CEEP 2030

Kill-a-Watt

Stirling’s Low Carbon Diet for its Biggest Power Users

Final Report

City of Stirling

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2 Executive Summary

In May 2013, the City of Stirling was advised that it has been a successful recipient of a Community Energy Efficiency Program grant from the Australian Government for its Kill-a-Watt program. The purpose of the grant was to deliver community energy efficiency education programs and undertake energy efficiency upgrades to several facilities, including the Terry Tyzack Aquatic Centre, Works Depot, Leisurepark Balga and Mirrabooka Library.

The key objectives of the program were to increase energy efficiency at facilities, improve energy management practices, educate and build community capacity, and share the outcomes and lessons learned. The program had a partial focus on targeting low socio-economic and disadvantaged communities, and to this end, a proportion of energy cost savings realised through grant funded retrofits would be funnelled into Low Carb Energy Grants for the community.

Through this program, the City implemented strategic energy efficiency upgrades to facilities including installing variable speed drives on pool pumps, lighting upgrades, air conditioning upgrades, building management system upgrades and energy monitoring upgrades. The targeted facilities were identified through the City’s Corporate Energy Management Plan as being within the ‘top ten’ highest corporate energy users, and the upgrades were identified as being a priority through various facility energy audit reports.

The City also delivered community energy efficiency education workshops, local business network events, resident home energy audits, Powerdown competitions for City staff; and also provided real-time home energy monitor services, home energy assessment kits, and energy saving booklets. For all community engagement activities, low socioeconomic groups were targeted as a priority. The City delivered print and digital communications and promotions for all the program’s activities both during and after implementation.

In relation to energy efficiency upgrades to facilities the key outcomes were a combined annual energy savings of 239,639 kWh (863 GJ) per year, energy cost savings of $48,352 per year, maintenance cost savings of $7,477 per year, 182 tonnes CO2-e reduced per year, and an overall payback return on investment of approximately 9 years. Mirrabooka Library achieved the best result for building retrofits, reducing its annual energy use by approximately 33%.

In relation to education and communication outcomes, approximately 2,000 people participated, across all activities, with 60% of participants living in suburbs of socioeconomic disadvantage. The outcomes from educational activities include:

- 112 home energy audits completed
- 800+ bilingual energy saving booklets distributed (in 8 languages)
- 54 loans of Home Energy Assessment Toolkits
- 2 Staff Easter power down competitions (Administration Centre)
- 2 Business energy network events

Surveys showed that participants in the community activities were 94-98% likely to implement energy saving initiatives at home, with 29-36% of these already having implemented changes after the workshops. Surveys also showed that 50% of respondents were aware that the City has been upgrading buildings and community facilities for energy efficiency, and nearly 74% were aware of the education activities on offer to help residents save on their energy bills.

The Kill-a-Watt program of works was managed using the City’s project management methodology and the City used its project management processes to tightly control and monitor the program’s scope, costs, risk, quality and timelines, with regular project reviews and communications between the project management team and project delivery teams.
The program encountered several key unexpected issues that affected the scope, timeline and budget. Firstly, significant delays with starting the program resulted in the initial three-year timeframe for works being compressed into two years. The program’s timeline was then subsequently delayed due to Local Government Reform uncertainty which potentially affected the ownership of, and therefore any proposed upgrades to, the Terry Tyzack Aquatic Centre.

In relation to scope, various issues prevented the program’s two largest proposed energy efficiency upgrades from being progressed. Local Government Reform delays meant that the cogeneration system at Terry Tyzack Aquatic Centre could not be implemented in the required grant timeframes. The cogeneration system installation proposed to be installed at Leisurepark Balga’s was not progressed because a detailed feasibility report deemed that the project was not cost effective. The City’s original high level energy report, on which the grant application was based, had been carried out a couple of years earlier and found that the project would provide a good return on investment.

With these large scope variations and other minor changes, the original program budget of $2.59 million was reduced in agreement with the funding body. The revised program had a total budget of $1,059,676 however it was completed under budget. The cost of completing activities was $879,056 resulting in $180,620 being unspent, equivalent to 17% of the total budget. In many cases, this was the result of competitive procurement processes where prices received through quotes were less than expected in the scoping stage. In some cases, planned activities were not implemented due to technical, financial or feasibility issues.

The key learning outcomes for the City in this process are as follows. In relation to program scope and costs, in some cases, it was determined in the detailed design phase that projects or parts of projects were no longer viable or cost effective, that the scope needed to be adjusted or that budgets were insufficient. This highlights the inherent risks of scope and costs changing between an initial high level audit carried out by a consultant and a subsequent detailed design also carried out by a consultant. The key learning for future projects is that a contingency budget must be included in all energy efficiency project costings and the City should be cautious with using high-level energy audit costings or other recommended costings or budgets that are more than one year old.

In relation to program timelines, the City should also allow extra time for internal consultation to ensure that the scope of works is equivalent to the human resource capacity and timeline available. The key learning is that compressing timelines on projects creates undue pressure on staff, especially when extra human resources cannot be allocated to increase productivity on projects. The other learning in this area is that in future, the City should add more contingency time to all project implementation timelines to allow for potentially unforeseen supply delays.

In relation to communications, the key learning was that educational activities were more successful when the City partnered with local organisations to provide activities that were at a convenient time and place for participants.

With all areas considered, this grant-funded program has achieved its intended objectives to improve energy efficiency at the City and encourage improved energy practices at the City and in the local community.

“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.”
3 Objectives

The objectives of the wider Community Energy Efficiency Program were to:

- Support a range of local councils and community organisations to increase the energy efficiency of different types of non-residential council and community-use buildings, facilities and lighting
- Demonstrate and encourage the adoption of improved energy management practices within councils, organisations and the broader community

With an aim to achieve the wider objectives, Stirling’s Kill-a-Watt Program had the following goals:

- Increase corporate energy efficiency at the City of Stirling
- Encourage improved energy management practices
- Share the project outcomes and lessons with the community and other councils and organizations
- Ensure that lessons learned are sustained within the organisation and in the community
- Educate and build community capacity about energy efficiency within the organisation, other organisations and the broader community
- Provide cost-effective, innovative approaches that could be more widely adopted by other building and facility owners
- Assist low socio-economic and disadvantaged communities to implement energy efficiency practices through Low Carb Energy Grants.
4 Energy Efficiency Activities

4.1 Facilities Upgraded

The following facilities received energy efficiency upgrades as part of the CEEP grant funded project:

- Terry Tyzack Aquatic Centre
- Leisurepark Balga
- Works Depot
- Mirrabooka Library

All of these facilities upgraded were identified in the City’s Corporate Energy Management Plan as facilities needing energy efficiency improvements. The City’s Corporate Energy Management Plan 2012 listed Terry Tyzack Aquatic Centre in the ‘top ten’ energy using facilities in the City of Stirling, specifically it was identified as the highest energy using facility, consuming 15% of the corporate energy baseline in 2010/11, and costing $403,055.

Leisurepark Balga is located in Balga, a low socioeconomic suburb (857.9 – Aus Decile 1). The City’s Corporate Energy Management Plan 2012 listed Leisurepark Balga in the ‘top ten’ energy using facilities in the City of Stirling, specifically it was identified as the third highest energy using facility, consuming 11.4% of the corporate energy baseline in 2010/11, and costing $287,419.

The City’s Corporate Energy Management Plan 2012 listed the Works Depot in the ‘top ten’ energy using facilities in the City of Stirling, specifically it was identified as the fourth highest energy using facility, consuming 5% of the corporate energy baseline in 2010/11, and costing $118,085.

Mirrabooka Library is located in Mirrabooka, a low socioeconomic suburb (876.2 – Aus Decile 1). The City’s Corporate Energy Management Plan 2012 listed Mirrabooka Civic Centre in the ‘top ten’ energy using facilities in the City of Stirling, specifically it was identified as the ninth highest energy using facility, consuming 2% of the corporate energy baseline in 2010/11, with a cost of $65,653.

4.2 Technologies Utilised

4.2.1 Mix of technologies used

The following mix of energy efficiency and monitoring technologies were utilised as part of the Kill-a-Watt program of works:

- Installation of Variable Speed Drives (VSD) on pool pumps
- Replacement of halogen, metal halide and fluorescent lighting with Light-Emitting Diode (LED) lighting
- Upgrades to Heating, Ventilation, and Air Conditioning Systems (HVAC)
- Upgrades to Building Management Systems (BMS)
- Installation of data logging equipment
4.2.2 Technological Choices

4.2.2.1 Variable Speed Drives (VSD)

Electricity consumption from pool pumps was identified as a large contributor to energy consumption and emissions at the City’s aquatic centres. Installation of variable speed drives on pool pumps was chosen as a technology because VSDs are known to improve energy efficiency by allowing pumps to operate at optimum speed according to demand rather than at constant maximum speed, resulting in an improved energy efficiency outcome. Efficiencies are also achieved through the power conditioning (for example power factor correction) provided by the VSDs.

4.2.2.2 LED Lighting

Lighting was identified as a significant consumer of electricity at several facilities. At Mirrabooka Library, lighting was the highest energy end use at 40% of the total building consumption. At the Works Depot, it was also the highest energy end use at 31% of total building consumption. Building energy audits and lighting assessments carried out by consultants identified that good energy savings could be achieved through the upgrading of a range of inefficient lighting, such as halogen, fluorescent and metal halide lights, to energy efficient LED lighting.

The LED lighting upgrades were complementary to the HVAC upgrades at Mirrabooka Library and the Works Depot as LED lights have a significantly lower operating temperature than conventional lights, and therefore will reduce the thermal load on the air-conditioning system in these buildings.

4.2.2.3 HVAC Upgrades

Air conditioning was determined to be one of the highest consumers of electricity at the Works Depot and Mirrabooka Library, accounting for 39.5% of total building consumption. A number of cost effective opportunities to improve air conditioning performance and efficiency were identified by the building energy audits. These included upgrading economy cycle systems, installing 365 day timers, optimising controls and recommissioning the systems, including rebalancing the air supplies.

4.2.2.4 Building Management System

Building Energy Audits had recommended that Building Management Systems (BMS) at the two aquatic centres would benefit from being upgraded to provide improvements in energy efficiency by enabling facility managers to:

- monitor the operations of facility systems
- identify issues and equipment failure
- identify unusual patterns of energy usage; and
- optimise systems’ performance through adjusting set points, reducing loads and operating hours and by extending the operational life of equipment and systems.

4.2.2.5 Data Logging Equipment

Existing electricity metering was insufficient to monitor energy use of the air-conditioning and lighting loads at Mirrabooka Library and the Works Depot in order to measure savings from the energy efficiency projects. As such, and based on the electrical wiring configurations at the two buildings, the City determined that data logging equipment could be installed on the lighting, air-conditioning and two power sub-circuits at Mirrabooka Library, which also provided the total Library electricity use (separate from the Community Centre which is on the same utility meter). Data logging equipment was also installed at the Depot to measure the air-conditioning energy use in the Administration building.
4.3 Upgrades to Facilities

The following energy efficiency projects were carried out in four City of Stirling buildings.

4.3.1 Terry Tyzack Aquatic Centre

4.3.1.1 Variable speed drive (VSD) installation

VSDs were installed on five pool circulation pumps and one air handling unit (AHU) motor as detailed below.

<table>
<thead>
<tr>
<th>Pump Name</th>
<th>Type</th>
<th>Wattage (kW)</th>
<th>Run Time (hrs p.d)</th>
<th>Control Sensor / Meter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leisure pool pump 1</td>
<td>Circulation pump</td>
<td>7.5</td>
<td>24</td>
<td>Flow</td>
</tr>
<tr>
<td>Leisure pool pump 2</td>
<td>Circulation pump</td>
<td>7.5</td>
<td>24</td>
<td>Flow</td>
</tr>
<tr>
<td>50 m pool pump</td>
<td>Circulation pump</td>
<td>25</td>
<td>24</td>
<td>Flow</td>
</tr>
<tr>
<td>25 m pool pump 1</td>
<td>Circulation pump</td>
<td>7.5</td>
<td>24</td>
<td>Flow</td>
</tr>
<tr>
<td>25 m pool pump 2</td>
<td>Circulation pump</td>
<td>7.5</td>
<td>24</td>
<td>Flow</td>
</tr>
<tr>
<td>AHU No. 2 motor</td>
<td>Fan Motor</td>
<td>18.5</td>
<td>24</td>
<td>BMS</td>
</tr>
</tbody>
</table>

4.3.1.2 Building management system upgrade

The existing BMS system was upgraded to allow the monitoring and some control (as well as future control optimisation) of the pool and spa heating systems (including boilers, pumps and VSDs), pool treatment system, and indoor pool HVAC systems.

4.3.2 Leisurepark Balga

4.3.2.1 Variable speed drive (VSD) installation – pool pumps

VSDs were installed on 13 pool heating and circulation pumps as detailed below.

<table>
<thead>
<tr>
<th>Pump Name</th>
<th>Pump Type</th>
<th>Motor Size (kW)</th>
<th>Run Time (hrs p.d)</th>
<th>Control System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leisure Pool Pump 1</td>
<td>Circulation Pump</td>
<td>11</td>
<td>24</td>
<td>Flow</td>
</tr>
<tr>
<td>Leisure Pool Pump 2</td>
<td>Circulation Pump</td>
<td>11</td>
<td>24</td>
<td>Flow</td>
</tr>
<tr>
<td>Hydro Pool Pump 1</td>
<td>Circulation Pump</td>
<td>5.5</td>
<td>24</td>
<td>Flow</td>
</tr>
<tr>
<td>Hydro Pool Pump 1</td>
<td>Circulation Pump</td>
<td>5.5</td>
<td>24</td>
<td>Flow</td>
</tr>
<tr>
<td>River Jet Pump</td>
<td>Circulation Pump</td>
<td>15</td>
<td>14</td>
<td>Flow</td>
</tr>
<tr>
<td>Pump Name</td>
<td>Pump Type</td>
<td>Motor Size (kW)</td>
<td>Run Time (hrs p.d)</td>
<td>Control System</td>
</tr>
<tr>
<td>---------------------------</td>
<td>----------------------</td>
<td>-----------------</td>
<td>-------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>25m Pool Pump 1</td>
<td>Circulation Pump</td>
<td>11</td>
<td>24</td>
<td>Flow</td>
</tr>
<tr>
<td>25m Pool Pump 2</td>
<td>Circulation Pump</td>
<td>11</td>
<td>24</td>
<td>Flow</td>
</tr>
<tr>
<td>HWP-01</td>
<td>Heat circulation Pump</td>
<td>3</td>
<td>20</td>
<td>Heat</td>
</tr>
<tr>
<td>HWP-02</td>
<td>Heat circulation Pump</td>
<td>3</td>
<td>20</td>
<td>Heat</td>
</tr>
<tr>
<td>Leisure Heating Pump</td>
<td>Heating Water Pump</td>
<td>0.55</td>
<td>24</td>
<td>Heat</td>
</tr>
<tr>
<td>Hydro Heating Pump</td>
<td>Heating Water Pump</td>
<td>0.55</td>
<td>24</td>
<td>Heat</td>
</tr>
<tr>
<td>25m Heating Pump</td>
<td>Heating Water Pump</td>
<td>0.55</td>
<td>24</td>
<td>Heat</td>
</tr>
<tr>
<td>Spa jet Pump</td>
<td>Jet pump</td>
<td>1.5</td>
<td>14</td>
<td>Flow</td>
</tr>
</tbody>
</table>

### 4.3.2.2 LED lighting upgrade

Existing inefficient lighting was replaced with LED lighting in the following areas of the building:

- Entry foyer, passageways and reception
- Leisure, 25m and hydrotherapy / program pool halls
- Kiosk, lounge and duty station
- Back of house areas including offices, kitchen, plant rooms and staff rooms
- Areas of the Community Centre including meeting room, lockers, stage/backstage, lobbies, passageways, boxing gym, spin room and sports hall
- Carpark and water playground post tops

The upgraded lighting included over 101 T8 fluorescent lights, 145 CFLs, 53 halogen downlights and 83 metal halide fittings. These were replaced with almost 388 LED fittings, including recessed light panels, surface mounted linear fittings, downlights, highbays and floodlights.

### 4.3.2.3 Building management system (BMS) upgrade

The existing BMS system was upgraded to allow monitoring and some control (as well as future control optimisation) of the pool heating system (including boilers, pumps and VSDs), pool treatment system, and HVAC systems for pool areas, entry and administration areas.
4.3.3 Works Depot

4.3.3.1 Heating Ventilation and Air Conditioning (HVAC) system optimisation

The HVAC system controls in the administration building of the Works Depot were upgraded and recommissioned, including the installation of a 365 day time clock controller and the rebalancing of air supplies. The system was programmed to turn off on public holidays and other times when the Depot is not in use and to provide automatic seasonal adjustment of the temperature settings.

4.3.3.2 Lighting upgrade

Existing lighting was upgraded to LED lighting in the following areas of the building:

- Administration Building - individual offices; toilets, corridors, foyers and lobbies; tea room and lunchroom.
- Workshop Building - workshops, offices, tea room and storerooms.
- Purchasing/Stores Building - offices.

The upgraded lighting included 92 T8 fluorescent lights, 42 CFLs and 36 metal halide fittings. These were replaced with 170 LED fittings, including recessed panels, surface mount linear fittings and downlights.

Eighteen motion sensors to automatically switch off lights in unoccupied areas were installed in:

- Toilets / change rooms, stores and first aid room of the Amenities Building; and
- Toilets of the Workshop Building.

4.3.3.3 Data logging equipment install

A data logger was installed on the HVAC three phase power circuit to measure the current, voltage, power and energy use of the HVAC system before and after the energy optimisation project.

4.3.4 Mirrabooka Library

4.3.4.1 Heating Ventilation and Air Conditioning (HVAC) optimisation

A new roof mounted relief air vent was installed to improve the efficiency of the HVAC system economy cycle operation (supplying main library area). The system was recommissioned by rebalancing the air flows in standard and economy cycle operation.

4.3.4.2 LED lighting upgrade

The library’s reception and main hall suspended track lighting was upgraded to LED lighting. This track lighting included 176 linear T8 fluorescent lamps and was replaced with 111 LED lamps.
4.3.4.3 Data logging equipment install

A data logger was installed to measure and remotely record the current, voltage, power and energy use of the four main three phase circuits of the Library, namely the lighting, mechanical services (HVAC), power and unprotected power. This enabled the City to measure the energy use of the lighting and HVAC systems before and after the two energy efficiency projects. It also provided the total energy use of the Library, separate from the Community Centre which is part of the building and included in the utility account data.

4.4 Issues and Learnings

4.4.1 Issues with implementing energy efficiency activities

4.4.1.1 Scoping issues or feasibility issues

There was a general issue with scope and costs changing between high level audit recommendations provided by consultants and subsequent detailed designs and budgets also provided by consultants. In numerous cases, it was determined in the subsequent detailed design phase that projects or parts of projects were not viable or cost effective, that the scope needed to be adjusted, or that budgets were insufficient. This was the result of a combination of scoping issues in energy audits and the time delay between the grant application and the awarding of the grant and delivery of projects (over two years).

Feasibility issues meant that the City was unable to proceed with the Leisurepark Balga cogeneration system installation project as the detailed feasibility study that was carried out by a consultant determined that the project was not cost effective (with a payback period of 11 years). The original high level energy report commissioned by the City a couple of years earlier – on which the grant application was based - had indicated that the project would provide a good return on investment. The City therefore recommended that the project not be implemented which was agreed to by the funding body.

In the detailed design phase of proposed HVAC upgrades, it was determined that an economy cycle already existed in part at Mirrabooka Library. This was not picked up in the original high level energy audit report upon which the original grant application was based. However, the existing economy cycle set-up was not operating efficiently due to restricted air flow from the ceiling void. Therefore, the scope was changed to instead install a roof cowl to allow the relief of air from the ductwork.

For the Works Depot’s proposed HVAC upgrades, the detailed design phase determined that it was not feasible to install an economy cycle due to the configuration of the ductwork and the additional energy required to operate a new relief air fan would negate any energy improvements. Again, this HVAC upgrade had been recommended in a previous high level energy audit report. With the new information, the scope was therefore reduced to install the 365 day timer, optimise the controls and recommission the system, including rebalancing the air supplies.

These incidents highlight the inherent risks of the projects’ scope and costs changing between initial high level audits and subsequent detailed designs.

4.4.1.2 External delays

The significant delay between the grant application, the awarding of the grant, and the program start date meant that the works needed to be rescheduled and compressed from three to two years. This created risk and issues with resourcing and delivery of a significant program of works.
Significant external delays caused by the State Government’s Local Government Reform (LGR) process in Western Australia meant that the City was unable to proceed with the Terry Tyzack Aquatic Centre cogeneration system installation project. Under LGR, the facility was proposed to change ownership to another Council. The cogeneration project could not be completed before proposed handover and therefore the cogeneration project had to be put on hold. When the State Government decided not to proceed with LGR, there was insufficient time to complete the cogeneration project within the required CEEP timeframes.

### 4.4.1.3 Supply delays

There were some significant delays in the delivery of the light fittings which had to be managed. As a result of these experiences, the City will allow more time for light fitting delivery in future project schedules (potentially up to 12 weeks). The City will also ensure that the contractor checks all fittings and components prior to taking possession and reports any missing or damaged parts immediately to the supplier.

The key learning in this area is that in future, the City should allow more contingency time to all project implementation timelines to allow for potentially unforeseen supply delays.

### 4.4.1.4 Procurement and budget issues

The City did not include contingency budgets for proposed energy efficiency upgrades in the original grant application. This put some financial pressure on the program when combined with the multi-year delay between the original energy audit recommendations and costings, and actually procuring contractors and equipment to implement the energy efficiency projects. In some cases it meant that the City had insufficient budget to procure to the desired scope.

The main issues with the Building Management System (BMS) upgrades were faced during the procurement process. It was difficult to obtain all the required information about BMS products on the market to allow the City to make informed decisions. Lower price expectations in the feasibility stage meant that there was insufficient budget at the procurement stage to install a comprehensive system with full controls/monitoring of all facility systems.

At the Works Depot and Mirrabooka Library, budget estimates for the supply of sub-metering and real-time monitoring through an online portal were insufficient, so it was not possible to proceed with this metering solution. To address the lack of budget to install real-time monitoring at the buildings, the City investigated other metering options and determined that the most cost-effective solution was to procure and install temporary data loggers to monitor electricity use on specific sub-circuits.

The key learning from these incidents is that a contingency budget must be included in all energy efficiency project costings and the City should be cautious with using energy audit costings or other recommended costings or budgets that are more than one year old.

### 4.4.2 On site or technology-specific issues

All of the facilities being upgraded were high use buildings and most were open to the public during retrofit upgrades. This created the need to schedule and implement works in order to minimise disruption, and in many cases, this involved out of hours work. These constraints were particularly pertinent at the aquatic centres which are open 364 days per year from early morning to late at night.
4.4.2.1 Leisurepark Balga VSDs

There were some technical issues with the installation and commissioning of the VSDs. Most significantly, one of the pool pumps seized following the installation of the VSD due to the poor condition of the motor and seals. This failure had to be corrected quickly due to the normal 24 hour operation of these pool pumps.

The project officer liaised with the contractor and site staff to understand and explain the above technical issues resulting from the installation of the VSDs. The contractor reacted quickly to problems and rectified failures as part of their commissioning works.

The City used the learnings from this project to better manage the subsequent VSD project. In particular, a pool pump and equipment condition evaluation was undertaken prior to the commencement of the project. This ensured that the pumps and motors were in a sufficiently good condition to allow the connection of a VSD. Facilities managers were made aware of issues at Leisurepark Balga so they could anticipate and quickly rectify any similar problems.

4.4.2.2 Leisurepark Balga lighting

Leisurepark Balga was a challenging site for replacement of light fittings as it is an aquatic centre that is open every day of the week, morning to night. The work was intrusive on the day to day operation of the facility – particularly in the pool areas - and much of the work had to be undertaken after hours.

There were some site installation issues as expected with a lighting project of this size in an aquatic centre, including in relation to lighting configurations and access, which were determined when existing fittings were removed.

The technical issues were dealt with through the discussion of solutions with the project officer, contractor and facility staff, as well as through improved ongoing communications between the different parties. Retrofit options were used or the ordering of new fittings approved where needed.

4.4.2.3 Works Depot lighting

The design allowed for direct replacement of existing fittings and the new fittings were selected based on recommended lux level requirements, room use and structural elements. Generally, very few issues were encountered during and after the works. Some staff found that the new lighting levels in the stores offices were too high for them. New dimming controls and switches were ordered for the stores office lighting to reduce the light level manually.

As a key learning, the City will ensure that lighting designs achieve the appropriate lux levels for staff. It will consider whether the use of dimmable light fittings is required.

4.4.2.4 Aquatic Centre BMS upgrades

As noted previously, there were challenges in obtaining information and understanding what BMS products were available in the market and in understanding the technical terminology involved. This made it challenging to determine what to include in the Brief for procuring the systems and to make an informed decision about quotation responses.

BMS budgets were insufficient to install a fully comprehensive system. This was partly due to the challenge of determining how systems were controlled by the existing BMS, which also had impacts on the commissioning of the new BMS.
There was limited documentation for the existing BMS controller at Terry Tyzack Aquatic Centre in particular as it was old and it was not possible to interrogate the keypad to ascertain in detail how systems were controlled. There were also limitations to what could be controlled by the BMS due to the age and condition of existing pool systems. This also added complexities to the commissioning of the BMS.

The challenges in understanding the City’s requirements and the products on the market were assisted by seeking advice from consultants with expertise in BMS technology. Information was also sought from suppliers. The project officer also involved and sought advice early from the City’s IT department to assist in understanding the communications and networking requirements of the project.

In relation to understanding the existing operation and control of the pool systems, the project officer worked closely with the facilities managers and contractor. Input from the facilities managers was also sought early in relation to their requirements and opportunities for improving the control/monitoring of systems, and in the evaluation of the functionality of the BMS’ offered during the procurement process.

5 Communications and Educational Activities

5.1 Target Groups

5.1.1 Educational Activities Target Groups

The key target group for educational activities were focused on City of Stirling residents living in suburbs identified in the lowest two quintiles of socioeconomic disadvantage – Balcatta, Glendalough, Osborne Park, Tuart Hill, Balga, Mirrabooka, Westminster and Nollamara.

Also, local service providers were targeted (whose clients would greatly benefit) including those that are financially disadvantaged, new migrants, families, seniors, and living with a mental illness:

- City of Stirling Day Centre, Nollamara
- Edmund Rice Centre, Mirrabooka
- Ishar, Mirrabooka
- Living In Retirement, Yokine
- MercyCare, Mirrabooka
- Metropolitan Migrant Resource Centre, Mirrabooka
- St Barts Community Supported Residential Units, Stirling
- The Smith Family Child Parent Centre, Westminster

Finally, local organisations were targeted that supported small businesses; Stirling Business Association, and Western Australian Business Assist.

5.1.2 Communications and Promotions Target Groups

- All City of Stirling residents.
- All users/visitors at the City’s six libraries, two aquatic centres, and Administration Centre.
- Other Local Governments.
5.2 Communications

5.2.1 Communication of Educational Activities

Marketing materials were developed for the suite of energy efficiency educational activities. These were distributed via:

- Print Media – local newspaper advertisements, the Stirling Scene (quarterly magazine to all residents).
- Posters & Flyers – in community buildings (6 libraries, 2 aquatic centres, and Administration Centre), and at service providers offices/centres.
- Digital Media - City’s website, eNewsletters, social media, digi-screens in community centres (6 libraries, 2 aquatic centres, and Administration Centre).

Examples of promotional materials are provided below:


Living Green in Stirling eNewsletter – June 2015

Living Green in Stirling eNewsletter – March 2016

Facebook post – 20 January 2016

Twitter post – 19 January 2016
City of Stirling website – captured 23 February 2016

“Save on Your Energy Bills” was at www.stirling.wa.gov.au/LivingGreen (removed when program finished)

Save on your Energy Bills
The City is currently offering FREE services to help Stirling residents reduce energy use in the home and save on their energy bills.

Save on Your Energy Bills poster

• Home Energy Audits
Request a 90 minute appointment in your home with an energy saving expert. Only 100 Home Energy Audits are available. You must be a City of Stirling Resident.

**Complete the Expression of Interest Form here.**

• Real-time Home Energy Monitor
Request use of a Home Energy Monitor for 4-8 weeks to find out what is costing you on your energy bills. A limited number of energy monitors are available. You must be a City of Stirling Resident.

**Complete the Expression of Interest Form here.**

• Energy Saving Workshops (groups)
Request to host an Energy Saving Workshop for your group or organisation. Choose from a 65 minute, 90 minute or 2.5 hour workshop. Suits groups of 15-40 people. A limited number of workshops are available. Your group/organisation must be located in the City of Stirling.

These services will be available until the 26 February 2016, unless all places are allocated earlier. Places are limited.

More information about these services can be found in each EOI form, or you can phone the City on 9205 8555.

Energy Saving (DwAff) Booklets
These booklets are now available HERE on the City's website. Available in English and a selection of bilingual versions.

These activities received funding from the Australian Government.

City of Stirling website – captured 23 February 2016

“Saving energy booklets” are at http://www.stirling.wa.gov.au/community/Action-for-sustainability/Pages/In-your-home.aspx
5.2.2 Communication of Projects

5.2.2.1 Print Media

Print media promoting the program and outcomes included; local newspaper advertisements and articles, the City’s Stirling Scene which is a quarterly magazine to all residents. An example is provided below:

![Stirling Notices (local newspapers) – 12 April 2016](image)

5.2.2.2 Digital Media

Digital media included; City’s website, e-Newsletters, social media, and ‘digi-screens’ in community centres (6 libraries, 2 aquatic centres, and Administration Centre). Some examples are provided below:

![‘Digi-screen’ promotions - snapshot only](image)


Win one of three Grand Cinema Gold Lounge vouchers!

Did you know that over the last few years, the City of Stirling has been working to improve the energy efficiency of our buildings and help residents to save on their home energy bills?

Simply complete a short survey about the City's energy saving projects to be in the running for one of these double Grand Cinema Gold Lounge vouchers including entry for two and a free food and beverage credit.

The survey closes Sunday 8 May 2016 to click the above link and complete the survey to enter the prize draw.

Sustainable Energy Projects

As part of the City's commitment to an Energy Wise City we are working hard to improve the energy performance of our buildings. This includes delivering a program of energy efficiency projects, installing solar energy systems, carrying out building energy audits, improving the monitoring of building energy consumption, incorporating Environmentally Sustainable Design (ESD) requirements in City building projects, and carrying out energy education activities.

The program of sustainable energy projects has included the installation of LED lighting, more efficient air-conditioning equipment, solar photovoltaic (PV) systems and solar water heaters. These projects are reducing energy consumption and costs in the City's buildings, increasing the City's clean energy capacity and reducing the City's greenhouse gas emissions.

Energy Efficiency

The City was the successful recipient of funding from the Australian Government to deliver community energy efficiency education programs and undertake energy efficiency upgrades to four major facilities; Terry Tyack Aquatic Centre, Leisurepark Balga, Works Depot and Mindarie Library.

Read more about these projects:
- Administration and service centres
- Aquatic and leisure centres
- Libraries and community centres

These activities received funding from the Australian Government.

Energy Use Dashboards

Want to know more about energy use at some of the City's major facilities? Click on the links below to view the energy use dashboard.

- Energy use - Administration Building
- Energy use - Leisurepark Balga
- Energy use - Terry Tyack Aquatic Centre

Living Green in Stirling eNewsletter – October 2015

More Energy Saving Upgrades

Lighting in the Administration Center's foyer and underground car park has been upgraded to 40W LED lighting, estimated to use 51% less energy.

The Works Depot office air-conditioning system was upgraded for efficiency using an estimated 19% less energy. The Depot storage area lighting was also upgraded to LED saving an estimated 55% less energy.

The Air-conditioning system upgrade project received funding from the Department of Industry and Science as part of the Community Energy Efficiency Program (CEEP).

Read more

Living Green in Stirling eNewsletter – September 2015

Leisurepark Balga Saving Energy

The City has completed another energy saving project, this time at Leisurepark Balga.

Variable Speed Drives were installed at the Centre which allow pool circulation and heating pumps to run at optimum speed.

Approximate Savings:
- 34% energy reduction - Pumps
- 16% energy reduction - Leisure Centre
- 136 tonne reduction pa - GHG emissions

This activity received funding from the Department of Industry and Science as part of the Community Energy Efficiency Program.

Read more
5.2.3 Timescales for communications and educational activities

Duration of the project and at completion as below:

<table>
<thead>
<tr>
<th>Activity</th>
<th>2014/15</th>
<th>2015/16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy efficiency workshops (Mirrabooka)</td>
<td>Q3</td>
<td>Q4</td>
</tr>
<tr>
<td>Easter staff power down (1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business energy network event (1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy efficiency workshops (Groups)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Real-time energy monitor loans</td>
<td>Q1</td>
<td>Q3</td>
</tr>
<tr>
<td>Interactive touch screen / digital promotion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home energy audits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy saving booklets - bilingual</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Easter staff power down (2)</td>
<td>Q3</td>
<td>Q4</td>
</tr>
<tr>
<td>HEAT Kit available</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HEAT Kit upgraded</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business energy network event (2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communications / Promotions - Print</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communications / Promotions - Digital</td>
<td></td>
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</tr>
</tbody>
</table>
5.3 Educational Activities

5.3.1 Energy Efficiency Workshops

City-organised workshops
In the first round of workshops, nine workshops were run in total with approximately 30 participants at the Mirrabooka Multicultural Centre which was in a low socioeconomic target suburb. Small groups attended three consecutive sessions learning about energy efficiency in the home including practical activities and take-home energy monitors. Attendees were also offered a free home energy audit. These workshops included a free crèche and interpreters.

Local Community Organisations Hosted Workshops
In the second round of workshops, local community organisations hosted energy efficiency workshops for their members/clients at no cost to participants. Approximately 260 residents attended these workshops hosted by six local organisations, of which 81% were in the targeted low socioeconomic suburbs.

5.3.2 Home Energy Monitors

Real-time home energy monitors were promoted to the community and all City residents could then request to borrow a real time home energy monitor with a display at no cost, with those living in the target suburbs prioritised. Electricians installed the monitors so participants could monitor their homes total energy consumption seeing both real-time energy use and historical use. A total of 35 households participated from 18 suburbs, with 37% from target suburbs.
5.3.3 Digital promotions

A digital promotions project was implemented. The City’s website was also updated to include fact sheets on the City’s energy efficiency projects and programs, and links to live energy use dashboards for three of the City’s buildings were also added. To complement these changes and additions to the City’s website, information was displayed on the City’s ‘digi screens’ in community facilities, an announcement was added to Messages on Hold, and advertisements were placed in local newspapers, via e-Newsletters and on social media.

5.3.4 Home Energy Audits

All City residents could request a free home energy audit, with those living in the target suburbs prioritised. Total of 112 residents participated from 26 suburbs, 20% in target suburbs.

Each free home energy audit would run for approximately 45 minutes and included the auditor conducting an energy audit of the home and working through the home action plan with the householders identifying areas for change or improvement. Also, tailored to each home’s needs, the auditor would complete small and low cost retrofits such as installing drought stoppers on doors, or insulation on the hot water system pipes.

5.3.5 Energy Saving Booklets – Bilingual translations

An existing Energy Saving information booklet in English was updated and then translated into eight languages identified to be the most important for the City’s non-English speaking residents. The revised Bilingual Energy Saving Booklets were then available in English with Arabic, Chinese Mandarin, Dari, Farsi, Italian, S’Gaw Karen, Swahili, and Vietnamese.

Approximately 800 booklets were distributed to workshop participants, and were also made available at the City’s Mirrabooka Multicultural Centre, the City’s Administration Centre, and at a number of local community facilities including the Edmund Rice Centre Mirrabooka, Mercy Care Mirrabooka, Metropolitan Migrant Resource Centre Mirrabooka, Stirling Adult Day Centre Nollamara, and the Smith Family Child and Parent Centre Westminster.

Each Booklet was also available digitally on the City’s website. An example of the ‘English – Arabic’ version pictured below.
5.3.6 Easter Staff Power Down Competitions

Two Easter Power Down Competitions were held for the approximately 500 staff based at the City’s Administration Centre. The Main Administration Building was fitted with six energy loggers monitoring six areas of the building. Staff were encouraged to switch off computers and other unessential electrical devices over the long weekend and a winning area was awarded with a morning tea. The winning area was calculated by the greatest percentage reduction of energy use compared to typical weekend energy use.

5.3.7 Home Energy Assessment Toolkit (HEAT Kit)

The HEAT Kit is an existing service offered to residents which were upgraded to include a 4 minute shower timer and a home energy thermometer. These revised kits contained a number of items which helped residents to assess the temperature of rooms in their homes; the effectiveness of window, wall and ceiling insulation; and monitor the energy consumption of common household electrical appliances over time.

The City has a total of 14 kits available for loan with around five kits out on loan each month during the program (total of 54 loans).
5.3.8 Business Energy Network Events

Two free business breakfast networking events were held at the Stirling Regional Business Centre educating local businesses about energy efficiency. All local business in the City were invited to attend via email, with approximately 40 business representatives attending each event. Attendees were from a variety of industries, many also from small businesses.

The 2015 event featured a presentation by energy efficiency expert Jon Dee, and all attendees received a free copy of Dee’s book The Energy Cut. At the 2016 event attendees heard presentations from three local businesses which included basic energy efficient measures, case studies, and monitoring tips.

5.4 Issues and Learnings

5.4.1 Energy Efficiency Workshops

There were some issues with implementing the educational activities. The first attempt at running energy efficiency workshops for residents received reasonably low registrations, and intermittent attendance. The low socioeconomic target group was met 100% but total numbers were lower than expected with only about 30 participants across all nine workshops.

The second time the educational activities were run, the City arranged for local organisations to host the workshops and therefore they promoted the activities directly with their members and clients, and many also held the workshop during a normal meeting or activity time, at their usual meeting place. The low socioeconomic target group was met (81%) and participation rose from approximately 30 to around 260 residents across six hosting organisations.

The key learning is that participation rates were significantly higher when the workshop was hosted by a community organisation at their normal meeting place, especially for groups that meet at a regular time. This was likely to have occurred for a number of reasons: it fits in with organisation’s existing schedules, it’s familiar / comfortable / easy for participants, and the required additional services are available (e.g. crèche, interpreters, and appropriate support workers).
5.4.2 Home Energy Monitors

There were significant issues with implementing the real-time energy monitors project. Not all electricity meters in homes were easily compatible with the energy monitors purchased by the City. The main reasons for this were: 3-phase power, solar PV systems combined with 3-phase power, insufficient space in the meter box, and distance between the home and the electricity meter box. Also, a great number of residents found the energy monitors too complicated to use. Other issues, including the presence of asbestos in the meter box and non-home ownership (rental and public housing), were initially highlighted as potential problems, however did not contribute to the issues with implementing this project.

3-phase power; households with 3-phase power require three CT clamps to monitor all incoming electricity. The 3-phase issue was overcome by asking residents additional questions during registration to identify 3-phase homes, and then providing 2 extra CT clamps for installation.

Solar PV systems with 3-phase power; some households with solar PV also had 3-phase power, sometimes this would result in the incoming solar power generated appearing as power use on the monitor. It took some ‘trial and error’ by the electrician to find a solution. Overcome in some cases depending on the set-up. For some homes this was not overcome, therefore they could not use the monitor effectively.

Insufficient space in the meter box; some electricity meter boxes simply do not have readily available space to install monitoring equipment, particularly groups of units. Not overcome in most cases; simply not enough space to attach the CT clamps, and required too much extra work/time and extra purchases.

Distance from electricity meter box; the real-time energy monitor optimum distance to transmit from the meter box to the display screen is 40-70 meters. In some cases (e.g. unit complexes) the electricity meter boxes are grouped on the front boundary of the property which could exceed the optimum range for some of the rear units. Not overcome in some cases.

Difficulty of the monitor; the real-time energy monitor came with an instruction booklet, however many residents struggled to understand the instructions, or the instructions didn’t solve their issue. Residents also had access to the product manufacturers online and phone technical support services; this worked well for some residents. Overcome some cases depending on the resident’s understanding of digital devices, others simply found the equipment too difficult to use or understand.

The key learning is that more in-depth research / consultation into the potential variations of the set-up of electricity meter boxes would have avoided some of the issues with 3-phase and solar PV as we could have been better prepared with the required equipment and additional questions for residents. Although asking residents additional questions in the registration process helped, it was difficult as many residents were unsure what was inside their electricity meter box. The monitoring equipment was simply too difficult to understand for many residents, especially those not confident with digital devices.

Overall this was a difficult and time intensive project to manage. The project manager did not have enough technical knowledge to know what questions to ask the householders to then be able to fully inform the electrician. The project manager also spent a lot of time attempting to assist residents who did not understand how to use the equipment.

The key learning is that better consultation with the electrician and the product manufacturer before starting the program would have avoided many of the problems, and it is likely it would have changed how or whether the City ran this program. Ultimately this program did not provide good value for time and money.
5.4.3 Interactive Touch Screen Displays

It was proposed to install interactive touch screen displays in the foyer of each of the City’s two aquatic centres, the Mirrabooka Library and at the Administration Centre for residents to interactively view energy efficiency information. On further consultation with the City’s IT department it was found that the initial plans would not be practicable. This was because of the time required for IT to research, select and order mobile devices or computer screens; the time to connect the devices to the City’s network or Wi-Fi; the ability to safely secure the device in a public place; and locking down the device so it could not be used inappropriately.

It was found that it was not feasible to find solutions for all of the above problems within the remaining timeframe, and that it would be just as effective to use existing infrastructure such as the City’s ‘digi-screens’.

With these issues in mind, interactive touch screen displays were not implemented in favour of using the existing large ‘digi screens’ already installed in the City’s community buildings. A series of digital informational displays were written, designed and added to the City’s ‘digi screens’. The ‘digi screens’ displayed the digital information in the City’s community facilities including libraries, aquatic centres and the Administration Centre foyer. To complement this, the City has added more detailed information to the City’s website including factsheets about energy efficiency projects and interactive energy efficiency information.

The key learning for this is that projects involving the purchase and installation of IT equipment at the City require detailed consultation with IT at least 12 months before implementation, especially if internet access is required.

5.4.4 Home Energy Audits

There were minimal issues with delivering the home energy audits. The main issue was with residents forgetting their appointments (not home) or residents cancelling in too short a time frame for the auditor (late cancel). The booking system between the City and the auditor overall worked very well, however ‘not home’ and ‘late cancels’ reduced the number of audits that could be completed within the allocated budget; 9 of 121 (7%) of audits invoiced were due to ‘not home’ or ‘late cancels’.

In regards to the booking process, the auditor booked audit appointments directly with the resident so that the resident had the auditors contact details if they needed to change or cancel their appointment. This generally worked well as the auditor would be contactable outside of office hours including the weekend and evenings.

The key learning is that the booking system could be improved by sending all residents a reminder text message or email 24hrs prior to their appointment. This would prompt residents to change or cancel their appointment earlier if required.

5.4.5 Energy Saving Booklets – Bilingual translations

The City was limited in its choice of suppliers to take advantage of an already existing energy saving information booklet; by investigation a local not-for-profit was the only current supplier. This led to a second issue; managing and liaising with a not-for-profit that was also coordinating a third party to complete translations. For these reasons, a number of delays were experienced and there were some quality concerns.

The key learning in this area is that if the City were to produce this type of information in the future, it would be more efficient to employ a business/organisation with greater resources to research and write original materials for the City. Translations could be organised via the City to enable greater control over the project schedule and quality.
5.4.6 Easter Staff Power Down Competitions

For the first Power Down competition in 2015, timelines were tight to purchase, receive, install and test the energy loggers before the Easter long weekend. As a result the City was only able to obtain 2 weeks of data prior to the competition to form the baseline weekend energy use. Some CT clamps were the wrong size and needed to be exchanged, therefore for these particular circuits, the City had as little as a few days of data prior to the long weekend.

For the second competition in 2016, there were concerns from staff that ‘early movers’ were not being recognised by the competition. As the City has been running staff energy efficiency promotions for over a year many staff had adopted new habits, already turning off electrical appliances every weekend, or even every night.

The key learning for this activity is that if the City were to expand this project to another workplace such as the Depot, the City would need to allow at least two months between installation and the competition weekend to ensure good quality baseline data.

5.4.7 Home Energy Assessment Toolkit (HEAT) - Upgrade

The Home Energy Assessment Toolkit was originally developed in 2009 by the now disbanded Climate Wise Team based out of the Southern Metropolitan Regional Council (WA). Due to this department no longer existing, information on where parts came from was unavailable, and an updated version of the information booklet was not available.

Overall, this was not a complicated project; however it took a number of months to confirm whether the Climate Wise team was still in existence or if there was any other department who could to assist with the upgrade of the kit. The addendum to the kit will need to be updated every 6-12 months due to this information changing so often. At some point in the next few years the information booklet will simply need to be replaced completely.

5.4.8 Business Energy Network Events

The only issue was that there was relatively low interest and attendance by businesses compared to the number of businesses in the City of Stirling. The City has direct email contact with about 20,000 businesses that have provided an email address (via the Australian Business Register). An invitation to the 2016 Save on your Business Energy Bills event was sent to 23,269 businesses, of which 23% (5,153) opened the eNewsletter, and 0.6% (129) clicked on the link to register for the event. Approximately 40 businesses attended each event.

Overall this project would not require great changes if it were to be run again. Use of contact details from the Australian Business Register has proved a useful tool to contact businesses.

5.4.9 Communications / Promotions

The addition of a funding body approval process into the City’s marketing approvals process added to the delays to complete and publish promotions. Turnaround time to receive approval varied from a day to a few weeks, with some publications getting to the final stage before printing before approval was received from the funding body.

Changes to the whole project deadline resulted in very little time to promote the projects completed. Promotions that were scheduled to run from April 2016 to June 2016 were condensed into April 2016 only; 3 months of promotion to 1 month only. Additionally, some of the promotions about energy efficiency upgrades had to be vague or left simple as the project was not quite completed, or data regarding savings could be not confirmed yet.
Digital media was always in the marketing and communications plan and proved to have good response rates especially from the Living Green in Stirling e-Newsletter. Social media was effective, depending on the nature of the communication (event, workshop, information). Digital media with short submission timelines proved an important medium for issuing updated information and reminders.

The key learning is that newspaper advertising and printed posters and flyers seem to be becoming an outdated medium for promotion; however they reach those in the community who are not technologically savvy so it is still an important part of the communications plan. Submitting basic draft materials for the quarterly Stirling Scene magazine was also worthwhile; in particular the Summer 2015 publication provided a spike in registrations for the energy saving education activities run during late 2015.

6 Outcomes and benefits

6.1 Energy Efficiency Outcomes and Benefits

6.1.1 Energy and cost savings improvements

In relation to energy efficiency upgrades to facilities the key outcomes were a combined annual energy savings of 239,639 kWh (863 GJ) per year, energy cost savings of $48,352 per year, maintenance cost savings of $7,477 per year, 182 tonnes CO2-e reduced per year, and an overall payback return on investment of approximately 9 years. Mirrabooka Library achieved the best result for building retrofits, reducing its annual energy use by approximately 33%.

Whilst this is a good outcome it is considerably less than was predicted. The reason for this difference is mainly due to reduced scope of works for several projects and in some cases, the predicted energy improvements, cost savings and the emissions reductions recommended in energy audits and feasibility studies appears to have been overstated.

The City engaged a consultant to carry out assessments of the energy and cost savings achieved by the completed projects. These assessments were based on a range of datasets including utility electricity use data, electricity sub-meter data, data logger data and contractor measurements of pre/post lighting circuit currents. Assumptions were made where data was limited or unavailable in order to make an estimate of expected savings. This has resulted in some limitations in the assessments as, in many cases, there was limited measured data before and after the project (sometimes only two months) due to the timing of the projects and the assessments/reporting.

The upgraded Building Management Systems at the aquatic centres were only commissioned in mid-April 2016. There has therefore been insufficient time to collect any meaningful building/system energy use data to estimate the energy savings achieved from the projects. In addition, the BMS are expected to facilitate energy savings over time as the operation of pool systems is optimised as a result of the greater capacity to monitor and review their operation through the BMS portals. For these reasons, any analysis of energy efficiency improvements or cost savings in this report does not include the BMS projects.

6.1.1.1 Lighting Upgrades

For the Leisurepark Balga lighting upgrades, the expected energy savings were less than those originally estimated by the lighting specialist. This is partly because those estimates included external lights and the gym which were not included in the final scope. This was because the gym lights had already been upgraded to LEDs in the interim and the external lights were found in the detailed design not to be cost effective to upgrade (as the original design used a power rating of 165W, when the original fittings were actually 30W). This
change in scope was partly offset by the inclusion of some new areas of the building which were found to have favourable payback periods.

The expected savings of a more than 60% reduction in the lighting energy use are however considered to be extremely good.

At Mirrabooka Library, the expected energy savings were significantly higher than originally estimated (around 50% higher). This was due to the power factor on the old fluorescent track lighting being extremely low due to the old magnetic ballasts (lighting controls), which would have increased energy used by the lights above that expected from these fluorescent lamps. The ballasts were removed with the upgrade to LED lighting and so additional savings were achieved above those expected from using lower wattage LEDs.

At the Works Depot, the expected energy savings from lighting upgrades were around 20% less than originally estimated. This was expected as there was a reduction in scope from the proposed brief, with the external lighting being excluded as it was not possible to find a suitable fitting within the budget. However, excellent savings of 49% in lighting energy use are expected from the upgrade.

6.1.1.2 Variable Speed Drives

For Leisurepark Balga, the energy savings from VSDs were significantly lower than originally estimated by the energy consultant who assisted with the grant application, being around a quarter of the estimate. There was limited information about the operation of the pumps available to carry out the energy saving estimate and it was assumed that savings of around 40% were possible by improving the low power factor on site and through reducing the operating load of the motors. The actual savings of 7.9% have been achieved to date through the conditioning of the electricity supply by the VSDs, with very little reduction in motor loads. However, additional savings may be achieved in the future through possible reductions in loads, following the ongoing review and optimisation of pool system operation through the additional data available from the VSDs and BMS.

At the Terry Tyzack Aquatic Centre, the energy savings from VSDs were significantly lower than originally estimated by the energy consultant who assisted with the grant application, being around a fifth of the estimate. This is partly due to a reduction in the scope of the project - with six VSDs installed instead of 19 as anticipated - as it was determined that a number of the pumps and motors were not in sufficiently good condition to have a VSD installed.

Similarly to Leisurepark Balga, there was also limited information about the operation of the pumps available to carry out the original savings estimate and it was assumed that savings of around 40% were possible by improving the low power factor on site and through reducing the operating load of the motors. The actual savings of 4.8% have been achieved to date through the conditioning of the electricity supply by the VSDs, with very little reduction in motor loads. However, additional savings may be achieved in the future through possible reductions in loads, following the ongoing review and optimisation of pool system operation through the additional data available from the VSDs and BMS.

6.1.1.3 HVAC optimisation

At Mirrabooka Library, the original estimate, based on an energy audit, was for around a 25% saving on HVAC energy use. However, the assessment of the project by the consultant estimated that HVAC energy use has increased by 11% since the optimisation work.
A new computer training suite package air-conditioning unit was installed in the Library in August 2015. The old unit was not operational in the period prior to the CEEP project (Apr-May 2015) but the new unit was used during the post period (Sep-Oct 2015) and would therefore have increased the total HVAC energy use for the Library. This could account for part or all of the estimated 11% increase in HVAC energy use.

In addition, less than three months of energy logger data was available for the pre-CEEP HVAC upgrade. The consultant’s estimate is therefore based on only two months of system operation after the upgrade which is not a good representation of the operation of the system over a whole year (which varies according to ambient temperature, humidity etc). It is possible that operational and/or seasonable differences between the two months before and two months after the project could account for some or all of the increase in HVAC energy use (for example if ambient temperatures or the number of library users were higher after the project. However, the operation of the HVAC system is being reviewed to ensure there are no issues.

A comparison with the original estimate is also not valid as during the detailed design of the upgrades, it was determined that an economy cycle already existed at Mirrabooka Library. Therefore, the scope was significantly reduced to instead improve the operation of the economy cycle by installing an air relief vent and recommissioning the system.

At the Works Depot, HVAC optimisation energy savings were 22% less than originally estimated. It was determined during the detailed design phase that it was not feasible to install an economy cycle at the Works Depot due to the configuration of the ductwork. The scope of the project was therefore significantly reduced, which has reduced the energy savings accordingly. However, the energy savings of 19% in the HVAC energy use, with a payback period of 3.1 years, are considered to be very good.

### 6.1.2 Other benefits from retrofit activities

There were many other benefits from the retrofit upgrades. LED lamps have a significantly longer life than older lighting types and so maintenance cost savings will be likely to be achieved. These savings have been included in the assessments. LED lights also have a significantly lower operating temperature than conventional lights, and so will likely reduce the thermal load on the air-conditioning systems in the buildings.

As well as providing energy savings, the new VSDs on the pool pumps have provided the City with additional information and data about the operation of the pumps and motors. This will assist with understanding the air/pool circulation and heating system operation and with identifying options for streamlining this operation.

The optimisation of system operation, including reducing run times and operating at lower loads, is expected to reduce required plant maintenance and to increase the life of the plant. The data loggers will enable the City to monitor energy use on other buildings or energy-using equipment in the future to assist with energy management and identifying options for reducing this energy use.

### 6.1.3 Ancillary benefits to the community

The retrofit upgrades provided ancillary benefits to the community in many ways. Replacing the old lighting in the buildings has improved the appearance and ambience of the buildings and made them more comfortable for patrons. The LED lighting has also provided an improved lighting quality in the buildings, for example improving the lighting temperature, levels, distribution in the Mirrabooka Library to assist members of the community in viewing the book shelves. In the Leisurepark Balga carpark, the upgrade has also increased the level of lighting which will improve security for people visiting the centre at night.
The upgrade and optimisation of the control and operation of the HVAC systems at the Works Depot and Mirrabooka Library are expected to improve the amenity of the buildings and the comfort to occupants and Library users. This is due to improved indoor air temperature control/levels, with less cold spots and less fluctuation in temperature. The air rebalancing is also expected to improve air flows through the buildings. In particular, the installation of an air relief vent at the Library has enabled a larger quantity of relief air to pass through the building by removing the restriction within the roof void which was limiting the air flow rate. The installation of a 365 day time controller at the Depot has enabled automatic seasonal adjustment of the temperature set points which is expected to provide greater comfort to building occupants through the better alignment of indoor temperature with the seasons.

At the aquatic centres, the greater access to data on building condition and plant operation through the upgraded BMS portals is expected to enable enhancements to the amenity of the centres and comfort for the community. Pool and air temperature and quality can be improved through the adjustment of set points following the monitoring of conditions and plant operation.

6.1.4 Energy Efficiency Upgrades Feedback

The City did not undertake any evaluation with the community in relation to the energy efficiency upgrades. There also has been no specific feedback from facility patrons on the VSD install, BMS upgrade and HVAC optimisation projects as they do not see the effects of the projects. The officers at the aquatic centres are satisfied with the operations of the VSDs and with their ease of use.

The Building Management Systems have only been installed for a short period so there has been insufficient time for facilities managers and staff to fully use and assess the systems. However, they were satisfied with the functionality of the proposed systems, following a briefing by the supplier during the procurement process.

The officers at the Works Depot were pleased with the new lighting and the ability to turn lights on and off without waiting for long periods for the (previous metal halide) lights to warm up.

6.1.5 Indications of improved energy management practices in the organisation

The upgraded BMS at the aquatic centres will enable the facility managers to review the building condition more actively due to the ease of viewing the setpoints and operation of the building systems through the BMS portal. For example, actual pool and zone temperatures can be regularly monitored with a view to optimising setpoints and scheduling times. This has already occurred with an interrogation of the BMS information at Terry Tyzack Aquatic Centre highlighting that the air temperature was higher than expected due to a system component not be replaced following the project. This was able to be quickly rectified.

In other areas, it is too early to see any evidence of improved energy management practices in the City more broadly as many of the projects have only recently been completed. The communications activities are already underway and these communications are expected to promote the energy efficiency projects more broadly and raise awareness of the benefits of energy management practices.

6.1.6 Opportunities for local industry

The energy efficiency retrofits have provided $714,006 of investment in the local energy efficiency industry, including in the areas of lighting, HVAC, VSDs, BMS, metering and energy consultancy.
6.1.7 Benefits to low socio-economic or disadvantaged groups

Two of the facilities upgraded are both used by the community and are in low socio-economic suburbs, being Leisurepark Balga and Mirrabooka Library. Any upgrades to these facilities would provide indirect benefits to the communities that use these facilities.

6.2 Education and Communication Outcomes and Benefits

6.2.1 Communication and Education Targets and Results Summary

The Kill-a-Watt program had the following communication and education targets and achieved the following results which will be described in more detail in this section:

Awareness Target
- More than 30% of City of Stirling residents are aware of energy efficiency outcomes and outputs achieved from CEEP grant by June 2016, measured by the City's quarterly Marketing Effectiveness Survey

Awareness Result
- 49.2% of 187 respondents were aware that the City has been upgrading buildings and community facilities for energy efficiency (3.74% unsure, 47.06% not aware).
- 73.8% of 187 respondents were aware that the City has provided services and programs to help residents to save on their energy bills (1.07% unsure, 25.13% not aware).

Action Target
- More than 50% of participants at the City of Stirling's energy efficiency education workshops and activities intend to implement, or have implemented, initiatives at home by June 2016 - measured by direct survey

Action Result
- 98% of Home Energy Audit participants intended to implement energy efficiency initiatives or had already implemented initiatives after the City's energy efficiency education (36% already implemented).
- 94% of Home Energy Monitor participants intended to implement energy efficiency initiatives or had already implemented initiatives after the City's energy efficiency education (29% already implemented).

Participation Target
- All workshops, demonstrations and events conducted as part of CEEP were more than 75% full and attendees find that the information provided is useful as measured by attendee surveys.

Participation Result
- Education activities were 79% full.
- 78% of participants found the information useful.

Low Socio Economic Communities Target
- 50% of participants at the City of Stirling’s energy efficiency education workshops and activities live in suburbs identified in the lowest two quintiles of socioeconomic disadvantage – Balcatta, Glendalough, Osborne Park, Tuart Hill, Balga, Mirrabooka, Westminster and Nollamara

Low Socio Economic Communities Result
60% of participants at the City of Stirling’s energy efficiency education workshops and activities live in suburbs identified in the lowest two quintiles of socioeconomic disadvantage.

6.2.2 Evaluation of education and communication activities

Feedback surveys were sent to all residents who received a Home Energy Audit, and borrowed a Home Energy Monitor. Response rates were high; 48% for Home Energy Audit survey and 49% for Energy Monitor. Additional verbal and written feedback was received by the City from participants of the above activities plus the Energy Saving Workshops and the two Business events.

A survey requesting feedback on the City’s communication of all these energy efficiency projects was issued in April 2016 via the City’s eNewsletters, social media and published on the City’s website. The survey had 187 respondents over 2 weeks, 91.98% of respondents’ home suburb is within the City of Stirling.

Results are as follows:

- 49.2% of respondents were aware that the City has been upgrading buildings and community facilities for energy efficiency (3.74% unsure, 47.06% not aware).
- 73.8% of respondents were aware that the City has provided services and programs to help residents to save on their energy bills (1.07% unsure, 25.13% not aware).
- 36% of respondents participated in and/or used any of the energy efficiency education programs and services provided. Respondents top 3 programs and services were:
  1. 17% of respondents used the Saving Energy Booklet
  2. 12% of respondents participated in a Home Energy Audit
  3. 9% of respondents participated in an Energy Saving Workshop
- 81% of respondents saw or heard about the energy efficiency projects and programs. Respondents top 5 mediums were:
  1. 45% eNewsletter
  2. 33% Local newspapers
  3. 27% City of Stirling website
  4. 17% Local Library
  5. 12% Facebook

6.2.3 Reach of education and communication activities

- 112 home energy audits (average of 2 people per household)
- 35 households borrowed real-time home energy monitors
- 290+ participated in energy saving workshops
- 800+ bilingual energy saving booklets handed out
- 54 loans of Home Energy Assessment Toolkits
- 550 participated in the Easter Staff Power Down Competitions
- 80 participated in the Business Energy Network Events
- 473 average eNewsletter reach (opens) per edition (with CEEP related articles)
- 253 total eNewsletter clicks on CEEP related articles:
  May 2015 – 394 opens, 19 clicks
June 2015 – 400 opens, 7 clicks  
July 2015 – 429 opens, 16 clicks  
August 2015 – 401 opens, 8 clicks  
September 2015 – 401 opens, 4 + 9 clicks (2 articles)  
October 2015 – 454 opens, 72 + 2 clicks (2 articles)  
November 2015 – 599 opens, 33 clicks  
December 2015 – 540 opens, 14 + 11 clicks (2 articles)  
January 2016 – 576 opens, 27 clicks  
February 2016 – 418 opens, 3 + 10 clicks (2 articles)  
March 2016 – 558 opens, 11 clicks  
April 2016 – 511 opens, 7 clicks  

  894 page views. Average time on page 3:04 minutes.  
  82.7% (740) via City’s Facebook advertising (av. time on page, 2:35 min)  
  4.70% (42) via navigating City’s website, (av. time on page 5:59 min)  
  3.91% (35) via City’s eNewsletters, (av. time on page 3:11 min)  

  911 page views. Average time on page 3:02 min.  
  (Note: relatively inactive before 11 April 2016)  

  (1 July 2015 – 8 May 2016):  
  1,718 page views. Average time on page 3:01 min.  

- Approx. 6,800 or 3% of the City’s population recall seeing digi screen information  
- Messages on Hold – data not currently available.

### 6.2.4 Feedback from the community

Listed below is feedback received via completed surveys and emails to the City:

#### Home Energy Audits

Survey response to “any other comments”:

- **A great initiative by the City for Stirling**
- **A great initiative City of Stirling and much appreciated. Julia was helpful too.**
- **A Physical walk through May have been better**
- **A very worthwhile exercise**
- **Appreciated the opportunity & it’s a helpful initiative**
  
  Did find it very helpful when discussing solar power and our chest freezer but some other parts were very basic. Would have liked to focus more on just the parts I had questioned on and not worry about the other bits but understand the auditor should discuss all areas.

- **Excellent. Covered such a wide range, gas electric and water with lots of useful tips**
- **Fantastic!**
- **Good to know that the adjustments I have made are limiting my energy use**
- **great service - thank you !**
- **I have already recommended this to other people. Great service - thanks!**
- **Lots of simple tips to help save energy**
- **Made you aware of costs power hour per unit**
- **NO**
- **Not sure its worth rate payers money. The information could easily be provided in a pamphlet for rate payers.**
- **Very good**
- **Very helpful. Thanks ??**
Very practical advice delivered in a most professional manner. Very pleased that we took up the offer and that we were accepted.

Very practical and experienced Auditor who should be helpful to people who want to improve and save energy costs.

very useful

was interesting to note that lights & having appliances on "stand by" were negligible for energy saving

We think it is a helpful service

Emails received:

Jason from 'Be Sustainable' came out to our home at the weekend to conduct the Home Energy Audit. We were very pleased with the audit as it gave us a number of areas to work upon. I found Jason very knowledgeable and helpful. Thank you and the City of Stirling for this opportunity, which I feel is a very valuable initiative.

That was a huuuuge help to have the monitor, and the assessment. Congrats on a great program, I hope we get the opportunity at a later date to assess the changes we make.

Thanks sooooo much for the sustainability audit Jason did at my house on Saturday – it was awesome – and what a lovely guy. I’ve made some changes already and have a long list of more to do. I love the initiative – and cannot believe it only took about three days between my submission and Jason walking through the door. Thanks a million.

Thank you for selecting me for this service. I received some valuable advice which I am now putting in place.

This is a great service and we really appreciate the council offering it.

Just wanted to give you some feedback on the Energy Audit I had done the other day. I was very happy with the information and feedback presented by Ross. His advice was very down-to-earth and useful and provided in a friendly yet professional manner. A big tick to City of Stirling for providing this program - I hope they will continue to do so and advertise it more widely.

We’ve just had our energy audit today, Ross was very experienced and knowledgeable, thank you for organizing and making these services available to us!

Thank-you for so comprehensively and graciously responding to my recent concerns relating to the Home Energy Audit and installation of the Home Energy Monitor - much appreciated.

Thank you! Our assessor came on Sunday and whilst we were pretty good, it’s always good to find more ways to be more sustainable and ways to reduce costs. We appreciate the City Council’s offer and are very grateful. Many thanks!

I was really impressed by the home energy audit. I found it really useful and have put in place the recommendations provided to me. I have already notice a drop in my power consumption as a result so would definitely recommend this to others. The man that did the audit was very helpful and friendly.

Energy Monitors

Survey response to “any other comments”:
It didn’t work how I expected it to.

Brilliant device :)

But this is only because it didn’t work for me so don’t know how good it could be.

I don’t think this is useful sadly and I really wanted it to be

It only shows electricity flow, without distinguishing between the directions.

Emails received:

That was a huuuuuge help to have the monitor, and the assessment. Congrats on a great program, I hope we get the opportunity at a later date to assess the changes we make.

We really appreciate the meter and are finding it enlightening. Who ever knew a kettle could use as much energy as a dishwasher!

Thank-you for so comprehensively and graciously responding to my recent concerns relating to the Home Energy Audit and installation of the Home Energy Monitor - much appreciated.

I didn’t really get much use out of the monitor, I found it too difficult to figure out to be honest. I work full time so it wasn’t really convenient for me to contact anyone during the day to get guidance. The monitor didn’t appear to work that well in my opinion, kept flickering on and off so I never really knew if it was working correctly so gave up in the end.

Energy Saving Workshops

Regardless of their varying levels of written English, participants in the 2015 Mirrabooka workshops expressed their appreciation with a ‘thank you card’ (scanned copy below).

“Thank so much for your teaching. This class was very useful and we enjoyed.”

Emails received (Mirrabooka 2015):

I learned a lot about how to save energy and money I really appreciate that. – Participant.
Thank you for organising this workshop and offering it to our clients. I’m glad it ended off well, the card is very sweet. Look forward to hearing from you for the next round of workshops. – MercyCare, Mirrabooka.

Emails received (Groups 2015/16):

We had 10 women from diverse backgrounds; Karen (Myanmar), Afghani, Egyptian, Sudanese, And we had 3 bi-lingual worker. We all enjoyed the workshop and I will see what the ladies remember tomorrow as we will have the next women support group. Thank you so much. – Metropolitan Migrant Resource Centre, Mirrabooka.

Thank you very much for all of your assistance with organising the session. It was fantastic and there was lots of discussion amongst participants. We had parents come along from Nollamara and Westminster and Julie and I sat in too (we learnt quite a bit – I’m going home to check my bills!). – The Smith Family Child & Parent Centre, Westminster.

Went well today - lots of thanks afterwards and continuous questions, had to throw everyone out! – Facilitator of the workshop hosted by Living in Retirement, Yokine.

Energy Saving Information Booklet - Bilingual

Although no direct feedback was received about the bilingual booklets from residents, many service providers in the City requested extra booklets to give to their clients.

Business Energy Network Events

Emails received (2015):

Brilliant presentation and thank you and extended team for all the effort in bringing it together. – Attendee.

Emails received (2016):

Thank you for arranging the event Julia. I felt that you had very interesting speakers who presented very well. I enjoyed the morning. – Attendee.

I really enjoyed attending this morning and to see the strong engagement from the attendees. – Presenter.

THANK YOU! You did a great job as MC - Co-Ordinator and this morning was a real eye opener for us. Can you let your presenters know that each and every one of them came across as value adders and their presentations were so powerful ALL OF THEM …. – Attendee.

Easter Staff Power Down Competitions

Although no specific written feedback was received about the power down competitions, there was a positive attitude towards the competition from staff, and support from management with the CEO and Business Unit Managers attending both the 2015 and 2016 morning teas to thank the winning area for their commitment to energy efficiency in the office.

6.2.5 Indications of improved energy management practices in the community
There have been indications of improved energy management knowledge and practices in
the community after residents participated in Kill-a-Watt education activities. This was
evaluated in post participation surveys; a summary of the main results are noted in the
tables below.

Survey responses showed that 75% of participants of the Home Energy Audits had an
increase in knowledge, 64% said that that it helped them to make changes at home, and
47% said that they will likely improve their home energy efficiency in the future, with 36%
already completing an action. 53 survey responses were received, response rate of 48%.

Survey responses showed that 47% of participants of the Real-time Energy Monitors had an
increase in knowledge, 41% said that they will likely improve their home energy efficiency
in the future, with 29% already completing an action. 17 survey responses were received,
response rate of 49%.

The 2016 Easter Staff Power Down Competition raised concerns from staff that ‘early
movers’ were not being recognised by the competition. As the City has been running staff
energy efficiency promotions for over a year many staff had adopted new habits, already
turning off electrical appliances every weekend, or even every night, demonstrating
improved energy management practices in the workplace.

Tables Summary of Survey Results:

Home Energy Audits

Survey Question: “How much did you know about saving energy in your home?”

<table>
<thead>
<tr>
<th></th>
<th>1 nothing</th>
<th>2 just the basics</th>
<th>4 a lot / expert</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before the Audit</td>
<td>0%</td>
<td>9%</td>
<td>42%</td>
</tr>
<tr>
<td>After the Audit</td>
<td>0%</td>
<td>0%</td>
<td>45%*</td>
</tr>
</tbody>
</table>

*Includes 21% responded ‘4’ Before the Audit (no knowledge change)
**Includes 4% responded ‘5’ Before the Audit (no knowledge change)

Survey Question: “How would you rate the Home Audit Action Plan worksheet?”

<table>
<thead>
<tr>
<th></th>
<th>1 disagree</th>
<th>2 somewhat agree</th>
<th>4 agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Helped me to learn about energy saving</td>
<td>0%</td>
<td>1%</td>
<td>5%</td>
</tr>
<tr>
<td>It has helped me to make changes at home</td>
<td>0%</td>
<td>3%</td>
<td>5%</td>
</tr>
</tbody>
</table>

Survey Question: “Since having the Home Energy Audit, how likely is it that you will change
something to save energy in your home?”

<table>
<thead>
<tr>
<th></th>
<th>1 not likely</th>
<th>2 somewhat likely</th>
<th>4 already done</th>
</tr>
</thead>
<tbody>
<tr>
<td>How likely is it that you will change?</td>
<td>0%</td>
<td>2%</td>
<td>15%</td>
</tr>
</tbody>
</table>
### Before using the Energy Monitor

![Table showing percentage of responses before using the Energy Monitor.](image)

- **Nothing**: 0%
- **Just the basics**: 12%
- **A lot / expert**: 35%
- **Already done**: 47%
- **Other**: 6%

*Includes 12% responded '3' Before using the Energy Monitor (no knowledge change)

**Includes 35% responded '4' Before using the Energy Monitor (no knowledge change)

***Includes 6% responded ‘5’ Before using the Energy Monitor (no knowledge change)

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### After using the Energy Monitor

![Table showing percentage of responses after using the Energy Monitor.](image)

- **Nothing**: 0%
- **Just the basics**: 0%
- **A lot / expert**: 18%
- **Already done**: 65%
- **Other**: 18%

*Includes 12% responded ‘3’ Before using the Energy Monitor (no knowledge change)

**Includes 35% responded ‘4’ Before using the Energy Monitor (no knowledge change)

***Includes 6% responded ‘5’ Before using the Energy Monitor (no knowledge change)

---

### Survey Question: “Since using the Home Energy Monitor, how likely is it that you will change something to save energy in your home?”

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>not likely</td>
<td>somewhat likely</td>
<td>already done</td>
<td></td>
<td></td>
</tr>
<tr>
<td>How likely is it that you will change?</td>
<td>6%</td>
<td>0%</td>
<td>24%</td>
<td>41%</td>
</tr>
</tbody>
</table>

---

### Other Education Activities

Although surveys were not sent to participants of the workshops, business energy network events, or Easter staff power down competitions, or sent to recipients of the bilingual energy saving information booklets, the feedback that was received (see 7.2.2.3) gave the indication that these activities helped improve energy management practices and knowledge in the community.

#### 6.2.6 Provision for local industry

Education and communication activities provided numerous opportunities for local industry involvement and employment. West Australian and Australian industry representatives participated as follows:

**Energy Saving Workshops:**
- West Australian energy efficiency educators / facilitators hired to facilitate.
- West Australian interpreters hired.
- West Australian child carers hired for crèche service.
- West Australian business provided catering.

**Real-time energy monitors (residents):**
- Australian supplier provided energy monitoring equipment.
- West Australian electrical contractor hired to install and uninstall the monitors.

**Interactive Touch Screen / Digital Promotion**
- West Australian business provided updates to the interactive energy use information on the City facilities.

**Home Energy Audits:**
- West Australian energy efficiency auditors hired.
Energy Saving Bilingual Booklets:
- West Australian energy efficiency educators hired to update.
- West Australian interpreters hired to provide translations.

Easter Staff Power Down Competition:
- Australian suppliers provided energy monitoring equipment.
- West Australian electrical contractor hired to install equipment.
- West Australian caterers provided morning tea.

Home Energy Assessment Upgrade:
- Australian supplier provided replacement and new parts.

Business Energy Network Event:
- West Australian local energy efficiency businesses given the opportunity to speak, network, and learn.
- An Australian Energy Efficiency business made a presentation.
- West Australian caterers provided breakfast.

Communications / promotions:
- West Australian business printed posters and flyers.
- West Australian community newspapers printed advertisements.
- West Australian business provided ‘messages on hold’.
- All other promotions were completed internally by the City of Stirling.

6.2.7 Project benefits to low socio-economic or disadvantaged groups

Educational activities benefited low socio-economic and disadvantaged groups. Overall, 245 of 406 (60%) of residents who participated in education activities lived in suburbs identified in the lowest two quintiles of socioeconomic disadvantage – Balcatta, Glendalough, Osborne Park, Tuart Hill, Balga, Mirrabooka, Westminster and Nollamara. More details are provided in the sections below.

Workshops (Mirrabooka)
- Approximately 30 participants.
- 100% of participants were from low socio-economic suburbs.
- Most were renting (private, state or community housing).
- Many were new migrants to Australia.
- Interpreters were requested for the following languages:
  - Dari
  - Farsi (Persian)
  - Vietnamese
  - Kirundi (Burundi)
  - Dinka
- Information booklets were available in the following languages; Arabic, Amharic, Burmese, Farsi, French, Kirundi, Swahili, Chinese, and Italian.
The following local service providers (organisations supporting migrants and financially disadvantaged) referred their clients to participate in the workshops:

- Ishar, Mirrabooka
- MercyCare, Mirrabooka
- Edmund Rice Centre Mirrabooka

### Workshops (Group)

- 260 residents attended workshops
- 81% of participants were from low socio-economic suburbs
- Participants included migrants, humanitarian entrants, seniors, families, women, people living with a disability, and people living with a mental illness.
- Bilingual energy saving information booklets were provided in the following languages:
  - Arabic
  - Chinese Mandarin
  - Dari
  - Farsi
  - Italian
  - S’Gaw Karen
  - Swahili
  - Vietnamese

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Support Service</th>
<th>Suburb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ishar</td>
<td>Multicultural women’s health centre, promotion of independence for women particularly of CaLD backgrounds.</td>
<td>Mirrabooka</td>
</tr>
<tr>
<td>Edmund Rice Centre Mirrabooka</td>
<td>Supporting humanitarian entrants and Indigenous families.</td>
<td>Mirrabooka</td>
</tr>
<tr>
<td>MercyCare</td>
<td>New migrants, workshops, skill building, financial management.</td>
<td>Mirrabooka</td>
</tr>
<tr>
<td>Metropolitan Migrant Resource Centre</td>
<td>Women, seniors, humanitarian entrants, and migrants.</td>
<td>Mirrabooka</td>
</tr>
<tr>
<td>City of Stirling Adult Day Centre</td>
<td>Aged, frail, and people living with a disability. Includes a Vietnamese group.</td>
<td>Mirrabooka</td>
</tr>
<tr>
<td>The Smith Family, Child and Parent Centre</td>
<td>Families with children under 9yrs living in Mirrabooka, Nollamara and Westminster.</td>
<td>Westminster</td>
</tr>
<tr>
<td>St Barts CSRU – Sunflower Villas</td>
<td>Community Supported Residential Units: Mid to long term residents living with a mental illness.</td>
<td>Stirling</td>
</tr>
<tr>
<td>Living in Retirement</td>
<td>Support group for retirees.</td>
<td>Yokine</td>
</tr>
</tbody>
</table>

### Home Energy Audits

- 112 Home Energy Audits were completed
- 20% of homes in low socio-economic suburbs
- 14% renting (private, community or state housing)
- Languages other than English spoken at home: Afrikaans, AUSLAN, Bahasa, Chinese, Vietnamese, French, Greek, Hindi, Gujarati, Italian, Macedonian, Sinhala.
Home Energy Monitor Loans
- 35 monitors were loaned
- 37% of homes were in low socio-economic suburbs
- 6% renting (private, community or state housing)
- Languages other than English spoken at home: Greek, Mandarin, German, Polish, Thai.

Energy Saving Booklets – Bilingual translations
- Approximately 800 booklets distributed across all the available languages:
  - Arabic
  - Chinese Mandarin
  - Dari
  - Farsi
  - Italian
  - S’Gaw Karen
  - Swahili
  - Vietnamese
- Bilingual booklets are also available from the City’s Administration Centre plus the following facilities located in low socio economic suburbs:
  - City of Stirling Adult Day Centre, Nollamara
  - City of Stirling, Mirrabooka Multicultural Centre
  - Edmund Rice Centre Mirrabooka
  - Mercy Care, Mirrabooka
  - Metropolitan Migrant Resource Centre, Mirrabooka
  - Smith Family Child and Parent Centre, Westminster
7 Budget

The program budget agreed with the Department of Industry, Science and Innovation is detailed in the table below.

### 7.1 Total Original Program Budget

<table>
<thead>
<tr>
<th>Education and Communications</th>
<th>Budget</th>
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<tbody>
<tr>
<td>Communications</td>
<td>13,020.00</td>
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<tr>
<td>Education</td>
<td>83,046.00</td>
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<td></td>
<td>96,066.00</td>
</tr>
</tbody>
</table>

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Retrofits to buildings and facilities</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Leisurepark Balga</strong></td>
<td></td>
</tr>
<tr>
<td>Variable Speed Drives</td>
<td>110,896.00</td>
</tr>
<tr>
<td>Building Management System Upgrade</td>
<td>85,000.00</td>
</tr>
<tr>
<td>Cogeneration Systems</td>
<td>17,000.00</td>
</tr>
<tr>
<td>LED lighting</td>
<td>196,829.00</td>
</tr>
<tr>
<td>Energy Assessment</td>
<td>5,000.00</td>
</tr>
<tr>
<td></td>
<td>414,725.00</td>
</tr>
</tbody>
</table>

| **Mirrabooka Library**      |           |
| Energy Monitors/Data Loggers| 8,293.00  |
| LED lighting                | 98,600.00 |
| Install economy cycle       | 22,600.00 |
| Energy Assessment           | 5,000.00  |
|                             | 134,493.00|

| **Terry Tyzack Aquatic Centre** |           |
| Variable Speed Drives         | 86,000.00 |
| Building Management System Upgrade | 100,000.00|
| Cogeneration Systems          | 15,000.00 |
| Energy Assessment             | 5,000.00  |
|                             | 206,000.00|

| **Works Depot**               |           |
| Energy Monitors/Data Loggers  | 8,293.00  |
| LED lighting                  | 72,000.00 |
| Energy Assessment             | 5,000.00  |
| HVAC upgrades                 | 36,600.00 |
| Lighting Controls             | 8,900.00  |
|                             | 130,793.00|

| **Retrofits to buildings and facilities Total** | 886,011.00 |

**Administration**

| Financial                    | 1,500.00  |
| Project Manager              | 76,099.00 |
| Administration Total         | 77,599.00 |

**Grand Total**

|                  | 1,059,676.00 |
## 7.2 Budget Variation Table

<table>
<thead>
<tr>
<th>Row Labels</th>
<th>Original Budget</th>
<th>Expenditure</th>
<th>Difference..</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Education and Communications</strong></td>
<td></td>
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<tr>
<td>Communications</td>
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<td>$13,021.79</td>
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<td>Promotions</td>
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<td>Community Workshops</td>
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<td>Home Energy Audits</td>
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<td><strong>Retrofits to buildings and facilities</strong></td>
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<td></td>
</tr>
<tr>
<td><strong>Leisurepark Balga</strong></td>
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<td></td>
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<tr>
<td>Variable Speed Drives</td>
<td>$110,896.00</td>
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<td><strong>Mirrabooka Library</strong></td>
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</tr>
<tr>
<td>Energy Monitors/Data Loggers</td>
<td>$8,293.00</td>
<td>$3,441.25</td>
<td>$-4,851.75</td>
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<tr>
<td>LED lighting</td>
<td>$38,600.00</td>
<td>$39,653.25</td>
<td>$1,053.25</td>
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<td>HVAC upgrades</td>
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<td>$16,458.00</td>
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<td></td>
<td><strong>$129,493.00</strong></td>
<td><strong>$119,758.50</strong></td>
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<td><strong>Terry Tzack Aquatic Centre</strong></td>
<td></td>
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<td></td>
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<tr>
<td>Variable Speed Drives</td>
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<td>Energy Monitors/Data Loggers</td>
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<td>HVAC upgrades</td>
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<td>$-7,260.00</td>
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<td>Retrofits to buildings and facilities Total</td>
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<td><strong>$71,753.64</strong></td>
<td><strong>$-14,257.36</strong></td>
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<tr>
<td><strong>Administration</strong></td>
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</tr>
<tr>
<td>Financial</td>
<td>$1,500.00</td>
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<tr>
<td>Project Manager</td>
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<tr>
<td>Recruit a Project Manager</td>
<td>$76,093.00</td>
<td>$76,650.92</td>
<td>$551.92</td>
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<td>Project Manager Total</td>
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<td><strong>$76,650.92</strong></td>
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<td>Administration Total</td>
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<td>$76,650.92</td>
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<tr>
<td><strong>Grand Total</strong></td>
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<td><strong>$879,056.06</strong></td>
<td><strong>$-180,619.94</strong></td>
</tr>
</tbody>
</table>
7.3 Budget Variation explanations

The program had a total budget of $1,059,676 however it was completed under budget. The cost of completing activities was $879,056 resulting in $180,620 being unspent, equivalent to 17% of the total budget. In many cases, this was the result of competitive procurement processes where prices received through quotes where less than expected in the scoping stage. In some cases, planned activities were not implemented due to technical, financial or feasibility issues.

The largest retrofit activity contributors to the underspent budget were as follows (greater than $10,000 unspent):

The Building Management System upgrade was completed at Terry Tyzack Aquatic Centre, costing $51,530 less than anticipated (52% unspent). The price obtained from the competitive procurement was significantly less than that budgeted, partly due to limitations in available information about how the facility systems were controlled by the existing BMS.

At Leisurepark Balga, the variable speed drives were installed, costing $45,713 less than anticipated (3% unspent). The preferred supplier provided a price that was significantly lower than other tender quotations received but was evaluated to provide the City with the best value for money, based on selected evaluation criteria (including understanding of project requirements, technical skills and experience, and suitability of selected equipment).

Similarly, variable speed drives installed at Terry Tyzack Aquatic Centre cost $38,452 less than anticipated (45% unspent). Detailed scoping of the project determined that a number of existing pumps and motors were not in sufficiently good condition to install a variable speed drive. This led to a reduced scope for this retrofit, and reduced cost.

At the Works Depot, HVAC upgrades cost $26,528 less than anticipated (72% unspent). It was determined during the detailed design phase that it was not feasible to install an economy cycle at the Works Depot due to the configuration of the ductwork. The scope of the HVAC project therefore had to be amended, and the Depot HVAC system was recommissioned and the controls optimised.

The Works Depot lighting upgrades cost $16,289 less than anticipated (20% unspent). This was partly due to a reduction in scope, with the external lighting being excluded as it was not possible to find a suitable fitting within the budget. In addition, based on experience from other work, the City sourced LED fittings (high bays, panels and downlights) that had a significantly lower price than the fittings originally selected during the detailed design/specification phase.

The scoping phase of the lighting upgrades identified several issues:

- some proposed lighting upgrades could not be implemented because of upcoming office refurbishments.
- installing LEDs would achieve better energy improvements than replacing fluorescent fittings
- the original cost estimate the City received for photo electric cells was under-costed by $18,100. The increase in cost meant that the required paybacks would no longer be achievable.

The City therefore recommended not continuing with these activities and gained approval from the funding body in the 5th Milestone report. Instead LED lighting and motion sensors were installed at a reduced cost from the initial budget, and estimated savings were recalculated.
In relation to communications and education, some planned activities were replaced by other activities. For example, interactive displays were budgeted for ($6,000) but these were not purchased. Once more detailed feasibility was investigated, the City’s IT department found that this would not be practicable. The City’s ‘digi screens’ were used as a replacement to present the required information to the community and this was implemented at no cost to the project. Other activities such as industry articles and comparison cards were budgeted for ($4,500) but they did not actually require funds to be expended. In many cases, digital advertising and promotion were used in preference to other more traditional approaches initially suggested such as signage and mail-outs.

7.4 Unexpected costs

The installation of LED lighting at Leisurepark Balga was $30,977 over budget (16% over budget). The increase in costs for this activity was easily covered by the underspent budget from other retrofits. The increase in project cost was partly due to an expansion of the scope of the project to include areas of the community centre side of the building (such as the sports hall, boxing gym), which were found during scoping/design to have favourable payback periods. The original budget was also based on a design and costing carried out by a lighting specialist in 2012, four years earlier.

7.5 City contributions

The total cost of completing activities was $879,056. As agreed in the funding arrangement, the City provided two thirds of the required funds as noted in the table below.

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Expenditure</td>
<td>$879,056.06</td>
</tr>
<tr>
<td>City contribution (two thirds)</td>
<td>$ 586,037.37</td>
</tr>
<tr>
<td>CEEP contribution (one third)</td>
<td>$ 293,018.69</td>
</tr>
<tr>
<td>CEEP Milestone Payments plus interest</td>
<td>$273,753.51</td>
</tr>
<tr>
<td>Total expected refund to the City</td>
<td>$ 19,265.18</td>
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</tbody>
</table>

7.6 Program value for money

For the energy efficiency upgrades, there is an expected return on investment payback of 9.5 years on the full cost. With just the City’s contribution (70%), payback is 6.7 years. In relation to the educational activities, all targets were achieved, whilst spending less than budgeted.
8 Project Management

8.1 Project Management Methodology

The program was managed using the City’s Project Management Methodology. The City used its project management processes to tightly control and monitor the project, with regular project reviews and communications between the project management and project delivery teams.

The program had a three-tier internal governance structure as detailed in the table below.

<table>
<thead>
<tr>
<th>Role</th>
<th>City of Stirling Officers</th>
<th>Responsibility</th>
</tr>
</thead>
</table>
| CEEP Steering Committee (CEEP SC)       | • Manager - Economic Development and Urban Regeneration (EDUR)  
                                         | • Manager – Recreation and Leisure Services (RLS)  
                                         | • Manager – City Building (CB)  
                                         | • Chairperson – Manager EDUR          | • Approve any variations to scope, schedule, cost and quality.  
                                         | • Approve Milestone Reports for submission to Department of Industry  
                                         | • Approve CEEP marketing activities  
                                         | • Consult with Executive Team and Council                                               |
| CEEP Program Manager (CEEP PM)          | Sustainability Coordinator (EDUR)                 | • Overall CEEP program management and reporting  
                                         | • Submit CEEP status updates and variation requests to CEEP SC  
                                         | • Submit milestone reports to CEEP SC and Department of Industry  
                                         | • Primary contact for Department of Industry  
                                         | • Submit marketing requests to CEEP SC  
                                         | • Supervise EDUR officers to complete all CEEP education activities  
                                         | • Ensure sufficient funding is available.  
                                         | • Support on projects which have not been yet been fully scoped.                     |
| CEEP Project Coordinator (CEEP PC)      | Building Specialist Services Coordinator (CB)     | • Project Coordination of fully scoped and budgeted CEEP facility upgrades and energy monitoring  
                                         |                                                                                     | • Recruit CEEP Project Supervisor                                                                 |
In the project initiation phase, a project charter was developed which included the scope, objectives, risks, budget and resources required. This project charter was approved and a program manager was assigned. In the program planning phase, a detailed project management plan was developed and consultants were then procured to provide expert recommendations when required to ensure that projects were feasible and that initial budgeting and energy efficiency improvement estimates were correct.

In program execution, project officers followed the City’s procedures in relation to procurement and contract management, and used the City’s risk framework to identify and manage risks. Project data was collected on costs and quality. In relation to program control and monitoring, the project team met monthly to provide updates on scope, cost, time, risk and quality. An overall program gantt was used to track all projects’ progress and the program budget was updated regularly.

Any significant risks were reported to the CEEP Steering Committee and the funding body. Milestone reports were provided to the funding body at agreed times. Any proposed variations were approved by both the CEEP Steering Committee and the funding body.

In relation to the individual projects in buildings, project officers followed the City’s rigorous building Capital Project Delivery procedures. These included Tender or Request for Quotation processes (depending on the value of the work), approvals to seek quotation, standard Project Briefs, project evaluation processes, regular supervisor project financial/progress reviews and external reviews of contractor Occupational Health & Safety documentation.

### 8.2 Project Resourcing

The program was managed internally by the Sustainability Coordinator and the energy efficiency projects were managed by the Building Specialist Services Coordinator. No external organisations or human resources were involved in a project management capacity. The City budgeted for a part-time project manager to oversee the delivery of the building projects. However, the market was such that the City was unable to find a part-time person with the necessary technical and project management skills to carry out this role.

As outlined above, timed delays and the inability to move the end date of the project meant that the works needed to be rescheduled and compressed from a three year project to a two year timeframe. This compressed timeframe created significant issues with resourcing the delivery of a large program of works.

In addition, the high level of reporting and program delivery requirements also created challenges for officers who were also responsible for delivering other energy efficiency projects and energy management activities concurrently at the City.
8.3 Undertaking Similar Projects in the Future

From the CEEP experience, the City is in a better position to manage future grant-funded projects. For example, the City would learn to better align the management of the individual projects with the City’s project reporting and financial systems. For this project, the City attempted to align its processes with the reporting requirements to the funding body, which created difficulties in aligning with the City’s systems and with reporting and managing the individual project budgets, particularly when the City had to manage a number of changes to scope and budget.

The key learnings in this area are that for a future grant project of similar magnitude and complexity, the City would need to ensure that additional budget was requested and sufficient time allowed in the project schedule to engage a person to carry out the project management role for energy efficiency upgrades. It should also be noted that it is critical that sufficient contingency time be allowed in the project schedule to properly complete the projects, allowing for unforeseen project issues, site issues, and delays in equipment delivery.

9 Conclusion

The Kill-a-Watt program achieved its intended objectives to improve energy efficiency at the City and encourage improved energy practices at the City and in the local community. In relation to energy efficiency upgrades to facilities the key outcomes were a combined annual energy savings of 239,639 kWh (863 GJ) per year, energy cost savings of $48,352 per year, maintenance cost savings of $7,477 per year, 182 tonnes CO2-e reduced per year, and an overall payback return on investment of approximately 9 years. Mirrabooka Library achieved the best result for building retrofits, reducing its annual energy use by approximately 33%.

In relation to education and communication outcomes, approximately 2,000 people participated, across all activities, with 60% of participants living in suburbs of socioeconomic disadvantage. The outcomes from educational activities include:

- 112 home energy audits completed
- 800+ bilingual energy saving booklets distributed (in 8 languages)
- 54 loans of Home Energy Assessment Toolkits
- 2 Staff Easter power down competitions (Administration Centre)
- 2 Business energy network events

Post implementation surveys showed that participants in the community activities were 94-98% likely to implement energy saving initiatives at home, with 29-36% of these already having implemented changes after the workshops. Surveys also showed that 50% of respondents were aware that the City has been upgrading buildings and community facilities for energy efficiency, and nearly 74% were aware of the education activities on offer to help residents save on their energy bills.

The cost of completing all energy efficiency upgrades, educational activities and communications was $879,056. The program encountered several key unexpected issues that affected the scope, timeline and budget. These issues were resolved in a timely manner through the City’s project management processes that tightly controlled and monitored the program’s scope, costs, risk, quality and timelines, with regular project reviews and communications between the project management team and project delivery teams.
10 Declaration

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 Stirling (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: Paul White  Date: 10.6.16

Name: PAUL WHITE

Position: Manager Economic Development and Urban Regeneration

Organisation: City of Stirling

Witness Signature: Clayton Chippel  Date: 10.6.16

Name: Clayton Chippel

Position: Sustainability Coordinator

Organisation: City of Stirling

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.
## Appendix A: Energy Efficiency Improvement Tables

<table>
<thead>
<tr>
<th>Building, Facility or Site</th>
<th>Name of Building, Facility or Site</th>
<th>Location (address)</th>
<th>Type of building, facility or site</th>
<th>Activity Type and Measure</th>
<th>Energy Efficiency Estimate Method</th>
<th>Baseline Energy Usage</th>
<th>Baseline Energy Efficiency</th>
<th>Energy Efficiency Improvement</th>
<th>Reporting Data (Measuring Energy Efficiency and Additional Data)</th>
<th>Cost of Activity</th>
<th>Estimated Cost Savings</th>
<th>Greenhouse gas emission reduction</th>
<th>Building, Facility or Site</th>
<th>Name of Building, Facility or Site</th>
<th>Location (address)</th>
<th>Type of building, facility or site</th>
<th>Activity Type and Measure</th>
<th>Energy Efficiency Estimate Method</th>
<th>Baseline Energy Usage</th>
<th>Baseline Energy Efficiency</th>
<th>Energy Efficiency Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Terry Tyzack Aquatic Centre</td>
<td>62 Alexander Drive, Perth WA 6052</td>
<td>Aquatic centre</td>
<td>Consultant assessment using measured data from the variable speed drives and electricity sub-meters</td>
<td>19,289,888 MJ per year</td>
<td>5,617.32 MJ per m³ per year</td>
<td>Reduction of 17 MJ per m³ per year</td>
<td>A total area of 3,812 m² and 585,000 visitors per year</td>
<td>$47,548</td>
<td>$3,431 per year</td>
<td>13.3 tonnes CO₂-e</td>
<td></td>
<td></td>
<td>62 Alexander Drive, Perth WA 6052</td>
<td>Aquatic centre</td>
<td>Upgrade of Building Management System (BMS)</td>
<td>Not able to assess savings due to project being completed mid-April 2016 so no meaningful building/system energy use data available post installation.</td>
<td>19,289,888 MJ per year</td>
<td>35.1 MJ per visitor per year</td>
<td>-</td>
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</table>
### Reporting Data (Measuring Energy Efficiency and Additional Data)

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<thead>
<tr>
<th>A total area of 3,812 m² and 585,000 visitors per year</th>
<th>Volume of heated water of 3,434 m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>364 days of operation</td>
<td>Redeveloped 2001</td>
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</tbody>
</table>

### Cost of Activity

- **$48,470**

### Estimated Cost Savings

- **-**

### Greenhouse gas emission reduction

- **-**

### Building, Facility or Site

<table>
<thead>
<tr>
<th>Name of Building, Facility or Site</th>
<th>Leisurepark Balga</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location (address)</td>
<td>Princess Road, Balga, WA 6061</td>
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<tr>
<td>Type of building, facility or site</td>
<td>Aquatic centre</td>
</tr>
<tr>
<td>Activity Type and Measure</td>
<td>Variable speed drives on pool pumps</td>
</tr>
</tbody>
</table>

#### Energy Efficiency Estimate

- **Method**
  - Consultant assessment using measured data from the variable speed drives and electricity sub-meters

#### Baseline Energy Usage

- **10,781,213 MJ per year**

#### Baseline Energy Efficiency

- **854 MJ per m³ per year**

#### Energy Efficiency Improvement

- **Reduction of 10.47 MJ per m³ per year**

### Reporting Data (Measuring Energy Efficiency and Additional Data)

<table>
<thead>
<tr>
<th>A total area of 3,510 m² and 330,000 visitors per year</th>
<th>Volume of heated water of 12,610 m³</th>
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</thead>
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<tr>
<td>364 days of operation</td>
<td>Constructed 2008</td>
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</tbody>
</table>

### Cost of Activity

- **$65,183**

### Estimated Cost Savings

- **$3,679 per year**

### Greenhouse gas emission reduction

- **25.2 tonnes CO₂-e**

### Building, Facility or Site

<table>
<thead>
<tr>
<th>Name of Building, Facility or Site</th>
<th>Leisurepark Balga</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location (address)</td>
<td>Princess Road, Balga, WA 6061</td>
</tr>
<tr>
<td>Type of building, facility or site</td>
<td>Aquatic centre</td>
</tr>
<tr>
<td>Activity Type and Measure</td>
<td>Upgrade of Building Management System (BMS)</td>
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</tbody>
</table>

#### Energy Efficiency Estimate

- **Not able to assess savings due to project being completed**
<table>
<thead>
<tr>
<th>Method</th>
<th>mid-April 2016 so no meaningful building/system energy use data available post installation.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline Energy Usage</td>
<td>10,781,213 MJ per year</td>
</tr>
<tr>
<td>Baseline Energy Efficiency</td>
<td>33.7 MJ per visitor per year</td>
</tr>
<tr>
<td>Energy Efficiency Improvement</td>
<td>-</td>
</tr>
<tr>
<td>Reporting Data (Measuring Energy Efficiency and Additional Data)</td>
<td>A total area of 3,510 m² and 330,000 visitors per year Volume of heated water of 12,610 m³ 364 days of operation Constructed 2008</td>
</tr>
<tr>
<td>Cost of Activity</td>
<td>$87,000</td>
</tr>
<tr>
<td>Estimated Cost Savings</td>
<td>-</td>
</tr>
<tr>
<td>Greenhouse gas emission reduction</td>
<td>-</td>
</tr>
<tr>
<td>Building, Facility or Site</td>
<td>Leisurepark Balga</td>
</tr>
<tr>
<td>Name of Building, Facility or Site 2</td>
<td>Leisurepark Balga</td>
</tr>
<tr>
<td>Location (address)</td>
<td>Princess Road, Balga, WA 6061</td>
</tr>
<tr>
<td>Type of building, facility or site</td>
<td>Aquatic centre</td>
</tr>
<tr>
<td>Activity Type and Measure</td>
<td>Upgrade of lighting to LEDs</td>
</tr>
<tr>
<td>Energy Efficiency Estimate Method</td>
<td>Assessment by consultant based on lighting circuit current values pre and post upgrade measured by contractor</td>
</tr>
<tr>
<td>Baseline Energy Usage</td>
<td>10,781,213 MJ per year</td>
</tr>
<tr>
<td>Baseline Energy Efficiency</td>
<td>3,071.57 MJ per m² per year</td>
</tr>
<tr>
<td>Energy Efficiency Improvement</td>
<td>Reduction of 94 MJ m² per year</td>
</tr>
<tr>
<td>Reporting Data (Measuring Energy Efficiency and Additional Data)</td>
<td>A total area of 3,510 m² and 330,000 visitors per year Volume of heated water of 12,610 m³ 364 days of operation Constructed 2008</td>
</tr>
<tr>
<td>Cost of Activity</td>
<td>$227,807</td>
</tr>
<tr>
<td>Estimated Cost Savings</td>
<td>$19,356 per year</td>
</tr>
<tr>
<td>Greenhouse gas emission reduction</td>
<td>68.0 tonnes CO2-e</td>
</tr>
<tr>
<td>Notes</td>
<td>For the Leisurepark Balga lighting upgrades, the expected energy savings were less than those originally estimated by the lighting specialist. This is partly because those estimates...</td>
</tr>
</tbody>
</table>
included external lights and the gym which were not included in the final scope. This was because the gym lights had already been upgraded to LEDs in the interim and the external lights were found in the detailed design not to be cost effective to upgrade (as the original design used a power rating of 165W, when the original fittings were actually 30W). This change in scope was partly offset by the inclusion of some new areas of the building which were found to have favourable payback periods.

The expected savings of a more than 60% reduction in the lighting energy use are however considered to be extremely good.

<table>
<thead>
<tr>
<th>Building, Facility or Site</th>
<th>Name of Building, Facility or Site</th>
<th>Works Depot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location (address)</td>
<td>16 Natalie Way, Balcatta, WA 6021</td>
<td></td>
</tr>
<tr>
<td>Type of building, facility or site</td>
<td>Office</td>
<td></td>
</tr>
<tr>
<td>Activity Type and Measure</td>
<td>HVAC optimisation activities (recommissioning of HVAC, installation of 365 clock controller)</td>
<td></td>
</tr>
<tr>
<td>Energy Efficiency Estimate Method</td>
<td>Consultant assessment based on electricity data for HVAC sub-circuit measured by data logger</td>
<td></td>
</tr>
<tr>
<td>Baseline Energy Usage</td>
<td>2,084,299 MJ per year</td>
<td></td>
</tr>
<tr>
<td>Baseline Energy Efficiency</td>
<td>100.2 MJ per occupant per day</td>
<td></td>
</tr>
<tr>
<td>Energy Efficiency Improvement</td>
<td>Reduction of 3.6 MJ per occupant per day</td>
<td></td>
</tr>
<tr>
<td>Reporting Data (Measuring Energy Efficiency and Additional Data)</td>
<td>A total area of 4,470 m² and 80 staff 260 days of operation</td>
<td></td>
</tr>
<tr>
<td>Cost of Activity</td>
<td>$10,072</td>
<td></td>
</tr>
<tr>
<td>Estimated Cost Savings</td>
<td>$3,282 per year</td>
<td></td>
</tr>
<tr>
<td>Greenhouse gas emission reduction</td>
<td>16.0 tonnes CO2-e</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Building, Facility or Site</th>
<th>Name of Building, Facility or Site</th>
<th>Works Depot</th>
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<tr>
<td>Location (address)</td>
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<tr>
<td>Type of building, facility or site</td>
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</tr>
<tr>
<td>Activity Type and Measure</td>
<td>Upgrade of lighting to LEDs</td>
<td></td>
</tr>
<tr>
<td>Energy Efficiency Estimate Method</td>
<td>Assessment by consultant based on lighting circuit current values pre and post upgrade measured by contractor</td>
<td></td>
</tr>
<tr>
<td>Baseline Energy Usage</td>
<td>2,084,299 MJ per year</td>
<td></td>
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</tbody>
</table>
### City of Stirling – CEEP2030 – Kill-a-Watt Program – Final Report

#### Baseline Energy Efficiency

<table>
<thead>
<tr>
<th></th>
<th>100.2 MJ per occupant per day</th>
</tr>
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</table>

#### Energy Efficiency Improvement

<table>
<thead>
<tr>
<th></th>
<th>Reduction of 5.6 MJ per occupant per day</th>
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</table>

#### Reporting Data (Measuring Energy Efficiency and Additional Data)

<table>
<thead>
<tr>
<th></th>
<th>A total area of 4,470 m² and 80 staff</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>260 days of operation</td>
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#### Cost of Activity

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<tr>
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<th>$64,611</th>
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#### Estimated Cost Savings

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<tr>
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<th>$10,341 per year</th>
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#### Greenhouse gas emission reduction

<table>
<thead>
<tr>
<th></th>
<th>24.5 tonnes CO2-e</th>
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### Building, Facility or Site

<table>
<thead>
<tr>
<th>Name of Building, Facility or Site</th>
<th>Mirrabooka Library</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Location (address)</th>
<th>21 Sudbury Place, Mirrabooka WA 6061</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Type of building, facility or site</th>
<th>Library</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Activity Type and Measure</th>
<th>HVAC optimisation activities (installation of air relief vent in roof and recommissioning of air-conditioning system)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Energy Efficiency Estimate Method</th>
<th>Consultant assessment based on electricity data for HVAC sub-circuit measured by data logger</th>
</tr>
</thead>
</table>

#### Baseline Energy Usage

<table>
<thead>
<tr>
<th></th>
<th>980,554 MJ per year</th>
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</table>

#### Baseline Energy Efficiency

<table>
<thead>
<tr>
<th></th>
<th>822.6 MJ per m²</th>
</tr>
</thead>
</table>

#### Energy Efficiency Improvement

<table>
<thead>
<tr>
<th></th>
<th>-17.3 MJ per m²</th>
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</table>

#### Reporting Data (Measuring Energy Efficiency and Additional Data)

<table>
<thead>
<tr>
<th></th>
<th>A total area of 1,192 m² and 129,000 users per year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>276 days of operation</td>
</tr>
<tr>
<td></td>
<td>Constructed 1997</td>
</tr>
</tbody>
</table>

#### Cost of Activity

<table>
<thead>
<tr>
<th></th>
<th>$16,458</th>
</tr>
</thead>
</table>

#### Estimated Cost Savings

<table>
<thead>
<tr>
<th></th>
<th>-$2,393 per year</th>
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</thead>
</table>

#### Greenhouse gas emission reduction

<table>
<thead>
<tr>
<th></th>
<th>-4.4 tonnes CO2-e</th>
</tr>
</thead>
</table>

#### Notes

At Mirrabooka Library, the original estimate, based on an energy audit, was for around a 25% saving on HVAC energy use. However, the assessment of the project by the consultant estimated that HVAC energy use has increased by 11% since the optimisation work.

A new computer training suite package air-conditioning unit was installed in the Library in August 2015. The old unit was not operational in the period prior to the CEEP project (Apr-May 2015) but the new unit was used during the post period (Sep-Oct 2015) and would therefore have increased the total HVAC energy use for the Library. This could
account for part or all of the estimated 11% increase in HVAC energy use.

In addition, less than three months of energy logger data was available for the pre-CEEP HVAC upgrade. The consultant’s estimate is therefore based on only two months of system operation after the upgrade which is not a good representation of the operation of the system over a whole year (which varies according to ambient temperature, humidity etc). It is possible that operational and/or seasonable differences between the two months before and two months after the project could account for some or all of the increase in HVAC energy use (for example if ambient temperatures or the number of library users were higher after the project. However, the operation of the HVAC system is being reviewed to ensure there are no issues.

A comparison with the original estimate is also not valid as during the detailed design of the upgrades, it was determined that an economy cycle already existed at Mirrabooka Library. Therefore, the scope was significantly reduced to instead improve the operation of the economy cycle by installing an air relief vent and recommissioning the system.

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<tr>
<td>Type of building, facility or site</td>
<td>Library</td>
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<tr>
<td>Activity Type and Measure</td>
<td>Upgrade of fluorescent track lighting to LEDs</td>
</tr>
<tr>
<td>Energy Efficiency Estimate Method</td>
<td>Assessment by consultant based on lighting circuit current values pre and post upgrade measured by contractor</td>
</tr>
<tr>
<td>Baseline Energy Usage</td>
<td>980,554 MJ per year</td>
</tr>
<tr>
<td>Baseline Energy Efficiency</td>
<td>822.6 MJ per m2</td>
</tr>
<tr>
<td>Energy Efficiency Improvement</td>
<td>Reduction of 160.7 MJ per m2</td>
</tr>
<tr>
<td>Reporting Data (Measuring Energy Efficiency and Additional Data)</td>
<td>A total area of 1,192 m² and 129,000 users per year 276 days of operation Constructed 1997</td>
</tr>
<tr>
<td>Cost of Activity</td>
<td>$99,859</td>
</tr>
<tr>
<td>Estimated Cost Savings</td>
<td>$18,213 per year</td>
</tr>
<tr>
<td>Greenhouse gas emission reduction</td>
<td>40.4 tonnes CO2-e</td>
</tr>
</tbody>
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