Contents

1.0 Executive Summary ................................................................. 4
2.0 Project Mechanism and Structure ................................................ 5
  2.1 General ............................................................................. 5
  2.2 Application Process ............................................................. 6
  2.3 Detailed Design and Documentation ........................................ 6
  2.4 Tender Process .................................................................. 7
  2.5 Construction Phase ............................................................. 7
  2.6 Public Awareness ................................................................. 8
  2.7 Final signoff ...................................................................... 8
3.0 Energy Consumption Analysis ..................................................... 9
  3.1 Total Energy Consumption ................................................... 9
  3.2 Air Conditioning and Ventilation Energy Consumption ............ 10
  3.3 Energy and Cost Summary ................................................... 11
4.0 Project Budgets and Timeframes ............................................... 11
5.0 Project Objectives .................................................................. 12
Appendix A – Baseline Energy Efficiency Improvement Summary .......... 13
# Report Details

<table>
<thead>
<tr>
<th>Details</th>
<th>Name</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author(s)</td>
<td>Simon Costanzo</td>
<td>BCA Engineers</td>
</tr>
<tr>
<td>Reviewer</td>
<td>Mark Chmielewski</td>
<td>BCA Engineers</td>
</tr>
<tr>
<td>Report File Reference</td>
<td>0953.131128.M.1</td>
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<td>A – Preliminary Review Issue</td>
<td>29th November 2013</td>
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<tr>
<td></td>
<td>B – Final Issue</td>
<td>3rd December 2013</td>
</tr>
<tr>
<td></td>
<td>C – Final Issue (revised references to CEEP)</td>
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1.0 Executive Summary

The Community Energy Efficiency Program (CEEP) is a competitive merit based grants program administered by the Australian Government. The program provides funding for Local Government and non-profit organisations to increase the energy efficiency of community use buildings, facilities and lighting. CEEP projects also promote behaviour change and improved energy management practices, and they make the business case for broader uptake of these technologies by industry, local government and community groups.

Alice Springs Town Council (ASTC) was selected for funding under Round 1 of the CEEP for the Alice Springs Public Library Air conditioning upgrade project on the basis of the following objectives:

- Reduce the overall energy consumption of the Alice Springs Library building
- To encourage Public attendance by providing improved indoor air quality within the Library
- Providing vastly improved conditions where both temperature and humidity are controlled to extend the life of culturally and socially sensitive collections of material in the Alice Collection Archives
- Remove systems utilising ozone depleting refrigerant by capturing the refrigerants and disposing of them according to best practice for recycling

Based on the original estimations completed prior to application for the grant, BCA Engineers predicted the new air conditioning and ventilation systems would provide an improvement in energy consumption in the order of 35%. Based on data obtained from the utility provider and sound assumptions, a reduction in energy consumption from 212,160kWhr to 137,270kWh has been achieved for the 2013 calendar year, which equates to a 35.3 percent saving in line with predictions.

Based on our analysis an estimated Energy Efficiency Improvement of 252 MJ/m² per annum has been achieved with actual improvement of 247 MJ/m² per annum.

We note that the Northern Territory has experienced significant utility price increases in the past 12 months which is reflected in the increase in electrical supply charges from 18.87c/kWhr to 23.27c/kWhr. This increase in tariff has reduced the simple payback period of the project from 13 years to 9.2 years.

The project had an original budget and signed funding agreement for a total of $489,463 + GST but unfortunately due to market conditions, the combined cost of construction works and all consultant fees was $530,800 + GST. The difference was funded directly by the ASTC.

Based on all of the information provided in this report, it is clear that the project has been a clear success and achieved the objectives originally aimed for as follows:

- The new air conditioning systems have achieved the 35 percent energy consumption saving predicted as part of the original modelling
- The overall annual cost savings are in excess of those predicted as the electrical supply tariff has increased in the past twelve months
- The indoor air quality has been improved with significantly higher outdoor air rates than the previous systems and higher grade filtration which is paramount in the Alice Springs environment
- Providing a better feeling indoor environment to encourage participation in Library events
- Providing dedicated temperature and humidity control to the Alice Collection and associated socially and culturally important archive materials to prolong their life
- All new systems have been installed with non-ozone depleting refrigerants and all existing redundant refrigerants removed from site and disposed of for recycling
Given the success of this project, the ASTC have been encouraged to review the energy consumption of other sites which they control. The support of the CEEP in this project has encouraged the ASTC to see the long term advantage of adopting improved energy management practices within their properties and there have been additional studies and changes (both big and small) in their assets to increase the energy efficiency of their portfolio.

2.0 Project Mechanism and Structure

This section provides a summary of the mechanisms put in place as part of this project, and indicates what structures and roles were played by the relevant stakeholders involved with the project.

2.1 General

The objectives of the Community Energy Efficiency Program (CEEP) are 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.

The Community Energy Efficiency Program (CEEP) provided the Alice Springs Town Council (ASTC) the opportunity to apply for a grant for this project on the basis of the following objectives:

- Reduce the overall energy consumption of the building
- To encourage Public attendance by providing improved indoor air quality within the Library
- Provide vastly improved conditions where both temperature and humidity are controlled to extend the life of culturally and socially sensitive collections of material in the Alice Collection Archives
- Remove systems utilising ozone depleting refrigerant by capturing the refrigerants and disposing of them according to best practice for recycling

In order to achieve the increase in energy efficiency within the building, the air conditioning systems in the Alice Springs Public Library were to be replaced with new, more energy efficient technology and methodology including the following:

- Improved thermal and functional zoning of the building including:
  - Thermal zoning of perimeter zones (North, South, East, West) and Internal
  - Functional zoning (dedicated Archive units)
- Installation of air-side energy recovery ventilation systems to pre-condition outside air prior to it entering the air conditioning systems
- Inclusion of variable output scroll compressors on air conditioning systems to ramp up and down to meet the cooling and heating capacities required
- Inclusion of variable speed plug fans on air conditioning supply air systems to reduce energy consumption associated with air movement
- Variable refrigerant flow/volume multi-head split type air conditioning systems with heat recovery technology
- Use of non-ozone depleting refrigerants on all air conditioning systems
2.2 Application Process

The ASTC identified that there was potential in the CEEP program to assist in reducing the energy consumption associated with the Alice Springs Library complex. It was acknowledged by the ASTC that the existing air conditioning systems were dated, had high on-going maintenance costs and did not meet the desired internal conditions that would be considered for a Public space such as the Library and that review and potential upgrade of the air conditioning systems could make a significant difference in terms of energy consumption.

The ASTC engaged BCA Engineers to complete an assessment of the existing air conditioning and ventilation systems including the following:

- Review of condition, capacity and compliance with relevant codes and standards
- Review of air conditioning and ventilation system options available to reduce energy consumption
- Recommendations of air conditioning and ventilation systems which would suit the nature of the building
- Comparison of existing and proposed systems listing advantages of the proposed system has over the existing configuration
- A review and comparison of the energy consumption of existing and proposed systems on an annual basis
- Nett cost estimates associated with the upgrade of air conditioning and ventilation systems
- An indication of payback on capital expenditure with respect to savings associated with operating cost savings
- Preliminary sketches of the proposed air conditioning systems

The ASTC in collaboration with BCA Engineers then completed and submitted the Application forms for a grant under the CEEP for the proposed upgrade of air conditioning and ventilation to the Library building.

After review, notification was given that the project was successful and the ASTC engaged BCA Engineers as the Principal Consultant to complete the detailed design and documentation of the proposed systems, review tender submissions and complete contract administration for the project.

2.3 Detailed Design and Documentation

On engagement, BCA Engineers mobilised to complete the following tasks:

- Complete site inspections to complete architectural layouts of the existing building including section details
- Perform site inspections to complete detailed drawings of existing air conditioning and ventilation systems so that any retained items could be coordinated with or modified to suit (no existing as-built drawings were available)
- Review and finalise heat load estimations for the building
- Obtain detailed selections from multiple air conditioning equipment manufacturers to identify the most suitable systems for the building
- Compile preliminary drawings and technical specifications for review by the ASTC
- Compile Tender drawings and technical specifications ready for issue to the market by the ASTC
As part of the process, BCA Engineers also engaged additional sub-consultants to complete the following as part of the building regulations:

- Building Certifiers to obtain Permits to Build and Occupy
- Structural Engineers to confirm structural adequacy of the building for the proposed systems
- Acoustic Engineers to review the acoustic impact of the design on occupants and environment

Once completed, detailed Tender documents were provided to the ASTC for release to the market as part of the Tender Process

2.4 Tender Process

The Tender documents were uploaded on the ASTC website and public notification was given via the local newspaper. A four (4) week tender period was given for contractors to submit their prices for the project in accordance with ASTC Tender requirements.

At the close of Tender, all submissions were opened and reviewed by the Tender Review Panel assembled for this particular project which included representatives from both ASTC and BCA Engineers. The Tender submissions were reviewed for a number of items, including overall cost, support of local businesses and technical compliance to name just a few.

Initial Tender submissions were in excess of the project budget allowances and in order to reduce the project cost, ASTC, BCA Engineers and the lowest tenderer entered negotiations to reduce the overall cost. This included some minor reduction in scope, review of proposed equipment to identify a lower cost but equivalent quality product, as well as negotiation on proposed rated submitted with the tender.

On completion of the negotiations, the tender sum was in-line with project budgets and the project was awarded to a Managing Contractor.

2.5 Construction Phase

The Managing Contractor was responsible for organising and administering all elements of the construction side of the project within and around the Library site including:

- Providing construction programs with regular updates to reflect changes in on-site conditions or latent conditions
- Controlling access to work areas and setting up control cordons to prevent unauthorised access in accordance with WH&H requirements
- Maintaining security to the building at all times
- Ordering all equipment in accordance with technical documentation
- Briefing, inducting and controlling all nominated sub-contractors throughout the construction phase
- Completing all demolition and installation in accordance with the detailed documentation
- Controlling waste removal from the site with disposal in accordance with local requirements
- Identifying any concerns for review by the ASTC and BCA Engineers where applicable
- Providing any ‘Requests for Information’ to BCA Engineers with sufficient time to review so as not to delay construction
- Provision of sufficient warning to permit inspections for quality of workmanship with sufficient notice
- Submitting progress claims for payment to reflect works completed
BCA Engineers’ engagement included the following to ensure the quality of workmanship and ensure that deadlines were being adhered to:

- Attendance at meetings on-site as required
- Reviewing samples provided by the Contractor relating to the mechanical and electrical services
- Review of shop drawings provided by the Contractors relating to the mechanical and electrical services
- Responding to Contractors ‘Request for information’
- Providing Engineer’s Instructions as required
- Review installation of works at multiple stage throughout construction and providing inspection reports relating to the works
- Review ‘Operating and Maintenance’ manuals relating to the building services
- Witnessing during the commissioning process
- Submission of all report required to the CEEP for review and sign-off

2.6 Public Awareness

At the completion of construction, the ASTC provided public announcements to advise the public of what works had been completed within the building and what the implications were in terms of energy and carbon equivalent savings. These public announcements took the following forms:

- Posters located in multiple locations around the Library
- An article in the Library Newsletter which is circulated to all members
- An article on the Library website
- A social media entry on the Libraries Facebook account

2.7 Final signoff

At the completion of construction, BCA Engineers completed a final inspection and witnessing of airflows and provided a final defects list indicating items requiring rectification prior to closure of the project. Once completed, BCA Engineers Issue certification Section 40’s for construction associated with Mechanical Services and liaised with Building Certifier to obtain Permits to Occupy in accordance with NT Regulations.
3.0 Energy Consumption Analysis

In order to evaluate the energy consumption of the new air conditioning and ventilation systems relative to the installed systems prior to the Activity commencing, we have reviewed energy consumption based on hard figures supplied by the utility provider, Power and Water.

3.1 Total Energy Consumption

The comparison has been based on the following information and assumptions:

- Average total consumption have been sourced and averaged from monthly energy consumption figures between 2008 and 2012
- January and February have been excluded from the analysis as the new air conditioning systems were not installed or operational at this time
- November and December have been excluded from the analysis as this period has not been completed and no utility provider figures are available
- Analysis figures have been limited to the period between March and October

<table>
<thead>
<tr>
<th>Month</th>
<th>5-year (2008-2012) Average Total Energy Consumption (kWhr)</th>
<th>2013 Total Energy Consumption (kWhr)</th>
<th>Percentage Reduction Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>27893.2</td>
<td>29607.7</td>
<td>-5.79</td>
</tr>
<tr>
<td>February</td>
<td>24635.8</td>
<td>24332.4</td>
<td>1.23</td>
</tr>
<tr>
<td>March</td>
<td>24221.2</td>
<td>17288.4</td>
<td>28.62</td>
</tr>
<tr>
<td>April</td>
<td>17996.1</td>
<td>13059.9</td>
<td>27.43</td>
</tr>
<tr>
<td>May</td>
<td>17238.2</td>
<td>11234.1</td>
<td>34.83</td>
</tr>
<tr>
<td>June</td>
<td>17172.3</td>
<td>10825.2</td>
<td>36.96</td>
</tr>
<tr>
<td>July</td>
<td>17922.3</td>
<td>9855.0</td>
<td>45.01</td>
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<tr>
<td>August</td>
<td>17931.0</td>
<td>14559.3</td>
<td>18.80</td>
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<tr>
<td>September</td>
<td>18091.8</td>
<td>15820.8</td>
<td>12.55</td>
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<tr>
<td>October</td>
<td>22099.4</td>
<td>16992.9</td>
<td>23.11</td>
</tr>
<tr>
<td>November</td>
<td>22062.7</td>
<td>-</td>
<td>100.00</td>
</tr>
<tr>
<td>December</td>
<td>23409.7</td>
<td>-</td>
<td>100.00</td>
</tr>
<tr>
<td>TOTAL (March to October)</td>
<td>152672.3</td>
<td>109635.6</td>
<td>28.41</td>
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</table>

Table 1 – Total Energy Consumption Summary

It can be seen in Table 1 above that total energy consumption for the Library has been reduced on a monthly basis between 12 and 45 percent, with an average over the eight month period of 28.4 percent. Given that the only services related and operational changes over this period were the replacement of the air conditioning and ventilation systems, we assume that the energy consumption savings are associated with this works completed under this project.

If the 28.4 percent saving was prorated across all months of the year, we would expect the energy consumption of the site to be reduced from 255,660kWhr to 183,0030kWh (based on calendar year 2011).
3.2 Air Conditioning and Ventilation Energy Consumption

In addition to the Total analysis above, the comparison related to air conditioning and ventilation energy consumption has also been based on the following information and assumptions:

- Monthly lighting and general power consumption figures of 3625kWhr per month – based on calculated consumption figures obtained during the initial energy assessment for the project

<table>
<thead>
<tr>
<th>Month</th>
<th>Monthly Energy Consumption Attributed to Lighting and Power (kWhr)</th>
<th>5-year (2007-2011) Average Air Conditioning Energy Consumption (kWhr)</th>
<th>2012 Air Conditioning Energy Consumption (kWhr)</th>
<th>Percentage Reduction Air Conditioning (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>3625.3</td>
<td>24267.9</td>
<td>25882.4</td>
<td>-6.65</td>
</tr>
<tr>
<td>February</td>
<td>3625.3</td>
<td>21010.4</td>
<td>20707.1</td>
<td>1.44</td>
</tr>
<tr>
<td>March</td>
<td>3625.3</td>
<td>20595.9</td>
<td>13663.1</td>
<td>33.66</td>
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<tr>
<td>April</td>
<td>3625.3</td>
<td>14370.8</td>
<td>9434.6</td>
<td>34.35</td>
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<td>May</td>
<td>3625.3</td>
<td>13612.9</td>
<td>7608.8</td>
<td>44.11</td>
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<td>June</td>
<td>3625.3</td>
<td>13547.0</td>
<td>7199.9</td>
<td>46.85</td>
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<tr>
<td>July</td>
<td>3625.3</td>
<td>14297.0</td>
<td>6229.7</td>
<td>56.43</td>
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<tr>
<td>August</td>
<td>3625.3</td>
<td>14305.7</td>
<td>10934.0</td>
<td>23.57</td>
</tr>
<tr>
<td>September</td>
<td>3625.3</td>
<td>14466.5</td>
<td>12195.5</td>
<td>15.70</td>
</tr>
<tr>
<td>October</td>
<td>3625.3</td>
<td>18474.1</td>
<td>13367.6</td>
<td>27.64</td>
</tr>
<tr>
<td>November</td>
<td>3625.3</td>
<td>18437.4</td>
<td>-3625.3</td>
<td>119.66</td>
</tr>
<tr>
<td>December</td>
<td>3625.3</td>
<td>19784.4</td>
<td>-3625.3</td>
<td>118.32</td>
</tr>
<tr>
<td>TOTAL (March to October)</td>
<td>29002.5</td>
<td>123669.8</td>
<td>80633.1</td>
<td>35.29</td>
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Table 2 – Air Conditioning Energy Consumption Summary

It can be seen in Table 2 above that air conditioning related energy consumption for the Library has been reduced on a monthly basis between 15 and 56 percent, with an average over the eight month period of 35.3 percent. Given that the only services related and operational changes over this period were the replacement of the air conditioning and ventilation systems, we assume that the energy consumption savings are associated with this works completed under this project.

If the 35.3 percent saving was prorated across all months of the year, we would expect the energy consumption of the site to be reduced from 212,160kWhr to 137,270kWh (based on calendar year 2011).
3.3 Energy and Cost Summary

The summary below provides for comparison of estimated energy consumption for the existing building configuration prior to construction and at completion of construction.

<table>
<thead>
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<th>Existing (6/12/12)</th>
<th>Measured and Predicted (10/11/13)</th>
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<td>Baseline Energy Usage</td>
<td>255,000 kWhr (213,000 kWhr for Air Conditioning)</td>
<td>183,000 kWhr (138,000 kWhr for Air Conditioning)</td>
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<tr>
<td>Baseline Energy Efficiency</td>
<td>874 MJ/m$^2$ per annum</td>
<td>627 MJ/m$^2$ per annum</td>
</tr>
<tr>
<td>Energy Efficiency Improvement</td>
<td>252 MJ/m$^2$ per annum (estimated)</td>
<td>247 MJ/m$^2$ per annum (actual)</td>
</tr>
<tr>
<td>Actual Cost of Activity</td>
<td></td>
<td>$495,000</td>
</tr>
<tr>
<td>Estimated Cost Savings (based on additional over like-for-like replacement)</td>
<td>$15,000 (based on 18.87c/kWhr)</td>
<td>$21,000 (based on 23.27c/kWhr)</td>
</tr>
<tr>
<td>Simple Payback</td>
<td>13 years (based on 18.87c/kWhr)</td>
<td>9.2 years (based on 23.27c/kWhr)</td>
</tr>
</tbody>
</table>

Table 3 – Air Conditioning Energy Consumption Summary

Based on the figure above which have been extracted from our analysis, it can be seen that the estimated Energy Efficiency Improvement of 252 MJ/m$^2$ per annum has effectively been achieved with actual improvement of 247 MJ/m$^2$ per annum.

We note that the Northern Territory has experienced significant utility price increases in the past 12 months which is reflected in the increase in electrical supply charges from 18.87c/kWhr to 23.27c/kWhr. This increase in tariff has reduced the simple payback period of the project from 13 years to 9.2 years.

Refer to Appendix A for a summary of the Energy Efficiency Improvement.

4.0 Project Budgets and Timeframes

The project had an original budget and signed funding agreement for a total of $489,463 + GST. This included funding of $243,182 from the Australian Government through the Community Energy Efficiency Program. Due to market conditions, the combined cost of construction works and all consultant fees the budget increased to 530,800 + GST. The difference was funded directly by the ASTC.

The project was approximately 8% over the original budget estimates. Although some allowances were made for the remote location of Alice Springs and the cost of locally delivered equipment and labour, we attribute this increase due to the locality and relatively small nature of the Alice Springs market. Professional fees for project management and additional advice were also higher than forecasted.

Due the remote location of Alice Springs, some delays were experienced in delivery of equipment and plant, in excess of those which were factored into the project program. The original documentation allowed for the Library to be closed for a given period while significant works were completed without the Public within the space. Due to careful negotiation between ASTC and Library staff and the Managing Contractor, the Library was able to remain open during the construction phase. This also meant additional delays were incurred during construction. The overall result was that the project took an additional three months over the original predicted program. Despite these delays, no additional costs were incurred.
5.0 **Project Objectives**

Based on all of the information provided in Sections 2.0 to 4.0, it is clear that the project has been a clear success and achieved the objectives originally aimed for as follows:

- The new air conditioning systems have achieved the 35 percent energy consumption saving predicted as part of the original modelling
- The overall annual cost savings are in excess of those predicted as the electrical supply tariff has increased in the past twelve months
- The indoor air quality has been improved with significantly higher outdoor air rates than the previous systems and higher grade filtration which is paramount in the Alice Springs environment
- Providing a better feeling indoor environment to encourage participation in Library events
- Providing dedicated temperature and humidity control to the Alice Collection and associated socially and culturally important archive materials to prolong their life
- All new systems have been installed with non-ozone depleting refrigerants and all existing redundant refrigerants removed from site and disposed of for recycling

Given the success of this project, the ASTC have been encouraged to review the energy consumption of other sites which they control. The support of the CEEP in this project has encouraged the ASTC to see the long term advantage of adopting improved energy management practices within their properties and there have been additional studies and changes (both big and small) in their assets to increase the energy efficiency of their portfolio.
## Project Energy Efficiency Improvement Template

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<thead>
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<th>PROJECT ID</th>
<th>CEEP 1077</th>
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<tbody>
<tr>
<td>FUNDING RECIPIENT</td>
<td>Alice Springs Town Council</td>
<td>DATE</td>
<td>10/11/2013</td>
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### Building, Facility or Site 1

<table>
<thead>
<tr>
<th>Name of Building, Facility or Site 1</th>
<th>Alice Springs Library</th>
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</thead>
<tbody>
<tr>
<td>Location (address)</td>
<td>Alice Springs Library Air Conditioning Upgrade</td>
</tr>
<tr>
<td>Type of building, facility or site</td>
<td>Library and associated Administration</td>
</tr>
<tr>
<td>Activity Type and Measure</td>
<td>Upgrade of HVAC System</td>
</tr>
<tr>
<td>Energy Efficiency Estimate Method</td>
<td>Desktop spread-sheet based simulation using nominated plant energy consumption, operating hours of facility and assumptions in line with original grant application - sourced from actual measured energy data</td>
</tr>
<tr>
<td>Baseline Energy Usage</td>
<td>183,000 kWh per annum with air conditioning component being 138,000 kWh per annum</td>
</tr>
<tr>
<td>Baseline Energy Efficiency</td>
<td>174kWh x 3.6 = 627 MJ per m² annum (cf 874 MJ per m² annum)</td>
</tr>
<tr>
<td>Energy Efficiency Improvement</td>
<td>Reduction of 247 MJ per m² annum (cf 252 MJ per m² annum)</td>
</tr>
</tbody>
</table>

**Reporting Data (Measuring Energy Efficiency and Additional Data)**
- Total Conditioned Area of 1050m² and 190 occupants
- Opening Hours as follows:
  - Monday, Tuesday and Thursday: 10am to 6pm
  - Wednesday and Friday: 10am to 5pm
  - Saturday: 9am to 1pm
  - Sunday: 1pm to 5pm
- Original Building Constructed in mid 1970's

**Cost of Activity**
- $495,000

**Estimated Cost Savings**
- $21,000 at current electricity prices (23.27c/kWh). No maintenance cost for the 12 month defect and liability period (DLP). Estimated costs per year going forward of $5,000 p.a. post DLP.

### Building, Facility or Site 2

<table>
<thead>
<tr>
<th>Name of Building, Facility or Site</th>
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<tbody>
<tr>
<td>Location (address)</td>
</tr>
<tr>
<td>Type of building, facility or site</td>
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<tr>
<td>Activity Type and Measure</td>
</tr>
<tr>
<td>Energy Efficiency Estimate Method</td>
</tr>
<tr>
<td>Baseline Energy Usage</td>
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<tr>
<td>Baseline Energy Efficiency</td>
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<td>Energy Efficiency Improvement</td>
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<td>Reporting Data (Measuring Energy Efficiency and Additional Data)</td>
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<td>Cost of Activity</td>
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