013 Public Lighting Charges Schedule
- All savings and cost figures are GST exclusive;
- Operating hours of lights are 11.94 hrs per day in Vic
• Emission factor is 1.35kg Co2-e per KWh
• The energy price is modeled at 10.3c per kWh derived from Councils energy bills (May 2013)
• No Green Power is used by the council