Community Energy Efficiency Program Final Report
Bankstown District Sports Club

Greenfield Parade, Bankstown
“Bankstown Sports Club Energy Efficiency Upgrade”

Prepared for: Department of Industry
Prepared by: Kevin Tu
Reference: CEEP2233
Date: 30 October 2014

“This activity received funding from the Australian Government”
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1. Executive Summary

The overall result of the project was a successful reduction in the energy intensity of the club. In particular, the following energy efficiency objectives were achieved:

- Decrease in energy intensity of 61.3 MJ/m²
- Energy saving of 1,447,480 kWh/year
- Energy cost saving of approximately $200,000/year

The works included the following:

- Modifying AHU’s with REX
- Installation of VSDs on AHU’s plus DCV override
- Repair of the carpark ventilation controls
- Installation of submetering
- Re-commissioning of the BMS

Overall, the savings from the project as could be determined shortly after the completion of the project was 55% less than was expected from the project. This error in estimation is largely attributed to the accuracy and validity of several assumptions that were made in the initial energy audit. However, conceptually, the measures that have been implemented were successful and should continue to provide increased value as further tuning of the system is performed over time.

The measured energy efficiency performance of the project is approximately 44% lower than originally expected. Several factors may have contributed to this figure:

- Difference in actual operating hours vs. Estimated operating hours
- Deviations from the assumed 30% reduction in fan speed from VSDs
- Weather conditions not permitting proper economy cycle
- Differences from assumed initial conditions and operating patterns
- Changes to the clubs activity levels

However, the project was achieved well within budget, though there were a few issues with subcontractors completing work to deadlines.

The total cost of the project was $653,103 ex GST; which was $204,192 ex GST less than the original predicted project cost. The project received $282,906 ex GST in Australian Government funding.

Energy efficiency outcomes and priorities were communicated to staff and patrons of the club through various measures which included:

- Media posts on the club website
- Printed articles
- Publicity banners
- Annual reporting
- Visual display screens

As a result of these activities, there has been increased awareness regarding energy efficiency amongst the club staff and patrons. In particular, the visual display screen provides live feedback to club members about the buildings energy performance and the associated carbon emissions savings, highlighting the clubs commitment to sustainable business practises.

Disclaimer:
Community Energy Efficiency Program Final Report
Bankstown District Sports Club

“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.”
2. Description of works

The following sections describe in detail the activities that were completed as part of the CEEP funded project.

2.1. Modify Air Handling Units (AHUs) with Rotary Heat Exchangers (REX)

Modify Air Handling Units (AHUs) with Rotary Heat Exchangers (REX).

<table>
<thead>
<tr>
<th>Designation</th>
<th>Serving</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHU-6</td>
<td>Part rain forest &amp; fountain</td>
</tr>
<tr>
<td>AHU-8</td>
<td>Chinese restaurant</td>
</tr>
<tr>
<td>AHU-9</td>
<td>Sports Bar - 4 zones</td>
</tr>
<tr>
<td>AHU-11</td>
<td>Rain forest area</td>
</tr>
<tr>
<td>AHU-13</td>
<td>(Basement)</td>
</tr>
<tr>
<td>AHU-14</td>
<td>Meeting Room</td>
</tr>
<tr>
<td>AHU-15</td>
<td>Gaming Area</td>
</tr>
<tr>
<td>AHU-16</td>
<td>Gaming Area</td>
</tr>
<tr>
<td>AHU-17</td>
<td>GF gaming Area below showroom</td>
</tr>
<tr>
<td>AHU-18</td>
<td>GF gaming Area below showroom</td>
</tr>
<tr>
<td>AHU-21</td>
<td>Function/meeting Rooms - 4 zone</td>
</tr>
<tr>
<td>AHU-23</td>
<td>Function Rooms</td>
</tr>
</tbody>
</table>

At present these air handling units operate with 100% outside air and the rotary heat exchangers. The units were designed and installed when smoking was allowed in the club. As this is no longer the case the outside air quantities can be reduced to the minimum allowable under the relevant Australian standard AS 1668.

Note the units will still operate on 100% air when the economy cycle is operational.

Scope of Works:

- Modify outside and return air paths and provide motorised dampers
- Install Variable speed drives to return/relief fans
- Modify controls and commission systems.

Implementation plan

1. Mechanical Consultant to prepare a detailed technical specification for the work containing performance and quality control requirements including:
   - Specify appropriate outside air quantities to comply with AS1668
   - Prepare drawings detailing modified outside air and return air paths
   - Specify suitable VSDs for return air fans
   - Prepare a functional description of the control logic for the BMS including required I/O list.
   - Be part of the commissioning process to ensure that the outside airflow for each AHU is correctly set and that economy cycle still operates under desired conditions

2. Obtain quotations from nominated specialist contractors for the specified work.
   Ensure that the proposed contractors have experience doing similar projects.

3. Assess tender submissions and appoint contractor to carry out the work

   A BMS specialist will be required to carry out modifications to the control algorithms and commission the BMS.

**Monitoring and Verification**

Inputs required include:

- Monitor plant operation for a period of 2 months including weekend operation before and after implementation of upgrades
- Obtain BOM or other independent weather data for the monitoring periods before and after installation to allow for normalisation to the ‘degree days’.

Use ESS Rule Method 3 to calculate the following:

- Normalised consumption
- Normalised energy baseline
- Baseline variability
- Reduced electricity consumption
- Confidence factor
- Energy savings, and
- The number of ESCs generated.

This method was chosen because it normalises energy consumption for a site to remove explainable variation from the baseline, by adjusting for variations in ambient conditions as calculated using Degree days heating and/or cooling as required.
2.2. Install variable speed drives to reduce AHU supply air flows plus Demand Control Ventilation (DCV) over-ride

<table>
<thead>
<tr>
<th>Designation</th>
<th>Serving</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHU-1</td>
<td>Lounge and gaming machine play</td>
</tr>
<tr>
<td>AHU-5</td>
<td>Foyer, Bottle shop, Piano bar</td>
</tr>
<tr>
<td>AHU-6</td>
<td>Part rain forest &amp; fountain</td>
</tr>
<tr>
<td>AHU-7</td>
<td>Bistro / Greenfield station 3 zone</td>
</tr>
<tr>
<td>AHU-8</td>
<td>Chinese restaurant</td>
</tr>
<tr>
<td>AHU-9</td>
<td>Sports Bar - 4 zones</td>
</tr>
<tr>
<td>AHU-10</td>
<td>Smoking Area &amp; poker machine play</td>
</tr>
<tr>
<td>AHU-11</td>
<td>Rain forest area</td>
</tr>
<tr>
<td>AHU-13</td>
<td>(Basement)</td>
</tr>
<tr>
<td>AHU-14</td>
<td>Meeting Room</td>
</tr>
<tr>
<td>AHU-15</td>
<td>Gaming Area</td>
</tr>
<tr>
<td>AHU-16</td>
<td>Gaming Area</td>
</tr>
<tr>
<td>AHU-17</td>
<td>GF gaming Area below showroom</td>
</tr>
<tr>
<td>AHU-18</td>
<td>GF gaming Area below showroom</td>
</tr>
<tr>
<td>AHU-19</td>
<td>Administration</td>
</tr>
<tr>
<td>AHU-20</td>
<td>Showroom</td>
</tr>
<tr>
<td>AHU-21</td>
<td>Function/meeting Rooms - 4 zone</td>
</tr>
<tr>
<td>AHU-22</td>
<td>Function Rooms - multi zone</td>
</tr>
<tr>
<td>AHU-23</td>
<td>Function Rooms</td>
</tr>
<tr>
<td>AHU-25</td>
<td>Chinese and part Piazza</td>
</tr>
<tr>
<td>AHU-29</td>
<td>La Piazza</td>
</tr>
<tr>
<td>AHU-32</td>
<td>La Piazza - sea food bar</td>
</tr>
<tr>
<td>AHU-33</td>
<td>Function Rooms 1st floor</td>
</tr>
<tr>
<td>AHU-34</td>
<td>Function Rooms 1st floor</td>
</tr>
<tr>
<td>AHU-35</td>
<td>Pre function 1st floor</td>
</tr>
<tr>
<td>AHU-36</td>
<td>Pre function 1st floor</td>
</tr>
<tr>
<td>AHU-37</td>
<td>Ground floor - link corridor</td>
</tr>
<tr>
<td>AHU-38</td>
<td>Monkey Mania Play area low level</td>
</tr>
<tr>
<td>AHU-39</td>
<td>Monkey Mania Play area high level</td>
</tr>
</tbody>
</table>

At present these air handling units operate at constant air flow with a fixed minimum outside air, irrespective of the load requirement or the level of occupancy. The project involves the installation of a Variable Speed Drive (VSD) on the Air Handling Unit (AHU) supply air fan and controlling the fan speed to meet cooling requirements. This is called conversion of a Constant Volume (CV) system to a Variable Air Volume (VAV) system. During commissioning the minimum airflow will be set to prevent dumping. It has been assumed that
all airflows can be reduced to an average of 80% annually. A CO₂ monitoring system is required to ensure adequate outside air is provided.

**Scope of works**

- Provide VSD for each AHU supply air fan
- Provide CO2 monitor for each conditioned space
- Provide additional I/O for BMS
- Program BMS

**Implementation Plan**

1. Mechanical Consultant to prepare a detailed technical specification for the work containing performance and quality control requirements including:
   - Confirm existing AHU's have suitable capacity and airflows to meet current heat loads and occupancy.
   - Specify suitable VSD and CO2 monitors
   - Specify appropriate outside air quantities to comply with AS1668
   - Prepare a functional description of the control logic for the BMS including required I/O list.
   - Be part of the commissioning process to ensure that the minimum airflow for each AHU is correctly set, low enough to provide energy savings but not so low as to produce dumping.

2. Obtain quotations from nominated specialist contractors for the specified work

   Ensure that the proposed contractors have experience doing similar projects.

3. Assess tender submissions and appoint contractor to carry out the work


   A BMS specialist will be required to carry out modifications to the control algorithms and commission the BMS
2.3. Repair Carpark ventilation controls

The carpark supply and exhaust systems are currently on manual control and operate continuously at a fixed speed of approximately 60%. This is most likely because of the failure of the original CO sensors installed. New CO sensors are more reliable and savings can be made by replacing all of the existing sensors and recommissioning the automatic operation of these fans.

Scope of Works:

- Provide 40 replacement CO sensors
- Rebalance air flows
- Recommission the automatic control via the BMS

Implementation plan

1. Mechanical Consultant to prepare a detailed technical specification for the work containing performance and quality control requirements including:
   - Specify VSDs for miscellaneous fans
   - Prepare a functional description of the control logic for the BMS (no additional I/O required)
   - Be part of the commissioning process to ensure that the systems are operating as per the proposed alterations and carry out spot checks on rebalancing.
2. Obtain quotations from nominated specialist contractors for the specified work
   Ensure that the proposed contractors have experience doing similar projects.
3. Assess tender submissions and appoint contractor to carry out the work
   A BMS specialist will be required to carry out modifications to the control algorithms and commission the BMS

Monitoring and Verification

Inputs required include:

- Monitor plant operation for a period of 2 months including weekend operation before and after implementation of upgrades

Use ESS Rule Method 3 to calculate the following:

- Normalised consumption
- Normalised energy baseline
- Baseline variability
- Reduced electricity consumption
- Confidence factor
- Energy savings, and
- The number of ESCs generated.
2.4. **Provide sub-metering and implementing an Energy Management Program**

A successful EMP will set energy usage performance targets, require reporting on the energy usage performance and allocate responsibility to someone to meet these targets. Each year the targets should be made more stringent. This will assist in changing a culture where any level of energy usage is acceptable to one where existing energy usage patterns become understood, variance from these patterns are investigated and new alternatives methods are considered for implementation.

Experience has shown that initial savings in energy usage from implementation of an EMP is in the order of 7.5%. This is a conservative estimate and does not include situations where it is generally known that there is a problem, a budget has not been allocated to deal with the issue and no one has the specific responsibility to report on the success or otherwise of the investigation/outcomes.

**Implementation Plan**

1. Installation of appropriate sub-metering for electricity and gas to allow investigation into power usage patterns for different plant and tenants.
2. Appoint an Energy Manager- This should be a part time responsibility of a senior manager. The Energy manager can engage outside consultants for specific tasks but must be responsible for both the budget and the energy performance
3. Set energy targets. - A reasonable starting point would be to allow 3 years to fully implement this plan. Therefore set an energy saving target of 2.5% for each of these 3 years. This target will be increased to allow for any capital projects are also carried out.
4. Reporting on energy consumption needs to be separate and additional to reporting on energy costs. Monthly reporting needs to be meaningful so raw usage data should be processed to take into account seasonal and climatic variations. One simple solution is to use a Moving Annual Total. The slope of the graph should be downwards if energy usage is reducing. Improvements and problems should be able to be identified each month.
5. Carry out maintenance and repairs to rectify energy wastage and implement new strategies and install new equipment to reduce energy usage.
6. Provide training of staff on use of energy, new equipment and new policies

**Measurement and Verification**

Energy savings for this business case will be included with other business cases using Normalised Metered Baseline Method for mechanical services. Use the *Normalised Metered Baseline Method* to calculate reduction in electrical use by the mechanical services.
2.5. Re-commission/re-tune the Building Management System (BMS)

The purpose of re-commissioning the Building Management System (BMS) and associated equipment is to obtain the best performance from the system which is currently installed to achieve energy efficiency within the Club. This project does not include any additions to plant or systems as this form part of other projects. It is taking the existing BMS and making sure that it works properly by a systematic approach to the re-commissioning of the system. A fundamental part of the project will involve repair to any components linked to the BMS, such as valves, damper and actuators, which are not working and recalibration of sensors.

Implementation Plan

This is achieved in a series of steps namely:

1. Establishing all points connected to the system.
2. Checking and calibrating all sensors, dampers and valves.
3. Assessing all software routines which exist at the present time. Review software and determine best algorithms for plant and systems being controlled.
4. Preparing new control software where required.
5. Development of management software to improve the reporting
6. Re-training of site personnel

These steps are set out in more detail below to provide a method statement for the project.

Establishing the Points

In terms of a BMS, the Points are all of the outputs to valves, dampers, motors etc and all of the inputs from sensors; contactors etc and collectively they form the Points Schedule for the BMS. The first step is for the Contractor to provide this full schedule with a plain English description of the function of each point.

Checking and Calibration

The next step in the project is to check the accuracy of the various input points and the function of the output points. This must be carried out for every point in the system and will involve the following:

- Making each sensor (for example temperature sensors) open circuit to ensure that they are wired correctly to the system.
- Checking that the sensor is securely fixed in its correct location.
- Calibrating each temperature and, where fitted, humidity sensors against known values to ensure accuracy and replacing where necessary.
- Exercising all of the valves and dampers to ensure full movement between open and closed and checking the function of the actuators in all cases. This must include checking the actuators are still fitted to their respective valves or dampers and that the movement is correct.
- Checking that all monitoring functions, such as that on electrical contactors operate correctly.
- Ensure that all on/off functions termed digital outputs actually send the correct signal to the item such as staring motors etc.
- Ensure that communications is being achieved to all elements of the system.
This section of the project deals with the hardware elements of the system and once it is established that all elements of the system operate correctly the next stage is to move to the software elements of the system.

**Assessment and Review of Current Software**

The next stage of the Project is to review the software which is resident within the system for each item of plant. The Contractor is required to produce control logic diagrams for each of the plant items which are linked to the BMS.

These diagrams must include all of the logic for the control of each plant item and must indicate whether the plant is time controlled and what the time settings are. Following the completion of this the information should be reviewed on a plant by plant basis to determine the optimum method of control to reduce energy consumption.

In general terms the plant will be set up to achieve the following:

**Air Handling Plant**

The area served by each air handling unit shall be reviewed and the maximum number of occupants for each area shall be evaluated based on normal experience. The minimum fresh air flow for each air handling unit shall be set at 10 litres per second per person.

Areas with significant fluctuations in occupancy may also benefit from implementation of Demand Controlled Ventilation, which could be reviewed in a separate business case.

AHUs equipped with heat recovery shall be set up such that energy recovery is optimised according to temperature control. Where humidity sensors are already installed then enthalpy control can be considered.

AHUs equipped with variable speed drive shall be set up such that the speed of the fan is adjusted as the temperature set point is reached. The air flow will not be adjusted lower than 50% of the full volume of the system and the air distribution within the space monitored to ensure that comfort conditions are not compromised.

Each AHU is to be set up to have separate time scheduling which is to be displayed in a dynamics graphic page so that the Operator can alter the operating times without accessing the control functions of the system.

**Chillers**

The production of chilled water will be controlled such that the energy consumption is minimised. Where sequence control is not achieved from integral controls then the BMS will be programmed to ensure that the minimum number of chillers are in operation based on the return chilled water temperature. This set point will be adjustable by the user.

In addition to this the Chillers and associated pumps will be programmed so that below a specific outside temperature the complete plant is held off.

**Boilers**

The Boiler(s) will be programmed in a similar manner as the Chillers except that the holding off of the units will be upon rising temperature rather than falling temperature. Where the boilers provide domestic hot water then the pumps only will be held off on rising temperature.

**General Air Conditioning**

All general air conditioning, such as DX equipment, will be controlled such that there is independent time control for each item of equipment.

This supplementary equipment will remain under operational control from the existing controls and it will be only the time control which is transferred to the BMS.

**Preparation of New Software and Development of Management Software**
Where changes to the club layout or room usage has not been reflected in the BMS software, appropriate changes will be made. The new software will be added to the BMS in a systematic manner such that the normal operation of the Club is not interrupted. The operation of the new control software will be thoroughly checked to ensure that all systems are operating correctly.

It is important to provide selective access to the BMS. Duty management personnel should have access to plant scheduling but should not be able to “lock” the operation of any of the points. This access should be restricted to the technical personnel within the Club.

**Alarms**

It is also important that the alarm capabilities of the system are optimised. It is common for alarms to be set up for all of the points within the system with the result that far too many alarms are produced and tend to be ignored. A full set of monitoring points will be produced with out of limits levels and alarm points identified. The out of limits points and the alarm points will be directed to different output devices with alarms only being printed where they can then be acted upon.

**Training of Personnel**

In many cases there is significant waste of energy because the personnel using the system do not fully understand the implication of the decisions which they are making. The final step in the re-commissioning of the system is the training of the personnel in the use of the system.

**Measurement and Verification**

Energy savings for this business case will be included with other business cases using Normalised Metered Baseline Method for mechanical services. Use the *Normalised Metered Baseline Method* to calculate reduction in electrical use by the mechanical services.
3. Project Objectives and Benefits

The objectives of the project were twofold:

1. Improve the energy efficiency of the HVAC system at the club; and
2. Demonstrate and communicate to staff and patrons the benefits of improved energy efficiency practices.

Project Demonstration and Communication Activities:

The objectives and outcomes of the project were to be communicated to staff and patrons through the following methods:

1. Energy efficiency web posts on the club website
2. Printed newsletter to members, supports, donors and visitors to the club
3. Media release to the local newspapers
4. Implementation of a project banner reading “Taking action on energy consumption thanks to CEEP!”
5. Visual sign tracking energy savings year on year in the club lobby

Activities which are still yet to be undertaken include:

1. Inclusion of energy efficiency performance in the club’s annual report
2. Printed newsletter to members, supports, donors and visitors to the club

Energy efficiency activities as described previously were the main objective for the project.
3.1. Energy Efficiency outcomes

Electricity consumption was sourced from electricity bills for the period January 2013 – August 2014.

There are two supply authority meters which provide power to the site which include:

- NMI 4103705050 – 6 Greenfield Parade
- NMI NCCZ01266 – 8 Greenfield Parade

Electricity consumption is spread across Peak, Shoulder and Off Peak time bands and is compiled as the basis for verifying the savings achieved from the project.

As the project was completed in stages and is dependent on seasonal variation, the verification period is determined from inspection of the data, allowing for enough coverage to be able to linearly extrapolate to an annual savings figure. This is performed separately for each NMI, reflecting the timing and type of works performed on each site.

In order to verify the savings from the HVAC upgrade project, the following has been taken into account:

- Seasonal variations in site activity on NMI 4103705050

**Note on subsystem verification:**

As the installation of submetering formed part of the project scope, baselining of the various subsystems was not possible as there was no period in which a sufficient baseline could be formed. Specifically, a baseline could not be created for:

- AHU energy consumption
- Carpark ventilation fan consumption

Furthermore, energy savings from the implementation of reduced outside air and proper economy cycle, and the implementation of VSDs cannot be differentiated from any sort of verified measurement. The works were also spread across both NMI’s and energy consumption from utility metered data is not able to be split by measure. These present several limitations to completing the savings analysis for each measure separately.

Therefore, the energy savings for the energy efficiency measures are aggregated as one group of HVAC upgrade measures.
3.1.1. 6 Greenfield Parade

As can be seen from the figure below, there is a clear seasonal variation in consumption across this meter. Typically consumption reaches maximum during the hot summer months and is minimum in the cold winter months. Therefore, the normalised baseline method is used to calculate the savings based on the number of Cooling Degree Days for each month.

From the available electricity data, a clear decline in energy consumption is observed from the start of 2014. Furthermore, analysis of the cooling degree days for each month showed that there were no CDD’s from May 2014 onwards. Therefore, the post project period is taken to be January 2014 – April 2014.

The pre-project period is chosen as the months in which CDD’s > 0 for 2013, namely January 2013 to April 2013, and October 2013 to December 2013.

![Monthly Consumption Graph](image)

*Figure 1.6 Greenfield Parade Electricity consumption*
The figure below shows the relationship between energy consumption and Cooling Degree Days. It is evident that during the post project period, there is a clear decrease in consumption, normalised by the number of CDD’s.

\[ y = 938.98x + 326215 \quad R^2 = 0.7133 \]
\[ y = 595.17x + 322009 \quad R^2 = 0.8531 \]

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>( n_b )</td>
<td>7</td>
</tr>
<tr>
<td>Normalised Energy Baseline (kWh/month)</td>
<td>382,542</td>
</tr>
<tr>
<td>Max ( T_b ) (kWh/month)</td>
<td>441,013</td>
</tr>
<tr>
<td>Min ( T_b ) (kWh/month)</td>
<td>324,687</td>
</tr>
<tr>
<td>Baseline variability (kWh/month)</td>
<td>58,163</td>
</tr>
<tr>
<td>Confidence Factor</td>
<td>85%</td>
</tr>
<tr>
<td>( n_a )</td>
<td>8</td>
</tr>
<tr>
<td>( T_a ) (kWh/month)</td>
<td>338,815</td>
</tr>
<tr>
<td>Reduced electricity consumption (kWh/month)</td>
<td>37,078</td>
</tr>
<tr>
<td>Annual savings (kWh/year)</td>
<td>444,939</td>
</tr>
</tbody>
</table>
The following table shows the monthly consumption from 2013 – 2014.

<table>
<thead>
<tr>
<th>Year</th>
<th>Month</th>
<th>Days</th>
<th>kWh/month</th>
<th>Daily mean Temperature (°C)</th>
<th>CDD</th>
<th>Normalised Tb (kWh/month)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>1</td>
<td>31</td>
<td>502,774</td>
<td>24.45</td>
<td>199.95</td>
<td>441,013</td>
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<tr>
<td>2013</td>
<td>2</td>
<td>28</td>
<td>477,143</td>
<td>22.75</td>
<td>133</td>
<td>401,167</td>
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<tr>
<td>2013</td>
<td>3</td>
<td>31</td>
<td>511,168</td>
<td>22</td>
<td>124</td>
<td>395,810</td>
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<tr>
<td>2013</td>
<td>4</td>
<td>30</td>
<td>349,763</td>
<td>18.15</td>
<td>4.5</td>
<td>324,687</td>
</tr>
<tr>
<td>2013</td>
<td>5</td>
<td>31</td>
<td>308,139</td>
<td>14.9</td>
<td>#N/A</td>
<td>#N/A</td>
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<td>2013</td>
<td>6</td>
<td>30</td>
<td>285,063</td>
<td>13.15</td>
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<td>#N/A</td>
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<td>2013</td>
<td>7</td>
<td>31</td>
<td>273,166</td>
<td>12.3</td>
<td>#N/A</td>
<td>#N/A</td>
</tr>
<tr>
<td>2013</td>
<td>8</td>
<td>31</td>
<td>286,469</td>
<td>13.75</td>
<td>#N/A</td>
<td>#N/A</td>
</tr>
<tr>
<td>2013</td>
<td>9</td>
<td>30</td>
<td>315,735</td>
<td>17.8</td>
<td>#N/A</td>
<td>#N/A</td>
</tr>
<tr>
<td>2013</td>
<td>10</td>
<td>31</td>
<td>346,371</td>
<td>19.3</td>
<td>40.3</td>
<td>345,994</td>
</tr>
<tr>
<td>2013</td>
<td>11</td>
<td>30</td>
<td>346,273</td>
<td>20.15</td>
<td>64.5</td>
<td>360,397</td>
</tr>
<tr>
<td>2013</td>
<td>12</td>
<td>31</td>
<td>418,516</td>
<td>22.7</td>
<td>145.7</td>
<td>408,725</td>
</tr>
<tr>
<td>2014</td>
<td>1</td>
<td>31</td>
<td>426,558</td>
<td>23.45</td>
<td>168.95</td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>2</td>
<td>28</td>
<td>387,426</td>
<td>23.1</td>
<td>142.8</td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>3</td>
<td>31</td>
<td>416,677</td>
<td>22.25</td>
<td>131.75</td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>4</td>
<td>30</td>
<td>340,082</td>
<td>19.05</td>
<td>31.5</td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>5</td>
<td>31</td>
<td>304,878</td>
<td>16.1</td>
<td>#N/A</td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>6</td>
<td>30</td>
<td>286,295</td>
<td>13.4</td>
<td>#N/A</td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>7</td>
<td>31</td>
<td>281,189</td>
<td>11.8</td>
<td>#N/A</td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>8</td>
<td>31</td>
<td>267,418</td>
<td>11.07</td>
<td>#N/A</td>
<td></td>
</tr>
</tbody>
</table>
3.1.2. 8 Greenfield Parade

As can be seen from the figure below, there is very little variation in consumption across this meter throughout the year. Therefore, the savings here can be considered separate from output and is eligible for Method 2 of the ESS methods.

From the available electricity data, a clear decline in energy consumption is observed from May 2014 onwards. This coincides with the completion of works on the AHU’s. Therefore, the post project period is taken to be May 2014 – August 2014.

The pre-project period is chosen as May 2013 – August 2013 as a level comparison between years.

![Monthly Consumption](image)

**Figure 2 8 Greenfield Parade Electricity consumption**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$n_b$</td>
<td>4</td>
</tr>
<tr>
<td>Normalised Energy Baseline (kWh/month)</td>
<td>684,525</td>
</tr>
<tr>
<td>Max $T_b$ (kWh/month)</td>
<td>698,198</td>
</tr>
<tr>
<td>Min $T_b$ (kWh/month)</td>
<td>670,424</td>
</tr>
<tr>
<td>Baseline variability (kWh/month)</td>
<td>13,887</td>
</tr>
<tr>
<td>Confidence Factor</td>
<td>98%</td>
</tr>
<tr>
<td>$n_a$</td>
<td>4</td>
</tr>
<tr>
<td>$T_a$/month (kWh/month)</td>
<td>624,366</td>
</tr>
<tr>
<td>Reduced electricity consumption (kWh/month)</td>
<td>58,939</td>
</tr>
<tr>
<td>Annual savings (kWh/year)</td>
<td>$707,269</td>
</tr>
<tr>
<td>Year</td>
<td>Month</td>
</tr>
<tr>
<td>------</td>
<td>-------</td>
</tr>
<tr>
<td>2013</td>
<td>1</td>
</tr>
<tr>
<td>2013</td>
<td>2</td>
</tr>
<tr>
<td>2013</td>
<td>3</td>
</tr>
<tr>
<td>2013</td>
<td>4</td>
</tr>
<tr>
<td>2013</td>
<td>5</td>
</tr>
<tr>
<td>2013</td>
<td>6</td>
</tr>
<tr>
<td>2013</td>
<td>7</td>
</tr>
<tr>
<td>2013</td>
<td>8</td>
</tr>
<tr>
<td>2013</td>
<td>9</td>
</tr>
<tr>
<td>2013</td>
<td>10</td>
</tr>
<tr>
<td>2013</td>
<td>11</td>
</tr>
<tr>
<td>2013</td>
<td>12</td>
</tr>
<tr>
<td>2014</td>
<td>1</td>
</tr>
<tr>
<td>2014</td>
<td>2</td>
</tr>
<tr>
<td>2014</td>
<td>3</td>
</tr>
<tr>
<td>2014</td>
<td>4</td>
</tr>
<tr>
<td>2014</td>
<td>5</td>
</tr>
<tr>
<td>2014</td>
<td>6</td>
</tr>
<tr>
<td>2014</td>
<td>7</td>
</tr>
<tr>
<td>2014</td>
<td>8</td>
</tr>
</tbody>
</table>
3.1.3. Updated Energy Efficiency baseline

<table>
<thead>
<tr>
<th>Name of site</th>
<th>Bankstown District Sports Club</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location (address)</td>
<td>6/8 Greenfield Pde, Bankstown NSW 2200</td>
</tr>
<tr>
<td>Type of site</td>
<td>Club</td>
</tr>
<tr>
<td>Activity Type and Measure</td>
<td>Modify AHUs with REX VSD on AHUs Repairing of carpark ventilation controls</td>
</tr>
<tr>
<td>Baseline Energy Usage</td>
<td>44,346,405 MJ/year(^1)</td>
</tr>
<tr>
<td>Baseline Energy Efficiency</td>
<td>44,346,405 / 85,000 m(^2) = 521.7 MJ/year</td>
</tr>
<tr>
<td>Energy Efficiency Improvement</td>
<td>1,447,480kWh/year saving Reduction 1447MWh / year x 3.6 x 1000 / 85,000 m(^2) = 61.3 MJ/m(^2)/year</td>
</tr>
<tr>
<td>Reporting Data (Measuring Energy Efficiency and Additional Data)</td>
<td>A total site area of 85,000 m(^2) Daily hours of operation from 9am – 6am - 365 days/year Building construction date:</td>
</tr>
<tr>
<td>Cost of Activity</td>
<td>$653,103</td>
</tr>
<tr>
<td>Estimated Cost Savings</td>
<td>$200,000/year(^2)</td>
</tr>
</tbody>
</table>

The savings shown here are significantly lower than the expected outcomes of the project. The original estimate of annual energy savings was expected to be: 2,574,000 kWh/year.

Several factors may have contributed to this figure:

- Difference in actual operating hours vs. Estimated operating hours
- Deviations from the assumed 30% reduction in fan speed from VSDs
- Weather conditions not permitting proper economy cycle
- Differences from assumed initial conditions and operating patterns
- Changes to the clubs activity levels

However, it should also be noted that the project has also come under budget. Therefore the financial viability of the project is still considerable. Furthermore, there is likely to be additional savings from further improvement to the control strategy, and subsequent tuning of the system parameters.

\(^1\) This value is based on the 2013 annual consumption from both NMIs

\(^2\) Based on an average electricity price of 14c/kWh
3.2. Financial outcomes

3.2.1. Project Budget

The original budget expected that Bankstown District Sports Club would co-contribute $574,389 ex GST, whilst receiving funding of $282,906 ex GST. As such, the total expected spend was $857,295 ex GST.

CEEP funding of $254,615 has been paid to date with a payment of $28,291 to be paid on completion of the 6th milestone report. The total funding following this payment will be $282,906.

<table>
<thead>
<tr>
<th>Contribution</th>
<th>CEEP</th>
<th>Bankstown District Sports Club</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expenditure</td>
<td>$254,615</td>
<td>$398,488</td>
<td>$0.00</td>
</tr>
<tr>
<td>Total</td>
<td>$254,615</td>
<td>$398,488</td>
<td>$0.00</td>
</tr>
</tbody>
</table>

The total expenses for the project amounted to $653,103 ex GST.

Therefore, the total project cost has come under budget by $204,192 ex GST.

There were several changes to the budget of the project over the period. In particular, initial budget estimates were based on expected costing for labor and materials, together with contingencies for parts which were being imported from overseas. Furthermore, allowances for project management were factored in.

The procurement stage was completed via an open tender which was evaluated against criteria such as quality, experience and pricing. This allowed Bankstown Sports District Sports Club to come under budget by contracting out the job at a lower price than was expected. As such, contingencies were not required at completion of the project. Marketing and related activities were completed internally and have not been valued here.

<table>
<thead>
<tr>
<th>Expenditure item</th>
<th>Sub-total (ex GST)</th>
<th>Actual (ex GST)</th>
<th>Difference (ex GST)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modify AHUs with REX</td>
<td>$130,000</td>
<td>$111,895</td>
<td>$18,105</td>
</tr>
<tr>
<td>Reduce AHU supply air flows plus DCV over-ride</td>
<td>$290,000</td>
<td>$283,771</td>
<td>$6,229</td>
</tr>
<tr>
<td>Repair Carpark Ventilation controls</td>
<td>$62,000</td>
<td>$43,874</td>
<td>$18,126</td>
</tr>
<tr>
<td>Install sub metering</td>
<td>$128,060</td>
<td>$86,430</td>
<td>$41,630</td>
</tr>
<tr>
<td>Re-tune and Re-commission BMS</td>
<td>$71,533</td>
<td>$71,533</td>
<td>$0</td>
</tr>
<tr>
<td>Project management fees</td>
<td>$81,000</td>
<td>$55,600</td>
<td>$25,400</td>
</tr>
<tr>
<td>Post project monitoring and verification</td>
<td>$15,000</td>
<td>-</td>
<td>$15,000</td>
</tr>
<tr>
<td>Marketing</td>
<td>$5,000</td>
<td>-</td>
<td>$5,000</td>
</tr>
<tr>
<td>Contingency</td>
<td>$74,702</td>
<td>-</td>
<td>$74,702</td>
</tr>
<tr>
<td>Total</td>
<td>$857,295</td>
<td>$653,103</td>
<td>$204,192</td>
</tr>
</tbody>
</table>
3.3. Social/Community outcomes

Energy efficiency continues to play a key role at Bankstown District Sports Club. The key stakeholders were both the club staff and patrons. Bankstown Sports conducted a media release of the attached to our media partners and posted the same on their website. We also conveyed the information to all of our staff at our annual business update. Further information was passed onto staff via their ‘green team’ sustainability committee.

The communication occurred in three stages:

Grant Approval

- Monthly printed/electronic newsletter to members, supporters, donors and visitors to the club
- Media release to local newspapers
- Speaking to local businesses and organisations about their stance on energy efficiency. e.g. Lions club, Rotary club meeting, etc.

Project Implementation

- Large banner outside Bankstown Sports Club reading “Taking action on energy consumption thanks to CEEP!”

Post project

- A visual sign tracking energy savings year on year will be placed in the club lobby

Furthermore, Energy efficiency performance will be included in the club’s annual report to highlight continued commitment and invite scrutiny to energy efficiency.
4. Project operation, mechanisms and processes

The HVAC upgrade project was managed by a representative from the clubs HVAC consultants, Engineered Environments. In this capacity, Engineered Environments the project from design to installation, through to commissioning.

Three key representatives from Bankstown District Sports Club assisted in managing the project from the clients perspective. These representatives included:

- Steve Williams – Maintenance Manager
- Michael Clancy – Operations Manager

The responsibilities of the facilities managers and supervisors were to manage the upgrade project, coordinating onsite works, as well as to provide site specific information from a building and operations perspective. Furthermore, site staff roles involved organisation of invoices and general management of timelines and expectations.

A representative from Energy Action Limited was responsible for the following:

- Development of the Project Plan
- Assistance with milestone reporting
- Project officer for the CEEP program
- Measurement and Verification of savings

The overall experience of the project was that this structure worked well. Internal departments worked well in conjunction with contractors to complete the project.

Project management concerns were limited to subcontractor invoicing and delayed project start times. Project start dates were postponed and contractors were not fully aware of the implications of project extensions. Fortunately contractors were able to employ the services of others to complete the project on time.

Contractor invoicing was disorganised and needed to be compiled and organised a number of times, future projects will involve our accounts department in a more proactive role.

One issue that arose during the project was the change in contractor from VIDAC electrical to Guthrie Electrical services. This occurred due to reasons on part of VIDAC electrical close to the start of 2014. As such, there were delays in the project as a new contractor was sourced to scope and complete the remaining works on the carpark controls.

Some other issues included delays in installation of the Sub-metering due to the requirement of shutting down the club mechanical services. There was no possibility with 24hr trading from December 1 to end of January to have electrical switchboards shut down for the safe integration of sub-metering. This is a result of the delays in receiving approval for the project to commence, which did not line up with the timeline of works.

As such, in terms of lessons learnt, greater care should be taken to organise works and timelines in such a way that these problems are avoided. Also, though the risk of contractors inability to complete a job as requested is considered low, a secondary contractor should be at the ready should this occur in cases where these works lie on the critical path.
5. Conclusion

The HVAC upgrade project involved a variety of related measures which included:

- AHU REX heat exchangers
- VSD installation on AHUs
- Repair of carpark ventilation controls
- Re-commissioning of the existing BMS
- Installation of sub-meters across the site

At this stage, the improvement in energy efficiency is measured to be 1,447,480kWh/year. This is approximately 44% less than the expected outcome. However, several factors may have contributed to the apparent shortfall in this figure:

- Difference in actual operating hours vs. Estimated operating hours
- Deviations from the assumed 30% reduction in fan speed from VSDs
- Weather conditions not permitting proper economy cycle
- Differences from assumed initial conditions and operating patterns
- Changes to the clubs activity levels

The improvements in energy efficiency were communicated to club staff and patrons through a variety of different media including:

- Published web articles
- Visual display screens
- Published monthly newsletters
- Media releases to local newspapers

The objectives of the project were achieved upon completion of the relevant milestones. The overall performance of the project is less than expected, though there is still opportunity for improvement through further tuning and alterations to the control strategy.

In general, the project was managed well through Engineered Environments from design to implementation and commissioning. Project was achieved well within budget, despite changes in contractors and delays in completion of works.

In terms of lessons learnt we would make the following comments:

- Scope of works should be clearly defined before commencement
- Project timelines should be maintained throughout the project
- Any changes to the scope or timelines should be clearly communicated
- Risks should be managed carefully to reduce impact on project timelines
- Invoices from contractors and subcontractors should be tracked closely to avoid confusion
Community Energy Efficiency Program Final Report
Bankstown District Sports Club

Declaration

The Authorised Officer of the organisation makes the following declarations:

☐ I declare that I am authorised to submit this Final Report (including any attachments) on behalf of [Name of organisation].

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

☐ I understand, and acknowledge that giving false or misleading information in this Final Report is an offence under the Criminal Code Act 1995.

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

Authorised Officer Signature: [Signature] Date: 31/11/14

Name: MICHAEL CLANCY Position: OPERATIONS MANAGER Organisation: BANKSTOWN SPORTS

Witness Signature: [Signature] Date: 31/11/14

Name: STEVE WILLIAMS Position: FACILITIES MAN Date: Organisation: BANKSTOWN SPORTS

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.