Sustainable Work   
Practices in Clubs



Prepared by ClubsNSW in partnership with Canberra Institute of Technology & Clubs Sustainable Futures

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| INTRODUCTION |

INTRODUCTION

Welcome to the Sustainable Work Practices in Clubs course. Completing the Sustainable Work Practices in Clubs course means that you are able to achieve the following nationally recognised units of competency:

|  |  |
| --- | --- |
| **Australian Quality Training Framework Code** | |
| **BSBSUS301A** | Implement and monitor environmentally sustainable work practices |

###### Benefits of this course

Participants will benefit by attaining recognised and portable qualifications in environmental management practices. It is through the assessment process that participants are held accountable and measured for their learning and ClubsNSW can measure the success of the training. Businesses will benefit from having trained staff in energy efficiency. Further, the assessments involve collecting and analysing club data, incorporating environmental management into strategic plans, completing a major project at the club and communicating the sustainability changes to staff and the community.

Changes made to each individual club facility through knowledge gained from the course will deliver real energy efficiency improvements. This will be via incorporating the knowledge of energy efficiency into business planning and strategic planning for the future. Specifically, targeted energy efficiency improvements will be factored into both future capital expenditure budgets and planning, as well as day to day operations of each club. The training is intended to deliver practical improvements, not just raising awareness of environmental management issues. It is our experience that a minimum saving of 5-10% in energy consumption could be achieved.

Energy efficiency will be measured through;

* Establishing targets and goals and measuring expected to actual results,
* Establishing and implementing the processes to attain targets and goals including selection of efficiency initiatives, negotiating barriers, working in a team and ensuring compliance. Measure expected / actual results,
* Calculating cost savings on utilities, based on actual bill data analysis, via sub-metering and
* Evidence of staff and community engagement e.g. surveys and media clippings.

# Assessment and accreditation

Sustainable Work Practices in Clubsinclude assessment materials built into the course and are clearly marked. It is important to note that accreditation is included as part of the NSW Office of Environment and Heritage educational program. Please note that ClubsNSW is not involved in the marking of assessments. It is marked by an external registered training organisation.

# Course Overview

This course has been specifically designed to help registered clubs understand, better manage and improve the energy efficiency of their facilities.

The course is written for managers of club buildings and services such as Facility Managers, Operations Managers, Duty Managers and those staff whose role involves the management of energy consuming equipment. It will assist you to keep ahead of minimum compliance standards and by doing so differentiate your business from others and obtain commercial benefits in the process.

The learning outcomes from this course will be from a combination of face to face learning and online, self directed learning. It is a requirement of this course that participants complete the course in the prescribed order. This includes the completion of the online units prior to the scheduled face to face sessions.This method will provide participants with an opportunity to review their online education in a group environment.

Participants are also required to undertake an energy efficiency project at their club. The project will form the basis of a targeted reduction in energy consumption and will be selected from a group of seven subject areas:

|  |  |
| --- | --- |
| Unit 1 | Being green: Principles, legislation and governance |
| Unit 2 | Green concepts in building design |
| Unit 3 | Heating, ventilation and air conditioning (HVAC) |
| Unit 4 | Lighting and lighting controls |
| Unit 5 | Renewable energy options |
| Unit 6 | Equipment efficiency |
| Unit 7 | Monitoring and evaluation |

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| --- |
| UNIT 1: BEING GREEN; PRINCIPLES, LEGISLATION AND GOVERNANCE |
|  |

UNIT1: BEING GREEN; PRINCIPLES, LEGISLATION AND GOVERNANCE

# Energy efficiency

Energy efficiency has been defined by the World Energy Council (2010) as a reduction in the energy used for a given service or level of activity. It is the sensible use of energy resulting from regulatory measures or voluntary choices in comparison to the amount of energy that would otherwise have been consumed.

When considering new and existing buildings, energy efficiency can be achieved in a number of different ways. Broadly speaking these methods include improving the performance of service systems, considering the way heat flows into and out of a building and designing to make use of natural energy sources.

To see what is possible in combining good design with energy efficiency, we will take a tour through CH2 Melbourne Council Chambers.

#### Interactive: Melbourne City Council Chambers (CH2)

|  |  |
| --- | --- |
| Watch the You Tube presentation: [http://www.youtube.com/watch?gl=AUandhl=en-GBandv=vJV0wnbAZ6M](http://www.youtube.com/watch?gl=AU&hl=en-GB&v=vJV0wnbAZ6M).  A 6 star energy rated building housing the new Council Chambers in Melbourne’s Little Collins St. ‘CH2’ called for a signage program reflecting its significantly high eco rating and philosophy. |  |

###### Australia’s current performance

The major findings from the Prime Minister’s Task Group on Energy Efficiency (2010) revealed that Australia’s performance on energy efficiency is generally mediocre. This stems from gaps within energy efficiencygovernment policy and a lack of over-arching mechanisms to deliversignificant change within industry and homes.

Barriers to change include gaps in data analysing energy consumption, energy price data and progress in people’s attitudes and behaviour to energy efficiency.

## Activity 1: Barriers

What are the barriers that prevent your organisation from improving your performance on energy efficiency?

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###### Green building and green principles

Building green is the practice of applying green principles throughout a building’s life-cycle. The life‐cycle begins when a site is selected for construction and ends when the building is demolished. Life-cycle can also apply to components within the building framework, such as air conditioning (HVAC).

Compare the application of green principles to a new building and a HVAC component throughout the life-cycle:

| **Life-cycle stage** | **Example of applying the green principles** |
| --- | --- |
| **Site and design** | Can reduce or enhance the use of sunlight as well as passive heating/cooling without the use of air conditioning (HVAC) |
| **Construction** | Pre-formed construction materials can reduce the time and energy required to cut to size and install onsite, as well as reducing waste and the associated energy used to produce the materials and dispose of off-cuts |
| **Operation and maintenance** | Reducing the operational requirements will reduce energy use and maintenance costs associated with wear-and-tear and temperature calibration  Commissioning of equipment to ensure the building runs as intended when designed |
| **Renovation** | Include appropriate energy-saving measures in addition to other environmental considerations |
| **Deconstruction** | Reuse of demolished materials in the new structure (e.g. bricks, ducting with other passive ventilation systems) can reduce energy associated with the manufacture of new product and transportation for delivery and disposal of old materials |

###### The benefits of green building

The primary motivation for operating a green building is to reduce the amount of resources used (such as water, electricity, gas etc) and therefore reduceoperational costs and exposure to future price rises for energy.

For example, in NSW, electricity prices increased 7% to 13% as of July 2010 and are predicted to rise from 20% to 42% in 2013 based on 2009-2010 pricing (IPART,2010). These price rises do not factor in any future government schemes, such as the proposed Commonwealth Carbon Pollution Reduction Scheme, which would add to the cost of fossil-fuel generated electricity.

In addition to saving on operational costs, there are additional benefitswhy building owners choose to make their building green. Let’s look at some of these below;

| **Additional benefit** | **Description** |
| --- | --- |
| **Corporate reputation** | Attitude towards the environment is increasingly important |
| **Employer of choice** | Employees are demanding a higher level of environmental integrity from their employers |
| **Risk management** | Consider such aspects as increasing resource costs, keeping ahead of the minimum environmental compliance requirements and cost of mitigation attempts later |
| **Community leadership** | Taking a pro-active approach and allowing others to learn from you; green marketing potential and positive customer perception |
| **Market demand** | Prospective tenants looking to reduce their operating costs and morale of the workforce |

# Law and codes

###### Federal environmental regulation

The main environmental regulation that affects clubs in relation to energy efficiency is the **Building Code of Australia** (BCA) (2010).

The Australian Building Codes Board (ABCB) is a joint initiative of all levels of Australian Government and includes representatives from the building industry. The Board was established in an inter-government agreement signed by the Australian Government and State and Territory Ministers responsible for building regulatory matters

All new and refurbishment work is required to meet the standards specified by the BCA for the relevant class and type of building. Clubs generally fall under class 9B although there can be multiple classes on the site depending on the proposed use of an area.

Section J of the BCA has been developed to address and establish energy efficiency standards across all building types. It prescribes compliance levels for;

|  |  |
| --- | --- |
| * Roofing and roof lights * Ceilings * Walls * Floors * Window glazing and shading | * Building sealing * HVAC * Artificial lighting and power * Hot water supply * Access for maintenance and monitoring facilities |

###### State environmental law

NSW Office of Environment and Heritage (OEH) have responsibilities and powers under a range of NSW environmental legislation. The list is too long to reproduce here, so we suggest you look at the legislation at <http://www.environment.nsw.gov.au/legislation>.

The most relevant State legislation for clubs includes The Protection of the Environment Operations Act (1997) which addresses issues such as requirements for minimising pollution from;

* Renovations or construction of new facilities,
* Daily operations including disposal of waste, greasy water,etcand
* Noise.

# Energy efficiency in NSW registered clubs

With around 1,300 registered clubs throughout NSW, clubs can have a significant influence on local and regional environments. Many clubs in NSW are large buildings, with plant and equipment that run for long hours and consume a great deal of energy and water. Daily operations can also produce many different types of waste such as food, bottles, paper and cans.

Clubs are seen as leaders within their community and with environmental issues like climate change and drought now very important to the public, clubs can take action to make a difference and inspire their members to implement changes in their own homes.

###### Sustainability Advantage

The NSW Office of Environment and Heritage (OEH) offers clubsthe opportunity to be part of a business support service,**Sustainability Advantage**.

Sustainability Advantage is designed to help organisations understand sustainability, successfully manage for a better environment and add business value. Sustainability Advantage follows an earlier program, **EcoClubs,** a partnership developed between ClubsNSW and OEHthat attracted over 70 clubs in participation.

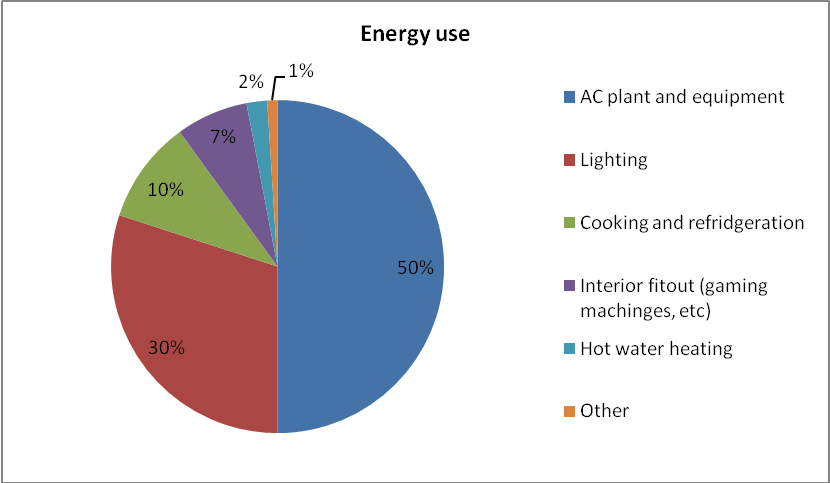
Since 2007, it is estimated the EcoClubsprogram has identified potential savings of 650,000 kL of water and 3.6 million kWh of electricity; clubs to date have implemented actions that have saved some 50,000 kL of water and 1.3 million kWh of electricity.

###### Energy use in clubs

There are numerous uses of energy in clubs. Let’s look at the major influences of consumption in a club;

|  |  |
| --- | --- |
| * Geographic location | * Visitation rates |
| * Size | * Age and type of equipment |
| * Hours of operation | * Availability of energy sources |
| * Ancillary services | * Start up/shut down system schedules |

Energy use was audited across eight NSW clubs in 2006 for the Cool Clubs Program. The graph below displays the breakdown of areas and it is clear that the largest area of energy consumption is within air conditioning plant and equipment.The second largest contributor to energy consumption is lighting.

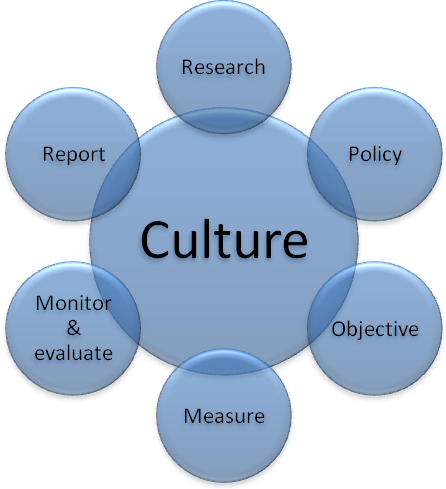


# Addressing the barriers

In consideration of the mediocre effort of Australian businesses so far in addressing energy efficiency and to ensure your club’s energy efficiency performance is a success, we need to address the following criteria;

1. Research
2. Club policy on how energy efficiency will be reflected in governance structures
3. Your energy efficiency objective and strategies to achieve the objective
4. Reporting of data including types of measurements and how often to report
5. Encouragement of a culture of energy efficiency within your club
6. Monitoring and evaluation of the project or system.

Using a Venn diagram, we can illustrate the barriers as such;



Let’s look at these barriers and how we can reduce them.

# 1. Research

There are two types of research that we will explore briefly – primary research and secondary research.

###### Primary research

Primary research (also called field or first-hand research) involves the collection of data that does not already exist. It is generally collected through two techniques – qualitative research and quantitative research.

**Qualitative research** aims to gather an in-depth understanding of the behaviour of members and patrons. The qualitative method investigates the *why* and *how* of decision making, not just *what*, *where*, *when*. Qualitative researchers typically rely on the following methods for gathering information:

|  |  |
| --- | --- |
| * Observation of people | * Structured interview |
| * Field notes | * Unstructured interview |
| * Reflexive journals | * Analysis of documents and material |

**Quantitative research** uses mainly statistical measurements. Usually a big sample of data is collected. Data mining a membership database and using the percentages to make decisions is an example of quantitative analysis. Quantitative researchers typically rely on the following methods for gathering information:

| * Percentages | * Graphs |
| --- | --- |
| * Surveys | * Tables |
| * Ranking | * Parameters |

## Activity 2: Primary research at your club

1. How might you use qualitative research in your project?

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2. How might you use quantitative research in your project?

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###### Secondary Research

Secondary research focuses on scanning the environment for new trends and opportunities. Also known as **desk research,** it involves processing data that has already been collected by another party.(http://www.statistics.gov.uk/census/)Researchers consult secondary research through:

|  |  |
| --- | --- |
| * Australian Bureau of Statistics (ABS) | * Previous research reports |
| * Industry statistics (ClubsNSW) | * Geographic information systems (GIS) |
| * Council data | * Commercial data |
| * OEH | * Save Power (NSW) |

## Activity 3: Secondary research at your club

From where might you obtain secondary research?

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# 2. Club policy and governance

Energy efficiency governance has been described as; theuse of political authority, institutions and resources by decision-makers and implementers to achieve improved energy efficiency (Pierreand Rhodes, 2000). The broader topic of environmental governance is a large area of study, so we’ll keep it simple here.

Getting support from board level in your organisation is critical in realising the success of your objective. The board have an important role to play in energy efficiency leadership and accountability.

The policy, which is approved by the board, could include aspects of;

* How the activities of the club accord with green principles or a commitment to moving towards green principles,
* Measures undertaken to minimise the impact of club activities and those the club supports on the environment,
* Financial resources dedicated to energy efficiency and energy efficiency related purchasing strategies,
* Human resource coordination to establish a culture of energy efficiency amongst all club stakeholders and
* Commitment to reporting to members on energy efficiency.

# 3. Your energy efficiency objective

Your energy efficiency objective will be the steps to realise the club’s vision for increased energy efficiency.

Objectives that are too broad are statements such as ‘save money’ or ‘use solar power’. These statements do not give instructions on how to save money or how to use solar power.

Features of an effective objective statement include:

* Clear and performance orientated
* Description of a bright, realisticand achievable future
* Motivational wording
* Provision of a framework for management action, and
* Alignment with clubvision

For example, your objective may read;

|  |
| --- |
| **Sustainable natural environment** |
| Objective: Responsibly and sustainably conduct our club business and to engender an environmental focus into everything we do and everyone we support |

**Developing actions**

The next step is to detail the actions that you will perform to realise your objective. Consider the actions that support the objective in the table below;

|  |
| --- |
| **Sustainable natural environment** |
| Objective: Responsibly and sustainably conduct our club business and to engender an environmental focus into everything we do and everyone we support |
| **We will achieve this objective by;** |
| * Year 1 - target 20 % reduction in baseline emissions via energy efficiency actions or carbon offsets through efficient use of; * Gas consumption * Other fuels consumed on-site and for business purposes (diesel, LPG, petrol) * Fugitive emissions from refrigerants * Disposal of waste and products at end-of-life (non-recyclables) * Water |
| * Year 1 - target 30 % reduction in baseline emissions via energy efficiency actions or carbon offsets through efficient use of; * Electricity * Emissions occurring further along the value chain from sources not owned or controlled by our organisation |
| * Year 2 – target 40% reduction in baseline emissions via energy efficiency actions or carbon offsets through efficient use of those outlined in Year 1 plus; * Solar orientation * Daylight * Glass |
| * Year 2 - target a further 15 % reduction in baseline emissions via energy efficiency actions or carbon offsets through efficient use of; * Electricity * Emissions occurring further along the value chain from sources not owned or controlled by our organisation |
| * Communication plan to engage members and staff to influence attitudes and behaviour at work and home |
| * Governance policy ensuring leadership at the top level of the organisation and a commitment to responsibility for our contribution to climate change |
| * Offset our remaining carbon emissions by purchasing green power or planting enough trees to absorb our emitted CO2 |

## Activity 4: Brainstorming your objective

Read through some examples of organisational objectives in regards to energy efficiency. Write down some words and ideas of how you would like to phrase your energy efficiency objective.

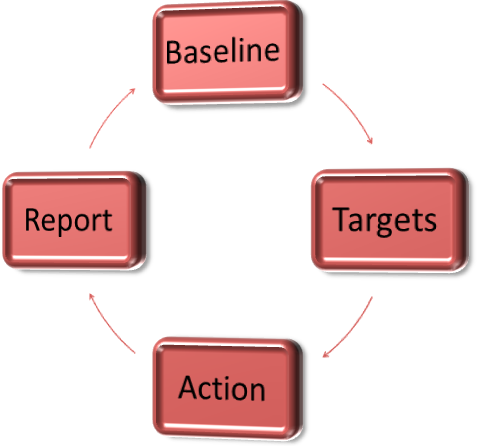
|  |
| --- |
| First-class management of energy-producing units with whole-process tracking management of wastes; find and correct environmental pollution events within plant area at real time and provide statistical reports to measure performance |
| Reduce GHG emissions by X%; encourage the efficient use of electricity and gas through training of staff and management; and encourage investment in technology and design by the board which reduce the use of electricity and gas by consumers. |
| Through internal redevelopment, adjust the orientation of club buildings so as to optimise elements of natural heat and light. |
| As part of our redevelopment, incorporate features into the building design to optimise elements of passive solar design. |
| We will utilise landscaping to optimise elements of passive solar design, climate control and to preserve solar access. |
| Promote the attitude of the club to energy efficient design to members and community through an education program and tours of our club’s energy efficient design. |

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# 4. Measuring and reporting the success of your objective

There are 4 steps to set up your measurement and reporting system;

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| --- | --- |
| Step 1: | Audit your business's carbon footprint and document findings |
| Step 2: | Detail your energy efficiency targets and document |
| Step 3: | Detail your action plan (timelines, responsibilities, allocated budget, etc) and document |
| Step 4: | Detail your reporting plan (timeliness and level of detail required) and document |



###### 1. Baseline and 2. Target

Establishing a clear picture of your organisation’s carbon emissions enables you to apply targets. Use the table below or create a similar table using headings appropriate to your objective to capture your current and target reduction carbon emissions.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Carbon emissions** | **Gas** | **Fuel** | **Refrigerant** | **Electricity** |
| **Current reduction** |  |  |  |  |
| **Target reduction** |  |  |  |  |

Using**single-authority meter readings** puts significant limitation on a club’s ability to understand where energy is being used on site so submeteringis used to identify the division of energy consumption.

|  |  |
| --- | --- |
| **Submeters** are essentially metering devices with monitoring capabilities and they are installed after the master meter in a building or facility. The installation of a submetering device provides the customer with energy consumption data showing how slices of the ‘energy pie’ are sub-distributed to various departments or processes within the club. |  |

It is interesting to note that recent changes to the Building Code of Australia (BCA)(2010)now requires new HVAC systems to be submetered for buildings with more than 2500m2 of floor space.

We look at submetering in more detail in Unit 6.

###### 3. Action

Devise an**action plan** to achieve your objective. For example, let’s take the first action to realise the objective in our previous example;

|  |
| --- |
| **Sustainable natural environment** |
| Objective: Responsibly and sustainably conduct our club business and to engender an environmental focus into everything we do and everyone we support |
| **We will achieve this objective by;** |
| * Year 1 - target 20 % reduction in baseline emissions via energy efficiency actions or carbon offsets through efficient use of; * Gas consumption * Other fuels consumed on-site and for business purposes (diesel, LPG, petrol) * Fugitive emissions from refrigerants * Disposal of waste and products at end-of-life (non-recyclables) * Water |

Below, we have given you an example of an action plan for the first action point from our previous example. Obviously, your action plan will contain different actions depending on your objectives and targets.

##### ****ACTIVITIES:****

|  |  |  |  |
| --- | --- | --- | --- |
| **1** | **Year 1 - target 20 % reduction in baseline emissions via energy efficiency actions** | | |
|  | | **Responsibility** | **Target Date** |
| **1.1** | **Gas consumption** |  |  |
| 1.1.1 | Install submetering | Facilities Mgr | 14 Jan |
| 1.1.2 | Analysis of previous consumption from bills | Admin | 1 Feb |
| 1.1.3 | Baseline measures compiled | Facilities Mgr | 14 Feb |
| **1.2** | **Other fuels** |  |  |
| **1.2.1** | Analysis of previous consumption from bills | **Admin** | **1 Feb** |
| **1.2.2** | Interview / survey of staff on consumption | **Admin** | **1 Feb** |
| **1.2.3** | Baseline measures compiled | Facilities Mgr | 14 Feb |
|  |  |  | Etc… |

###### 4. Report

Documentation of your energy efficiency successes and barriers to success cannot be underestimated – it is so **very important**! It is important for sharing your information throughout the organisation so that board members, management, staff and members are aware of your successful approaches to energy efficiency and barriers to success.

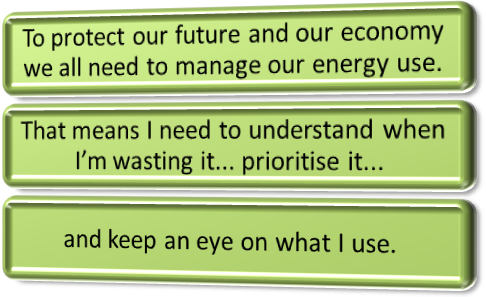
Here, we define **formal reporting** as consisting of written documents that address the criteria of the objective while **informal reporting** consists of emails, face-to-face meetings, conversations and so forth to communicate how you are progressing against your action plan. The following reporting framework is the most successful;

| **Audience** | **Frequency** | **Type** | **Content** |
| --- | --- | --- | --- |
| **Board** | Monthly | Formal | Report against the **objective**; success and barriers to success; budget considerations |
| **CEO** | Weekly | Formal | Report against the **action plan**; success and barriers to success; budget considerations |
|  |  | Informal | Keep the CEO abreast of general developments via email, memo and face-to-face meetings |
| **Operational staff** | Daily | Formal | Instructions to **carry out activities** against the action plan |
|  |  | Informal | Keep the staff abreast of general developments via email, memo and face-to-face meetings |

# 5. A culture of energy efficiency

The Prime Minister’s Task Group on Energy Efficiency (2010) suggests that a culture of energy efficiency means a holistic, long-term and consistent strategy to engage households, communities,business and industry by making energy efficiency routine.

The task group states that the current culture towards energy efficiency is that it saves money and is important for the environment; we all need to do a little bit, like changing light bulbs. However, we must create a culture where our thinking is...



###### Communicating out

Announcing your energy efficiency objective is not a one-time announcement to your stakeholders; they are a continual conversation. One of your goals here is to change behaviour so you will need to use interactive methods like briefings, focus groups and face-to-face opportunities to talk. The more you want to change behaviour, the more interactive your communication with stakeholders will be.

Stakeholders are those groups and individuals who benefit in some material way from the existence of the club. These may include:

* Members
* Club management and staff
* Sub-clubs
* Contractors and suppliers and
* Organisations benefitting from club sponsorship and donations

Once you have identified your stakeholders and selected some delivery methods to get your message out, you will need to create a communication plan. Your communication plan simply puts in writing the choices that you have made. It helps you ensure that you stay clear on when and how feedback will be provided so that you fulfil your commitments in a timely manner.

###### Communicating in

Clubs that share their objective with their employees get far greater alignment with their vision. This makes implementation much easier and helps to give your vision a life of its own. It also helps in creating a common culture by giving employees a set of common goals on which they can act every day, brings coherence to the workplace and allows better coordinated action.

We need to identify the means by which we can affect culture in the direction we want to go. Below are some examples of communication tools to consider and there may be others.

| Internal communication tools | |
| --- | --- |
| Paper-based | Memos (internal correspondence), newsletter, brochures, performance appraisal documents, slogans, pay packet enclosures, notice boards, welcome letters |
| Manager face to face | General meetings, team addresses, one-on-one manager to staff communication |
| Electronic | E-mail, web sites and intranets |
| Management behaviour | Any and all management behaviour that sends a message, either intentionally or unintentionally about the vision, mission, values and positioning of the club |
| Staff To management forums | Surveys, other forums such as staff meetings, individual meetings |
| Policies and procedures | Policies and procedures need to reinforce and be consistent with the messages being sent by other channels |
| Training | Training and learning settings are often used to teach specific skills and values – for example, customer service |

# 6. Monitoring and evaluation

As with all systems, monitoring and evaluation is important to ensure the targets are adequate and the action plans that have been developed are being implemented and monitored appropriately. Review should be factored into your reporting framework.

We look at monitoring and evaluation in-depth in Unit 7 of this course.

### Assessment 1: Environmental law and codes

These questions are assessable: performance element 1.1 and 1.2

1. In addition to the Building Code of Australia,what other two state environmental laws apply to your club?

|  |  |
| --- | --- |
| i. |  |
| ii. |  |

2. Go to the Building Code of Australia’s website, <http://www.abcb.gov.au/>.What are two methods for assessing compliance with the code?

|  |  |
| --- | --- |
| i. |  |
| ii. |  |

### Assessment 2: Research and documentation

These questions are assessable: performance element 1.4-1.7, 2.1 and 2.2

###### Instructions

These questions must be answered in direct relationship with your energy efficiency project.

1. **Research**: Consider the table below. Specify which research method you will employ to investigate the question or statement and why you would use this method. The first question is completed for you.

|  |  |  |
| --- | --- | --- |
| **Question** | **Research method** | **Reasoning** |
| What is our strategic aim of the energy efficiency project? | Primary research through meeting with a Chair and CEO | Getting support from the board and CEO is critical in realising the success of our objective |
| a. What types of energy does our business use? |  |  |
| b. I need baseline data on our energy consumption for the last 3 years. |  |  |
| c. I need data on energy consumption used by different departments |  |  |
| d. What is the attitude of our staff to energy efficiency initiatives? |  |  |

2. **Measure and document:**

a. Please document the results of your research in the table below. There are a variety of sites available to calculate your carbon emissions (CO2). Use the one that is most appropriate to your club such as: <http://www.aglcarboncalculator.com.au/>

**Sources of carbon emissions**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **HVAC** | **Tonnes** | **Energy** | **Tonnes** | **Transport** | **Tonnes** | **Other** | **Tonnes** |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| **Total** |  | **Total** |  | **Total** |  | **Total** |  |

b. Consider the table below and complete for your objective. You need to add appropriate headings to the columns.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Carbon emissions** |  |  |  |  |  |
| **Current usage** |  |  |  |  |  |
| **Target reduction** |  |  |  |  |  |

c. Describe the research methods you used to measure your club’s **current** carbon emissions?

|  |
| --- |
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|  |

d. Describe the research methods you used to determine your club’s target **reduction** in carbon emissions?

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| --- |
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e. Briefly describe improvements you would recommend to the **work processes**you usedto gain access to information and data which assisted in creating your current and target reduction carbon emissions.

|  |
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3. In the section on **club policy and governance**, one policy suggestion is; financial resources dedicated to energy efficiency and energy efficiency related purchasing strategies.

a. Explain why **purchasing strategies** would be an important part of an energy efficient policy?

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b. Research your club’s current purchasing strategies. Explain if and how current purchasing strategies are made within green principles.

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c. You would like to recommend to the organisation that green principles be adopted in purchasing strategies. To whom and in what manner would you report your research, findings and any recommendations?

|  |
| --- |
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|  |

### Assessment 3: Your objective and action plan

These questions are assessable: performance element 2.3, 2.4 and 3.3

###### Instructions

These questions must be answered in direct relationship with your energy efficiency project. Complete the table below detailing the objective for your project and the action plan to realise the objective.

|  |
| --- |
| Insert club’s vision |
| Insert objective heading | |
| Insert energy efficiency objective | |

**Actions to achieve objective:**

|  |  |
| --- | --- |
| 1 | Insert action |
| 2 | Insert action – Tab for further rows or delete as required |

**Activities:**

| **1** | **Insert action 1** | | |
| --- | --- | --- | --- |
|  | | Responsibility | Target Date |
| 1.1 | Insert tactic |  |  |
| 1.2 | Insert tactic |  |  |
| 1.3 | Insert tactic |  |  |
| 1.4 | Insert tactic |  |  |
| 1.5 | Insert tactic |  |  |

| **2** | **Insert action 2** | | |
| --- | --- | --- | --- |
|  | | Responsibility | Target Date |
| 2.1 | Insert tactic |  |  |
| 2.2 | Insert tactic |  |  |
| 2.3 | Insert tactic |  |  |
| 2.4 | Insert tactic |  |  |
| 2.5 | Insert tactic |  |  |

### Assessment 4: Formal reporting

These questions are assessable: performance element 2.1

**Reporting**: Use the template provided to prepare a report for the board of directors on your energy efficiency project. Present the report to the board (either in person or through the CEO and board papers) and summarise the outcomes of the presentation.

|  |
| --- |
| **Board Report, Thursday, 25 November 2010** |
| **Sustainable Work Practices in Clubs Education Program: Project Overview** |
| [Insert your name], [insert your position] was successful in gaining a position in the NSW Office of Environment and Heritage (OEH) Sustainable Work Practices in Clubs Education Program. This program is being facilitated by ClubsNSW, Clubs’ Sustainable Futures and Canberra Institute of Technology (CIT).  One of the program requirements is the completion of an energy efficiency project at the club. This report seeks to give the board of directors an overview of the project and any budgetary requirements. |
| Project overview |
| Budget requirements |
| Recommendations  1. It is recommended that the board approve this project and budget. |
| Written by |

# Unit 1: References

ABCB. (2010). *Building Code of Australia, Class 2 to 9 Buildings* (Vol. 1). Commonwealth of Australia: Canberra

ClubsNSW. (2006).*10 Ways to Green Your Club.*Author.

OEH. (2010). About POEO Legislation. Retrieved 20 Jan 2011 at <http://www.environment.nsw.gov.au/legislation/aboutpoeo.htm#major>

OEH. (2010).*Sustainability Advantage.*Retrieved 3 November 2010 at <http://www.environment.nsw.gov.au/sustainbus/sustainabilityadvantage.htm>

IPART. (2010) *Electricity Price Rises Change Media release (27 Oct 2010)*.<http://www.ipart.nsw.gov.au/files/Media%20release%20-%20Electricity%20Price%20Rises%20Change%20-%2028%20April%202010%20-%20WEBSITE%20VERSION.PDF>

Prime Minister’s Task Group on Energy Efficiency. (2010).*Report of the Prime Minister’s Task Group on Energy Efficiency*.Blue Star Aust Pty Limited: Australia

World Energy Council. (2010). *Energy Efficiency Policies around the World: Review and Evaluation.*<http://www.worldenergy.org/publications/energy_efficiency_policies_around_the_world_review_and_evaluation/1_introduction/1175.asp>

UNIT 2: GREEN CONCEPTS IN BUILDING DESIGNS

UNIT 2: GREEN CONCEPTS IN BUILDING DESIGNS

In this unit, we introduce you to some basic green concepts when considering the design or renovation of a building.

# Solar orientation

One of the most fundamental green building design principles is solar orientation. This relates to how a building is positioned relative to the movement of the sun throughout the day and the seasons.

We have all heard that the sun rises in the east and sets in the west. In fact, this only occurs twice a year and for the rest of the year the rising and setting sun positions for summer and winter are very far apart.

|  |  |
| --- | --- |
| The illustration demonstrates how the sun traces a different arc in the sky with a summer sun positioned higher in the sky compared to a lower winter sun. This fact alone determines the design and effectiveness of external shading to control building temperature. An increase in temperature in a building due to its exposure to heat from the sun is known as solar heat gain. |  |

Ideally a building should be oriented so that it long side faces north or up to 15° either side of north. Compared to a building with its long sides facing east or west, a north facing building with appropriate shading on the northern, western and eastern facades will be substantially cooler in summer and warmer in winter.

In practical terms, this means a building’s air conditioning system does not need to work as hard as an east or west facing building.

#### Interactive: Solar orientation

There are a number of videos on the internet demonstrating solar orientation which are worth a look. However, be careful! Most of the videos are taken in the Northern Hemisphere and Australia is located in the Southern Hemisphere.

###### Solar heat gain and HVAC

|  |  |
| --- | --- |
| Keeping a building as cool as possible is very important as this has a direct bearing on the use of air conditioning for cooling. The majority of clubs have a greater daily need for cooling rather than heating. Although largely due to the Australian climate, clubs are occupied by many people and have significant amounts of equipment that give off heat such as electronic gaming machines.  The aim is to control solar heat gain particularly through windows throughout the year. It is worth noting that in the Australian summer, the solar heat gain through an unshaded window can be 100 times greater than through the same area of insulated wall. This estimated external heat load, as a rule of thumb, contributes about 50% to the overall peak load. We will cover more on glass in the following section. |  |
| Active and passive solar systems are used in the Solar Umbrella house to achieve nearly 100% energy neutrality. |

The table on the following page indicates the difference in heat gain through glass depending on its orientation. A comparison of south facing glass to west facing glass indicates a difference of approximately 500 watts per square metre.

What should also be taken into account is the rising solar heat gain throughout the day. As the solar heat gain rises during the day, the HVAC system needs to work harder to keep internal spaces cool and comfortable.

###### Calculating external peak heat load through windows

The amount of air conditioning at an instant point can be worked out by the formula; Solar heat gain (Watts/m2) x Total window area (m2) = peak heat load (Watts).

Depending on the air conditioning cooling capacity this is the extra work required to cool the internal environment. Generally, a HVAC system within a club operates at peak only 7% of the time.

Aspects to keep in mind when calculating peak heat load is the type of windows used, any external shading and the use of natural ventilation. We cover these aspects further on in this unit.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| PEAK SOLAR HEAT GAIN THROUGH REFERENCE GLASS | | | | | | | | | | |
| Watts per square metre (W/m2) | | | | | | | | | | |
| South Latitude | Month | Exposure | | | | | | | | |
| N | NE | E | SE | S | SW | W | NW | Horiz |
| 20° | Jan | 47 | 290 | 550 | 470 | 65 | 470 | 550 | 290 | 850 |
| Feb and Oct | 80 | 360 | 520 | 370 | 35 | 370 | 520 | 360 | 780 |
| Mar and Sept | 210 | 440 | 510 | 270 | 32 | 270 | 510 | 440 | 740 |
| Apr and Aug | 350 | 500 | 460 | 160 | 28 | 160 | 460 | 500 | 660 |
| May and July | 440 | 520 | 400 | 80 | 25 | 80 | 400 | 520 | 570 |
| June | 470 | 530 | 380 | 57 | 25 | 57 | 380 | 500 | 540 |
| Nov | 45 | 270 | 510 | 440 | 60 | 440 | 510 | 270 | 790 |
| Dec | 47 | 250 | 540 | 520 | 88 | 520 | 540 | 250 | 840 |
| 30° | Jan | 100 | 340 | 550 | 440 | 56 | 440 | 550 | 340 | 830 |
| Feb and Oct | 200 | 410 | 520 | 340 | 35 | 340 | 520 | 410 | 740 |
| Mar and Sept | 330 | 480 | 500 | 280 | 28 | 280 | 500 | 480 | 670 |
| Apr and Aug | 450 | 510 | 430 | 120 | 25 | 120 | 430 | 510 | 560 |
| May and July | 500 | 510 | 370 | 50 | 22 | 50 | 370 | 510 | 460 |
| June | 510 | 510 | 330 | 32 | 19 | 32 | 330 | 510 | 410 |
| Nov | 95 | 320 | 520 | 410 | 50 | 410 | 520 | 320 | 780 |
| Dec | 70 | 300 | 540 | 470 | 68 | 470 | 540 | 300 | 840 |
| 40° | Jan | 230 | 420 | 550 | 430 | 50 | 430 | 550 | 420 | 790 |
| Feb and Oct | 320 | 460 | 510 | 320 | 35 | 320 | 510 | 480 | 680 |
| Mar and Sept | 440 | 510 | 470 | 180 | 20 | 180 | 470 | 510 | 580 |
| Apr and Aug | 510 | 510 | 380 | 110 | 22 | 110 | 380 | 510 | 410 |
| May and July | 520 | 490 | 320 | 38 | 16 | 38 | 320 | 490 | 320 |
| June | 520 | 470 | 270 | 32 | 16 | 32 | 270 | 470 | 270 |
| Nov | 220 | 390 | 520 | 400 | 47 | 400 | 520 | 390 | 740 |
| Dec | 180 | 370 | 550 | 450 | 57 | 450 | 550 | 370 | 800 |

###### External Shading

|  |  |
| --- | --- |
| The most effective method to reduce solar heat gain is to use external shading. Generally, external shading is used to shade windows only. However, the shading of walls, particularly east and west facing walls, is just as important.  Creative architectural design can be employed to ensure that external shading devices are designed as part of the external expression of the building rather than as an ‘add-on’ at the end of a project. Importantly, the external shading devices need to be designed to accommodate winter sun for free heating. | Example of external sun shading: fixed blades at Pittwater RSL Club |

When considering an existing building there are many options for external shading and what method to use will depend on the orientation of your club. Some common methods of shading include the following;

| **Method of shading** | **Advantages** | **Disadvantages** |
| --- | --- | --- |
| **Evergreen trees** | Reduce heat load between 40-80% in summer  Inexpensive | May take time to establish |
| **Eaves, awnings and louvres** | Reduce summer heat loads by up to 70%  Ability to set at appropriate angles for seasons | Require more upfront capital costs |
| **Internal adjustable shading (blinds and curtains)** | Reduce heat load by 15-45% in summer  Inexpensive  Can be used if external fittings aren’t feasible | Cost / benefit ratio may not be as high as other methods of shading |
| **External adjustable shading (shutters and blinds)** | Reduce heat gain by up to 85% in summer  Ability to set at appropriate angles for seasons | Upfront cost may be high |
| **Window glazing** | Reduce solar heat gain by up to 60% in summer | Upfront cost will vary depending on the type of system and placement |

### Assessment 5: Analysing solar heat gain at your club

These questions are assessable: performance element 3.1

Research the solar orientation of your club and complete the report on solar heat gain. The details you are required to collect are as follows;

* Determine the orientation of your club’s premises using available floor plans (either North-South or East-West)
* Determine the position of the long side of your club.
* Detail what shading is on the north, west and east facades
* Measure the area of your club’s windows for each wall. Use the data for latitude 30° and the formula:

|  |
| --- |
| **Solar heat gain: (W/m2) x Total window area (m2) = estimated external peak heat load** |

|  |  |  |
| --- | --- | --- |
| **Date of report:** |  | |
| **Club:** |  | |
| **Orientation:** |  | |
| **Long side position:** |  | |
|  | **Shading** | **Peak heat load** |
| **North facade:** |  |  |
| **East facade:** |  |  |
| **West facade:** |  |  |
| **Conclusion:** |  | |
|  |  | |
| **Recommendations:** |  | |
|  |  | |
| **Actions arising:** |  | |
|  |  | |

# Glass

One of the most important material selections to be made in a building is the type of glass used for windows. BCA currently sets minimum performance standards relating to glass as significant heat loss and heat gain can result from incorrect selection.

Glass performance is described via a range of criteria;

|  |  |  |
| --- | --- | --- |
| **Criteria** | **Description** | **Measure** |
| **Solar heat gain co-efficient (SHGC):** | The amount of solar gain increases with the strength of the sun, and with the ability of any intervening material to transmit or resist the radiation | Values range from 0 to 1  A lower value represents less solar gain |
| **Solar reflectance:** | The ability of a material to reflect incoming light  The albedo of an object is a measure of how strongly it reflects light from light sources such as the sun | Values range from 0 (dark) to 1 (bright)  Albedos of typical materials in visible light range from up to 0.9 for fresh snow to about 0.04 for charcoal |
| **U value:** | Measures the ability of heat to conduct through a material | Values range between 2 and 10  The lower the figure the greater the resistance to heat flow and therefore the better the insulation properties |

## Activity 5: Glass at home

Have a look at the type of glass installed in your home. How do you think the type of glass installed effects your domestic power consumption?

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Glass is available in many different forms and systems depending on the installation and climatic requirements. We will look at four glass types – monolithic, laminated, high performance solar and double glazing.

| **Glass type** | **Description** | **Advantages** | **Defence against heat transfer** |
| --- | --- | --- | --- |
| **Monolithic** | Common single-pane glass | Cheap and easy to install | Very poor |
| **Laminated** | Two panes of glass are bonded under heat and pressure or with a resin | Has better acoustic properties than monolithic and is resistant to shattering | Poor |
| **High performance solar or ‘E’** | Metallic coating | Filters high-energy UV-light whilst allowing more visible (white light) to penetrate | Good |
| **Double glazed** | Two glass layers with a gas-filled gap approximately 6 - 12mm in width | Reduces the flow of heat through window by 50% compared with a monolithic pane | Best |

|  |  |  |
| --- | --- | --- |
| Laminated | High performance solar | Double glazing |
|  |  |  |

#### Interactive: Energy efficient windows

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| --- | --- |
| View the monkeysee.com video on energy efficient windows at: <http://www.metacafe.com/watch/5520880/energy_efficient_windows_solar_heat_gain_and_u_factor/>  Andersen Windows’ Brian Gunderson talks about the numbers behind energy efficient windows. Here you’ll learn about rating systems for windows and doors and what you should look for when choosing energy efficient window and door products. |  |

###### Retrofitting

In most instances, solar performance films can be added to glass to improve efficiency. This can be a cost-effective solution for retrofitting. It can reduce heat by 40-80% however the trade-off is that it can block more natural light compared to the window-types listed above, thus adding to the internal lighting requirements. The cost is around $30-$40/m2.

###### Payback period

An Adelaide city council study costed high performance solar glass and double glazed at about $125-130/m2, however the payback was 5-8 years (shorter for double-glazing).

## Activity 6: Glass audit

Have a look at the type of glass installed in your club. Describe the types of glass installed and explain how it may be effecting the power consumption at your club.

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# Daylight

As clubs have generally large footprints,in that they are wide and deep in dimensions, the effectiveness of daylight from perimeter windows is less than other types of buildings. Using daylight results in less dependence on energy consuming artificial lighting thereby significantly decreasing a building’s energy bill.

It is important to note that daylight is different to sunlight. Daylight is generally light reflected from the southern half of the sky (in Australia) and does not contain the heat loads associated with direct sunlight.

To achieve increased daylight in existing buildings consider skylights, tubular daylight devices (TDD) and light shelves. The design of a new building can consider window placement and size (fenestration).

|  |  |
| --- | --- |
| Tubular daylight device | Light shelf |
|  |  |
| Series of tubes containing reflective and refractive optical components that direct light from the roof throughout a building | Horizontal devices are positioned above the window façade; they consist of an external cover that shades the window whilst reflective light toward the ceiling of a room |

###### Other benefits of daylight

Other benefits associated with daylight are an improved indoor environment quality where the occupants enjoy a more pleasant space with a connection to the outdoors.

## Activity 7: Daylight and your club’s design

1. In the 1980s, the trend in club design encouraged artificial environments with little daylight. With regard to the current age of your building and when the last major renovations were done, describe what challenges you may have in capturing daylight.

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2. How might you address these challenges?

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# Use of natural ventilation

Assuming the environment surrounding a club is suitable in climate and urban-location, natural ventilation reduces the dependency on mechanically assisted air movement. In fact, natural ventilation can save 10%-30% of total energy consumption.

Natural ventilation systems rely on pressure differences to move fresh air through buildings. Pressure differences can be caused by wind or the buoyancy effect created by temperature differences or differences in humidity. In either case, the amount of ventilation will depend critically on the size and placement of openings in the building. It is useful to think of a natural ventilation system as a circuit, with equal consideration given to supply and exhaust. Openings between rooms such as windows, louvres, grills, or open plans are techniques to complete the airflow circuit through a building.

However, unlike true air-conditioning, natural ventilation is ineffective at reducing the humidity of incoming air. This places a limit on the application of natural ventilation in humid climates.

|  |  |
| --- | --- |
|  |  |
| Natural ventilation at the School of Slavonic and Eastern European Studies, London | Natural ventilation at NRDC, Santa Monica |

## Activity 8: Natural ventilation and your club’s design

1. As with daylight, the trend in club design encouraged artificial environments with little natural ventilation. With regard to the current age of your building and when the last major renovations were done, describe what challenges you may have in capturing natural ventilation.

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2. How might you address these challenges?

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# Thermal mass and insulation in buildings

Floors, walls and roofs of buildings are the defence barriers against temperature fluctuations. Increasing the amount of insulation in a wall or roof will strengthen the defence barrier and will assist in keeping internal temperatures stable thus reducing a building’s reliance on mechanical cooling or heating throughair conditioning.

Thermal mass is the use of large quantities of a dense material to form the defence barrier. A material that has high thermal mass such as rammed earth and concrete absorbs heat and releases it slowly reducing the surrounding air temperature. A concrete slab in summer can absorb a large amount of heat will reduce internal daytime temperatures.

Contrastingly exposing the slab to the winter sun will allow heat to be absorbed and released during the day to maintain the internal temperature. However, if there is little solar heat gain due to shading or small window size, this can result in higher heating requirements and costs. Increasing northern-facing window areas can alleviate this problem.

|  |  |
| --- | --- |
|  |  |
| Advantage of high thermal mass material such as a concrete slab for temperature regulation in summer | Advantage of high thermal mass material such as a concrete slab for temperature regulation in winter |

#### Interactive: Melbourne City Council Chambers (CH2)

|  |  |
| --- | --- |
| Revisit the YouTube presentation: [http://www.youtube.com/watch?gl=AUandhl=en-GBandv=vJV0wnbAZ6M](http://www.youtube.com/watch?gl=AU&hl=en-GB&v=vJV0wnbAZ6M).  What was the additional benefit of utilising concrete for thermal mass in this building? |  |

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|  |

# Unit 2: References

Adelaide City Council. (No date).*Green Building Facts Sheets – Energy Efficient Glazing*. Retrieved 23 Oct 2010 at [www.adelaidecitycouncil.com](http://www.adelaidecitycouncil.com).

Ander, G. (2008).*Daylighting.*Retrieved 24 Oct 2010 at [www.wbdg.org](http://www.wbdg.org).

Baggs, D. & Mortensen, N. (2006).Thermal Mass in Building Design in*BDP Environment Design Guide* May. Retrieved 26 Oct 2010at [www.yourbuilding.org](http://www.yourbuilding.org).

Digert, N. (2010) Tubular Daylighting for Commercial Retrofit Applications – it’s never too late to daylight in*Enlighten*, Vol.2, 5.Retrieved 26 Oct 2010 at[www.daylighting.org](http://www.daylighting.org).

Lyons, P., Hockings, B. & Reardon, C. (2008).Glazingin*Your Home Technical Manual* (4th ed.) Retrieved 23 Oct 2010 at www.yourhome.gov.au.

Reardon, C. (2008) Shadingin *Your Home Technical Manual* (4th ed.) Retrieved 23 Oct 2010 at www.yourhome.gov.au

Reardon, C & Clarke, D. (2008).Passive Cooling in*Your Home Technical Manual* (4th ed.). Retrieved 26 Oct 2010 at [www.yourhome.gov.au](http://www.yourhome.gov.au).

Sustainable Energy Authority Victoria.(No date).*Thermal Mass*. Retrieved27 Oct 2010at [www.sustainability.vic.gov.au/](http://www.sustainability.vic.gov.au/)

Sustainable Energy Authority Victoria.(No date).*Window Protection*. Retrieved 23 Oct 2010 at [www.sustainability.vic.gov.au/](http://www.sustainability.vic.gov.au/resources/documents/Thermal_mass.pdf)

Sustainable Energy Authority Victoria. (No date).*Windows Placement and Sizing.*Retrieved25 Oct 2010 at [www.sustainability.vic.gov.au/](http://www.sustainability.vic.gov.au/resources/documents/Thermal_mass.pdf)

Sustainability Victoria.(No date).*Daylighting- Light Shelves.*Retrieved24 Oct 2010 at [www.sustainability.vic.gov.au/](http://www.sustainability.vic.gov.au/resources/documents/Thermal_mass.pdf)

USEPA. (2009).*Heat Island effect.*Retrieved 22 Oct 2010 at [www.epa.gov](http://www.epa.gov).

Walker, A. (2010) *Natural Ventilation.*Retrieved 26 Oct 2010at [www.wbdg.org](http://www.wbdg.org).

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| UNIT 3: HEATING, VENTILATION AND AIR CONDITIONING |
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UNIT3: HEATING, VENTILATION AND AIR CONDITIONING

# Heating, ventilation and air conditioning defined

People experience temperature and humidity in different ways, largely depending on how they are dressed for environmental conditions. Age is also a factor and it is common for older people to experience hot and cold temperatures more acutely than others. This presents unique challenges as clubs play host to a broad spectrum of people of all ages.

Heating, ventilation and air conditioning - or HVAC - is the technology to help maintain optimum indoor quality and thermal comfort for people’s health and wellbeing. Some of the factors that affect people’s health and wellbeing are: temperature, humidity, air movement, carbon dioxide levels, odour, dust particles and contaminants.

A HVAC system is the single largest energy consumer in a club and generally represents approximately 50% of electricity usage. Therefore targeting energy efficiency through improved use of HVAC systems is critical to achieving overall energy efficiency targets.

For the past 20 to 30 years manufacturers of HVAC equipment have focussed their efforts on making the systems they manufacture more efficient. This has been largely driven by an increase in compliance standards, an example of which is the recently revised energy efficiency provisions under Section J of the Building Code of Australia 2010. These provisions have a direct bearing on the size and configuration of a new HVAC system.

# Components

In simple terms an air conditioning system works on the same principle as your refrigerator at home. The refrigerator rejects heat from its insides to outside (in the room) similarly; the air conditioning system, when in cooling mode, rejects heat from inside to outside.

HVAC systems vary widely in terms of the individual components that make them up and how they are set up within a building (CSIRO Natural Edge Project Lecture Notes, 2007).However, the essential components of an air conditioning system are:

|  |  |
| --- | --- |
| Evaporator: | Also called a ‘cooling coil’ which cools by passing air over the evaporator coils |
| Condenser: | Also called a ‘condenser coil’ which rejects heat from inside the room to outside |
| Refrigerant: | A heat transfer fluid that is held in a tube that connects the evaporator to the condenser and undergoes changes in its physical properties during the cooling process |
| Compressor: | Forces the refrigerant between the evaporator and condenser coils and is responsible for increasing the pressure of the ‘gas’ refrigerant so that it can reject heat via the condenser to outside air which in turn changes the ‘gas’ to a liquid |

The diagram below would be typical of the components of a packaged unit; that is a split system, or wall or roof-mounted unit.

|  |
| --- |
|  |

# Types of HVAC systems

HVAC systems come in all shapes and sizes depending on their application. Professionals involved in the design, selection and commissioning of HVAC systems are called Mechanical Engineers and it is strongly advised that assistance from an appropriately qualified and experienced mechanical engineer be sought to ensure that a suitable system is selected.

|  |  |
| --- | --- |
| Split system The most recognisable form of air conditioning, which is commonly used in small administration offices, homes and small meeting rooms, is known as the split system, which involves a wall or ceiling mounted unit comprising a fan and evaporator linked by pipe work to an outdoor unit consisting of a condenser and compressor. These units deliver conditioned air directly to the room. |  |
| Ductwork Where larger spaces are required to be air conditioned a system of ductwork is used to distribute the air, typically via ceiling mounted grilles or registers. Ducted air conditioning is generally provided by larger air conditioning systems such as packaged units or via central plant. |  |

|  |  |
| --- | --- |
| Packaged units Packaged units consist of the compressor, condenser, evaporator and fans all in one unit and are typically mounted on an external roof.  Packaged units have ducts and outlets in ceilings that carry air to and from the room. Ducts are cylindrical or rectangular tubing suspended in the ceiling that takes air from the packaged plant and distributes it to different rooms and zones in the building. These units can also be used as a reverse cycle air conditioning unit that allows for both heating and cooling. |  |
| Central plant Central plant air conditioning is located in a central location generally in a plant room rather than distributed across the roof as small packaged units. A central plant system is generally employed to service large buildings with correspondingly large air conditioning requirements. |  |
| Chillers Central plant air conditioning can include air cooled or water cooled systems and generally involve multiple compressors and larger chillers. Chillers provide cooled water for supply to cooling coils by removing heat and expelling it through cooling towers. |  |

###### Water-cooled or air-cooled

There are advantages and disadvantages between water-cooled and air-cooled systems.

|  |  |  |
| --- | --- | --- |
| **System** | **Advantages** | **Disadvantages** |
| Water-cooled | More energy efficient  Lower noise  Lower ongoing energy bills directly associated with energy use | Can take up more space  Requires more maintenance than an air-cooled system  More expensive to install  Not feasible if water relatively scarce |
| Air-cooled | Take up less space  Can be used where water availability is lacking  Lower maintenance generally | Create more noise locally  Less energy efficient than water-based models  Can increase ongoing electricity costs compared to water-cooled models |

Maintenance and appropriate sizing is the key to achieving the energy efficiency advantages of a water-cooled system. Other factors contributing to achieving the energy efficiency advantages of a water‐cooled system include consideration of passive ventilation and insulation, the internal/external heating loads from the incoming solar radiation and people and equipment within the building.

## Activity 9: Your club’s HVAC system

1. Conduct a site inspection of your club and catalogue the different types of HVAC systems used. Include patron areas, function rooms, administration areas and back-of-house areas. Write up your findings here;

|  |  |
| --- | --- |
| **Area** | **HVAC system** |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

2a. Who currently services your HVAC systems?

|  |
| --- |
|  |

b. How are their services monitored to ensure the systems are operating as energy efficiently as possible?

|  |
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|  |

# Energy consumption of HVAC systems

A measure of energy efficiency is the coefficient of performance– or COP – for the heating and cooling output of the system. The COP measures the ratio of electrical energy input used to remove or add heat from water or air (kW/kW).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | | | and |  |
|  |  |  | | |
| where |  | is the heat moved from the cold reservoir (to the hot reservoir) | | |
| ...and | ∆W = kW | is electrical input (or work consumed by the heat pump) | | |

For a 350kW chiller unit, a typical water-cooled system will have a COP of 5 compared to 2.7 for an air-cooled unit because water has a higher thermal capacity compared to air.

The heat/cool load requirement must be determined to ensure an appropriate system is installed after all other passive heating/cooling and ventilation has been considered. Most HVAC systems operate at non-peak load, therefore consideration of the efficiency of a system at non-peak load is important when selecting and sizing a system.

###### Minimum COPs

According to Section J, 5.2 (Table 5.4) of the BCA, the minimum COPs are as follows;

|  |  |  |
| --- | --- | --- |
| **System** | **Minimum COP** | **kW** |
| Packaged unit | 2.7 | 65-95kW |
|  | 2.8 | > 95kW |
| Central plant chiller: water-cooled | 5.2 | Part load |
|  | 4.2 | Full load |
| Central plant chiller: air-cooled | 3.4 | Part load |
|  | 2.5 | Full load |

###### Monitoring and controlling systems

Monitoring an existing HVAC system for energy use reductionor improvements to its controls are two procedures to improve HVAC energy efficiency.

For example, to improve energy efficiency with chillers, vigilant **monitoring** by a technician should be performed as a part of a special program or regular maintenance to ensure the chiller is working at maximum efficiency under either part or full load as often as possible.Chillers in commercial HVAC are some of most energy-consuming areas consuming up to 35% of power needs. They can be difficult to operate efficiently because they are not always running at full load whereas the manufacturer rates the chiller efficiency at full load.

|  |  |
| --- | --- |
| A Variable Speed Drive (VSD) is a **control system** for the rotational speed of an electric motor by controlling the frequency of the electrical power supplied to the motor.  A VSD is a specific type of adjustable speed drive and is used in HVAC systems on equipment such as compressors, fans and motors. There are two main advantages in using VSDs; |  |
| 1. VSD will allow a motor or fan to gradually increase its speed when switched on rather than being expected to work at full capacity immediately thereby reducing the strain on the working parts of the equipment.  2. The energy used by equipment when it is not required to run at full speed. The VSD becomes an accelerator pedal that can be adjusted depending on the system’s load requirements. | |

## Activity 10: HVAC coefficient of performance

We will calculate the coefficient of performance of your HVAC at one of our face-to-face sessions. COP for your air conditioning unit. You will need the following figures:

* Electrical input (kW)
* Thermal cooling capacity (kW)
* Thermal heating capacity (kW)

Bring these with you for the face-to-face session for further discussion. The information will be visible on a metal plate within the unit. Ask your electrician/maintenance personnel for assistance with this request.

# HVAC controls

Significant amounts of energy can be saved by turning off equipment and HVAC when it is not in use or required.

###### Assigning duties

The most basic form of HVAC control is relying on people to remember to turn off systems although this is not a failsafe method. This can be managed through the appointment of responsible persons at a particular time once operations have ceased through the provision of a checklist of tasks, identifying which areas can be switched off or when the system can be manually shutdown as a whole.

###### Automated programs

There are many other forms of HVAC controls including digital programs to control time schedules, shutting down at temperature set points, analysing trend logs and setting alarms and building management systems (BMS).

A BMS can be a HVAC based system or a more sophisticated system that controls other devices such as lighting levels, operation of curtains and blinds and security and access. The greater the combination of automated devices the greater the potential energy savingsalthough the capital cost for a full BMS system is high.

###### Zones

Air conditioning systemscan be controlled by way of zones or separate rooms. Too often a single function room will be occupied yet the adjacent and vacant function room will have their air conditioning running.

The addition of CO2 sensors can also regulate CO2 levels to vent rooms as required whilst maintaining adequate internal temperature.

## Case Study 1: Energy performance contracting at Penrith City Council

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| --- | --- |
| Energy performance contracting is an innovative and relatively new industry in Australia that is becoming increasingly popular. Penrith City Council, located in Sydney’s western suburbs, was one of the first councils within Australia to undertake an energy performance contract (EPC) to achieve improved energy efficiency and reduced greenhouse gas emissions where the company is paid for services rendered from the cost saving arising under the contract terms. |  |

Penrith City council used such an ethos with Siemens to undertake an energy (and water) efficiency audit. The resulting payback was $640,000 in electricity and water savings over three years and around 4000t CO2.

Instrumental in this was the installation of a Building Automation System that for HVAC targeted chiller operation, time scheduling for operation and reduced occupancy, demand management, temperature calibration based on outside air temperature and night purging for ventilation.

The EPC identified a series of improvements and upgrades to be undertaken at both administration buildings to achieve improvements in energy efficiency.

These included:

* Upgrades to the heating, ventilation and air conditioning system at the Civic Centre to optimise air conditioning controls, installation of a building management system, installation of variable speed drives on air supply fans and improvements to heating and cooling sequencing.
* Lighting improvements at the Civic Centre through the installation of occupancy sensors, automatic lighting controls, lamp replacements and upgrades and reduced lighting.
* Improvements to water management by restricting water flow rates, installing vandal proof taps and checking all water fixtures for leaks.

Siemens Building Technologies completed the installation of all works in November 2003 and since that time the project has resulted in significant financial and greenhouse gas savings.

Since installation of the energy efficiency measures monitoring has been ongoing to ensure that data to demonstrate energy and greenhouse gas savings is captured. As of October 2007, this data reveals significant savings in both energy and greenhouse gas emissions. In fact, the savings have exceeded those guaranteed by Siemens by more than 67% for energy and 71% for greenhouse gases.

Over the almost four year period since installation Council has achieved cost savings of $792, 132 compared to guaranteed savings of $515,676. Similarly the greenhouse gas savings over the same time period have amounted to 5,271 tonnes of carbon dioxide compared to guaranteed savings of 3,416 tonnes.

These energy savings are the equivalent of taking more than 1,300 cars off the road or supplying enough power for more than 1,000 energy efficient homes.

In addition, the higher than expected savings achieved through the contract has allowed Council to repay the internal loan which financed the works within three years, despite the initial agreement setting a loan period of five years.

# Planned maintenance

Regular and planned maintenance of a HVAC system to keep the system in good working order is important for both energy efficiency reasons and for extending the life of the equipment.

Depending on the type of air conditioning system, planned maintenance generally includes cleaning of filters, grilles, fans and couplings,replacing bearings and checking to ensure that system leaks are not occurring.

###### Cooling towers

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| Maintenance of equipment is necessary in larger plants with cooling towers. Cooling towers are heat removal devices used to reject heat from water used in air conditioning and are generally located on the roof of a building. This is achieved by using an evaporative cooling effect whereby water is sprayed whilst air is drawn (usually via fans) across the water. | |
| The net result is that the heat originally contained in the water is evaporated, delivering cooler water ready for its re-use.  Cooling towers do involve exposing water to the atmosphere. Therefore, their maintenance to avoid bacterial growth leading to the risk of Legionella is paramount. It is also important to ensure that water is not being lost due to prevailing wind conditions leading to excessive water use.  A cooling tower does consume water and captured rainwater can be used providing that correct chemical dosing and testing occurs. |  |

### Assessment 6: Your organisation’s maintenance work processes

These questions are assessable: performance element 2.1, 2.3, 3.2, 3.4 and 3.5

Read the article below then consider the questions.

###### How do I prepare a maintenance schedule?

A maintenance schedule details when works, either major or minor, will be started and completed.Generally, you will also prepare a cleaningschedule as maintenance and cleaning go hand in hand.

The first step in preparing a maintenance schedule isto determine what needs to be done. In determiningwhat works need to be done, you should undertakethe following steps.

1. Stand back and look at your premises. Youknow your premises better than anyone and ifyou’re honest with yourself you will know some ofthe jobs that need doing.

2. Compare the fit out and finishes in your premisesto the construction requirements for newpremises.

3. List all of the things that need doing.That list will now form the basis of a maintenanceschedule.

Now you know what is required, you need to examinethe list and make a judgement on each item.Determine the priority for each of the items.Start by asking yourself if the item will have animmediate impact on safety, security, customer service and reputation.

Once you have given each item a priority, you canthen start to determine timeframes.Your timeframes will be affected by a number ofissues, not least, the cost and the ability for you to do the work yourself or the need to employ a contractor to undertake the works.You should set a realistic timeframe for each itembased on its priority.

###### Write up your Maintenance Schedule

Once you have determined the works required andthe timeframes for each item write up yourmaintenance schedule. An example is given as a download in the online training module and in the Support Materials section of this learner guide.

##### Questions

1. Consider your organisation’s building maintenance. Briefly describe the organisational structure of this area (e.g. number of full-time and part-time staff, contractors and other relationships and their roles, duties or services).

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2a. Research how the organisation plans its maintenance program and describe the process.

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b. How effective is this process in ensuring maintenance work is carried out in a timely and cost-conscious manner?

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c. Are green principles applied during the work process? If so, describe one application.

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3. After completing your research into the maintenance area of your organisation, are there any recommendations you would advise to assist in achieving your project’s objective?

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# Unit 3: References

ABCB. (2010). Section J5 Air Conditioning and Ventilation System: Building Code of Australia Class 2 to 9 Buildings (Vol. 1). Commonwealth of Australia: Canberra.

AE Smith (No date).*Chiller Monitoring*. Retrieved 10 Nov 2010 at [www.aesmith.com.au](http://www.aesmith.com.au).

Air Conditioning and Refrigeration Guide. (2005).*Air Conditioning Circuit and Cycle Diagram*. Retrieved 5 Nov 2010 at[www.air-conditioning-and-refrigeration-guide.com](http://www.air-conditioning-and-refrigeration-guide.com).

City of Sydney. (No date).*Cooling Towers Information for owners and maintenance personnel*.Retrieved 10 Nov 2010 at [www.cityofsydney.nsw.gov.au](http://www.cityofsydney.nsw.gov.au).

ClubsNSW. (2006).*10 Ways to Green Your Club.*Author.

Efficiency Vermont. (No date).*Successful Cooling System Energy Optimization.*Retrieved 5 Nov 2010 at [www.efficiencyvermont.com](http://www.efficiencyvermont.com).

Energy Rating. (2009).*Fact Sheet on Water Chillers: Minimum Energy Performance Standards.*Retrieved 10 Nov 2010 at[www.energyrating.gov.au](http://www.energyrating.gov.au).

Energy Rating. (2009).*Frequently Asked Questions: How can the capacity output of an air conditioner be greater than the power input?* Retrieved 08 Nov 2011 at [www.energyrating.gov.au](http://www.energyrating.gov.au)

Graham,C. (2009).*High-Performance HVAC*.Retrieved 10 Nov 2010 at [www.wbdg.org](http://www.wbdg.org)

Melbourne City Council. (No date).*Energy Performance Contract*.Retrieved 10 Nov 2010 at[www.melbourne.vic.gov.au](http://www.melbourne.vic.gov.au).

CSIRO. (2007). Opportunities for Improving the Efficiency of HVAC systemsin *Energy Transformed Sustainable Energy Solutions for Climate Change Mitigation: The Natural Edge Project.*Retrieved 5 Nov 2010 at [www.naturaledgeproject.net](http://www.naturaledgeproject.net).

Piper, J. (2006).*Strategies for HVAC Systems*.Retrieved 9 Nov 2010 at[www.facilitiesnet.com](http://www.facilitiesnet.com).

###### Case Study 1: Energy Performance Contracting

Siemens. (No date).*Can I reduce my facilities running costs and reduce their carbon footprint while mitigating financial risk?*Retrieved 10 Nov 2010at <http://aunz.siemens.com>.

UNIT 4: LIGHTING AND LIGHTING CONTROLS

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|  |
| “Jeff has some interesting ideas on how to save energy” |

UNIT 4: LIGHTING AND LIGHTING CONTROLS

Energy efficient lighting involves the use of lights that produce adequate lighting levels for the required task with minimal electrical energy. Using effective lighting design excessive use of lighting is avoided and appropriate lighting controls are used to ensure that lighting operates for the period required.

# Lighting and the Building Code of Australia (BCA)

Section J, 6.0 of the BCA outlines regulations to curb unreasonable energy use in the lighting systems in all building types. The section addresses the following elements:

* Limits on the power consumption rate of artificial lighting installations including the perimeter and outside of the building,
* Control of switching arrangements for lighting and power including automated cut-off in some cases and
* Control of interior decorative and display lighting.

# Lighting in clubs

Clubs have a large amount of lighting needs. Back of house lighting generally consists of more functional types such as fluorescent tubes whereas front of house lights vary more widely.

Lighting plays an integral part in the overall presentation that a club makes to its members. It has a very important role in interior design and when used effectively can create impressive moods in which to relax and be entertained.

###### Lighting andtheenergy bill

Whilst clubs vary in their configuration and operation, lighting generally accounts for approximately 30% of the total energy use in a club (ClubsNSW, 2006). This figure may vary depending on the size of your club, the extent of car park lighting, external flood lighting, security lighting and internal feature lighting.

Changing the approach to lighting presents clubs with a great opportunity to significantly reduce their energy bill and greenhouse gas emissions.

Now let’s take a look at some of the energy efficient lighting options available to clubs and how to choose which lighting will feature in your building.

Common lighting options

Choosing the right type of lighting needs to be made carefully to ensure that it performs the task required of it and it complies with lighting standards.

|  |  |
| --- | --- |
| Halogen downlight The dominant type of light fitting in clubs is the halogen ‘downlight’ and some clubs having many thousands installed. These lights are actually very inefficient, both in terms of energy use and their effectiveness to light up a space. Halogen downlights generally use narrow beam angles and rely on a transformer to step their voltage down from 240 volts to 12 volts. Consequently they use more power via the transformer which is lost as heat. |  |

|  |  |
| --- | --- |
| Compact fluorescent lamps (CFL) Compact fluorescent lamps are the most common energy efficient option in lighting currently available. They are approximately three times more expensive to purchase than a halogen downlight (owing to the cost of production) but the payback period is quite short due to the lower energy bills and lower greenhouse gas emissions. They are available in a wide range of shapes and sizes for any application. |  |
| Light emitting diodes (LED) LED lighting is becoming a more popular option due to its exceptional energy efficiency. Due to its small size, a single diode on its own has quite a narrow beam angle, meaning that lamps will often contain multiple diodes. They contain no mercury and their lamp life is not affected by constant switching on and off. |  |
| Solar powered lighting Solar powered lighting operates by storing energy from the sun in the batteries for use at night in the lamp. They are commonly used for garden and park lighting and may provide an option for clubs to use them externally as they are a cheaper alternative to electrically wired lamps. |  |

###### Considerations when choosing lighting

Look at the table below to discover some of the factors to consider before selecting your lighting options.

|  |  |  |
| --- | --- | --- |
| **Factors** | **Considerations** | **Measures** |
| **Efficacy** | The amount of light obtained from a given power input. A 20W compact fluorescent lamp can have the same efficacy as a 75W incandescent bulb. | Lumen per Watts |
| **Lamp life** | The longer the lamp life better as this reduces the need to replace lighting. | Based on how long it takes 50% of a group of lamps to fail. Measured in hours. |
| **Beam angle** | The measure of the conical width of light from a light source. The amount of light required for a room will depend on meeting building code standards for function as well as the size of the room. | Measured in degrees.  The smaller the number of degrees, the narrower the beam. |
| **Transformer** | Transformers convert mains power (240V) to a lower voltage suitable for halogen lighting (12V). This process results in power wastage. | N/A |
| **Dimming** | Dimming a light can reduce the energy required to illuminate an area. However, not all existing lamps operate with dimmers. | N/A |

###### Factors in lighting options

Now that you have an understanding of the factors to consider, take a look below at how these factors are represented in the different lighting options:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **50W Halogen downlight** | **35W IRC Halogen downlight** | **Compact fluorescent lamp** | **LED down light (12V)** | **LED down light (240V)** |
| **Wattage** | 50W +15W in transformer | 35W +15W in transformer | 11W | 3.5W + 15W in transformer | 3.5W |
| **Voltage** | 12V | 12V | 240V | 12V | 240V |
| **Light output (compared to 50W halogen)** | 100% | 100% | 85% | < 50% | < 50% |
| **Beam angle** | 60 degrees | 60 degrees | 180 degrees | 35 degrees | 35 degrees |
| **Dimmable** | Yes | Yes | Dimmable lights available but higher cost | Some types | Yes |
| **Lamp life (hrs)** | 2,000 | 5,000 | 15,000 | 50,000 (or more) | 50,000 |
| **Retrofit capability** | N/A | N/A | Fits into standard downlight housing; re-wiring required by electrician; transformer not required | Fits into standard downlight housing; no electrician required; transformer retained | Conversion kit required; rewiring by electrician; transformer not required |

###### Performance comparison

As previously discussed, many clubs have numerous energy intensive downlights in their ceilings. The following table shows a comparison, across many factors, of 1,100 standard (50W) halogen downlights to other options currently available assuming 18 hours per day usage:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **50W halogen downlight** | **35W IRC halogen downlight** | **Compact fluorescent lamp** | **LED down light (12V)** | **LED down light (240V)** |
| **Cost of fitting** | | | | |
| N/A | N/A | $10 (one-off) | N/A | $10 (one-off) |
| **Initial capital cost (1,100 globes)** | | | | |
| N/A | $14,365 | $24,310 | $29,835 | $66,300 |
| **Annual energy saving** | | | | |
| N/A | 108,897kWh | 392,031kWh | 337583kWh | 446,480kWh |
| **Annual electricity running cost** | | | | |
| $33,976 | $26,135 | $5,749 | $9,670 | $1,829 |
| **Total running cost over 50,000 hrs** | | | | |
| $377,910 | $328,185 | $74,698 | $73,593 | $13,923 |
| **Annual savings (relative to 50W halogen)** | | | | |
| N/A | $6,533 | $39,842 | $39,987 | $47,827 |
| **Payback period** | | | | |
| N/A | 2.2 years | 0.6 years | 0.75 years | 1.4 years |

# Life cycle analysis

As noted previously, the selection of a light fitting should be made with the life cycle in mind. The table indicates a comparison over 50,000 hours (i.e. the reported lamp life of LED lamps) to illustrate that considerable ‘churn cost’ – the cost associated with repetitive lamp replacement – encountered when using standard halogen downlights.

###### Disposal of CFLs

Whilst the lamp life of your light fitting is important so is its disposal. There has been understandable concern in the community over the potential leaching of mercury into the environment from the incorrect disposal of CFLs that is not a concern with LED as they do not contain mercury.

There are companies that can collect and safely dispose of CFL fittings. The service usually involves the provision of a box for tube collection which is then collected and sent to a special facility to remove the mercury. This can be reused in dentistry applications.

# Lighting control systems

A lighting control system consists of a device that controls electric lighting and devices, alone or as part of a daylight harvesting system. As previously discussed, lighting controls can form part of a building management system (BMS). Lighting control systems are used for working, aesthetic and security illumination for interior, exterior and landscape lighting.

In contrast to intricate lighting control systems, different types of lighting controls include activation via motion, audio and infra-red detection. These types of controls are effective for rooms that are used intermittently and can include toilets, staff rooms, offices, function rooms, corridors, plant and storerooms. They can cost as little as $100 and are a relatively cheap method with short payback time.

Lighting towards the perimeter of a club and adjacent to natural light via windows and doors can be controlled by daylight sensors which only activate the internal lights during very cloudy conditions and on sunset. If linked to automated motion sensors, the amount of artificial light can be either dimmed or increased as required.

## Case Study 2: Lighting refurbishment at 260 Elizabeth Street

|  |  |
| --- | --- |
| Centennial Plaza, 260 Elizabeth Street, Sydney is a fully refurbished office space. The building houses 14,200m2 of office accommodation across 10 levels. As a part of the refurbishment, the owners installed new T5 light CFL fittings to all floors and base building areas.  The installation of motion sensors and Managed Lighting Systems (MLS) in the common areas of building and car park with an Ausindustry grant of $75,000 provided a payback of 1.9 years.  Designed to achieve 4.5-star NABERS Energy rating the building also features tenancy-based lighting controls via a Sustainability Incentive, low-emission paints, low-emission carpet tiles, waterless urinals and water-saving devices and bike racks and shower facilities for cyclists. | Centennial Plaza, 260 Elizabeth Street, Sydney |

Have a look at some of the figures below:

|  |  |
| --- | --- |
| * Green Building Fund contribution: | $75,000 |
| * Annual cost savings: | $40,000 |
| * Annual energy reduction: | 315,000kWh |
| * Annual CO2 reduction: | 330 tonnes |

### Assessment 7: Lighting audit at your club

These questions are assessable: performance element 3.6

In this assessment, you will compare the cost of running your current lighting with the cost of replacing and running an energy efficient option.

1. Count or estimate the number of halogens and incandescent globes in your club.

|  |  |
| --- | --- |
| Type | Count |
| Halogens: |  |
| Incandescent: |  |
| **Total:** |  |

2a. Using the information from this unit or by performing a web search, find the equivalent CFL or LED globe that would perform similarly in terms of efficacy. Efficacy is the light output/power input or lumens/watts.

b. Obtain a price per globe or estimate a price per globe using information provided in this unit or by performing a web search.

With the information collected, complete the table below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Type | CFL or LED | Cost | CFL or LED | Cost |
| Halogens: |  | $ |  | $ |
| Incandescent globes: |  | $ |  | $ |

3a. Review your most recent electricity bill and source the **cents per kWh** and **total consumption**.Calculate the following;

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| A: Total power required for lighting for a day |  | B: Cost for powering lighting requirements |  |  |
| Hours of operation x Watt/1000 x no. lights |  | Lighting requirements for a day x cents per kWh |  | Multiply A and B together to get C |
| **A:** | **x** | **B:** | **=** | **C: $** |

b. Multiply the figure C by the number of days your club is open each year to obtain a yearly figure at E.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Take the figure at C from the answer you found in 3a. |  | Number of days your club is open each year |  | Multiply C and D together to get E1 |
| **C:** | **x** | **D:** | **=** | **E1: $** |

c. Repeat the calculations using your substitute CFL or LED globe from question 2.

###### ****CFL calculations****

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| A: Total power required for lighting for a day |  | B: Cost for powering lighting requirements |  |  |
| Hours of operation x Watt/1000 x no. lights |  | Lighting requirements for a day x cents per kWh |  | Multiply A and B together to get C |
| **A:** | **x** | **B:** | **=** | **C2: $** |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Take the figure at C2 |  | Number of days your club is open each year |  | Multiply C2 and D together to get E2 |
| **C:** | **x** | **D:** | **=** | **E2: $** |

###### ****LED calculations****

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| A: Total power required for lighting for a day |  | B: Cost for powering lighting requirements |  |  |
| Hours of operation x Watt/1000 x no. lights |  | Lighting requirements for a day x cents per kWh |  | Multiply A and B together to get C3 |
| **A:** | **x** | **B:** | **=** | **C3: $** |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Take the figure at C3 |  | Number of days your club is open each year |  | Multiply C3 and D together to get E3 |
| **C3:** | **x** | **D:** | **=** | **E3: $** |

d. Summarise your findings in the table below.

|  |  |  |
| --- | --- | --- |
| Halogens/Incandescent | CFL | LED |
| **E1 = $** | **E2 = $** | **E3 = $** |

What are the differences in costs per year between the existing halogen/incandescent globes and the CFL and LED globes?

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##### Optional extension exercise

The questions below are not assessable

4a. Calculate the one-off cost of substituting all existing halogen/incandescent globes using the unit price of the new globes.

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| --- | --- |
| $ |  |

b. Calculate the percentage that switching to energy efficient globes makes of the overall power saving for a year?

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c. How long is the payback period?

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# Unit 4: References

ABCB (2010). Section J6Artificial Lighting and Power: Building Code of Australia Class 2 to 9 Buildings (Vol. 1). Commonwealth of Australia: Canberra

Commonwealth of Australia. (No date). Choosing Appliances and Lightingin *Your Home Renovator’s Guide*. Retrieved 11 Nov 2010 at [www.yourhome.gov.au](http://www.yourhome.gov.au).

ClubsNSW. (2006).*10 Ways to Green Your Club.*Author.

Dept. Climate Change and Energy Efficiency. (2010). *Lighting*. Retrieved 10 Nov 2010 at [www.climatechange.gov.au](http://www.climatechange.gov.au)

Dept. Sustainability, Environment, Water, Population and Communities. (2010). *Safe Disposal of Mercury-Containing Lamps*. Retrieved 9 Nov 2010 at [www.environment.gov.au](http://www.environment.gov.au).

Investa. (2010). Leading By Example in *Energy Smart Buildings,* Vol.1 p.34. Retrieved 10 Nov 2010 at [www.lighting.rala.com.au](http://www.lighting.rala.com.au)

U.S .Dept. of Energy. (2008). *Using Light-Emitting Diodes*. Retrieved 9 Nov 2010 at[www1.eere.energy.gov](http://www1.eere.energy.gov/buildings/ssl/efficacy.html).

UNIT 5: RENEWABLE ENERGY

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UNIT 5: RENEWABLE ENERGY

Renewable energy includes all sources of energy that are captured from on-going natural resources. There are a number of different types of renewable energy sources available to clubs. In this unit we will investigate the following sources of renewable energy;

* Solar
* Wind
* Geothermal
* Co-generation
* Tri-generation
* Biodiesel.

# Solar

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| Solar energy is derived from light or heat generated from solar radiation. This type of energy is the cleanest, greenest and most reliable source of renewable energy available.  There are actually two methods by which solar energy can be converted to a usable source of power. Both methods use solar panels to collect solar energy, however one focuses on the sun’s heat while the other focuses on the sun’s light.  Let’s compare the two processes below: | |  |
| **Solar thermal** | This can be gathered without the installation of photovoltaic (PV) cells. Most often solar panels capture heat then transfer this energy to water which flows through tubes (known as solar thermal collectors) in the panels. As the heated water is circulated through the panels it heats the air in the space, distributing solar power as heat. | |

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| **Photovoltaic (PV)** | This is what people are usually thinking of when they mention solar energy. PV panels capture the light emitted by the sun and convert this energy into usable electricity. The solar energy excites electrons in the molecular matrix of the panel, producing electron flow which is electrical current. In this process direct current (DC) is produced. The DC electricity must then go through a conversion process, passing through an inverter, to change energy into alternating current (AC) electricity. |

###### Photovoltaic (PV) systems

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|  | Photovoltaic (PV) systems should be orientated toward the sun facing true north or at an angle to maximise exposure to the sun. However, a useful output will still be achieved at angles 30-60° east or west of true north. |
| The importance of winter power generation also has an influence if meeting hot water needs. For a system connected to the club, to maximise winter output the angle should be set at the current latitude (Sydney is about 34° S) plus 15°.  Otherwise, for maximising annual output to the grid or club connection, the angle should be latitude minus 10°. | Solar output variation at latitude 35° for a given orientation to the sun and tilt angle from the roof. |

###### Tilt Angle

For maximising annual output in summer the angle of the panel should be tilted at the current latitude minus 10° (e.g. Sydney is about 34°S). Conversely, to maximise winter output the angle should be set at current latitude plus 15°.

Unless an automated tracking system is installed, it won’t be feasible for clubs to readjust the tilt angle of installed panels as the seasons vary. For a grid connected system, to achieve maximum output and payback a tilt angle that maximises summer output would be most effective. From the diagram it can be shown that an output of 80-90% can be achieved at a tilt angle of 5-70° if directly facing north.

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| The proper tilt angle for a club-connected system with a winter boost requirement or grid connected system is shown in the illustrations below. To maximise the annual power output the angle should be set at the latitude minus 10°. | |
|  |  |
| Winter boost requirement | Grid connected system |

###### Cost for a PV system

The cost for a system will include the capital outlay for the panels inverter and smart-meter for grid connection.

Prices vary depending on the size of the system, where the existing switch room is located and the type of system selected (e.g. mono-crystalline versusSolyndra technology). A large system of around 30kW may require around 300m2 of roof space and cost around $100,000. The payback time is estimated at 10 years depending on sunlight availability and cost of supplied electricity. Given that electricity prices will rise in the future the payback period will shorten.

###### Output of a PV system

The actual power output depends on the number of peak sun hours, a measure of total available solar output (kWh/m2) per day. Sydney on average receives 5.1 peak hours, varying from 3.3 in July to 6.9 in December. A typical 1kW grid connected PV system in Sydney will yield about 1400kWh per year or about 1000kWh if connected directly to the club. This is because some power is lost through the conversion of DC to AC via the inverter.

Output will also vary depending on the temperature of the panels. For each degree over 25°C panel efficiency decreases by 0.5%. Providing adequate ventilation to the rear of modules (e.g. raised from roof surface and exposure to relatively cool breezes) will help maximise output.

# Wind energy

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| Wind power involves converting the energy produced by wind into electricity by using wind turbines. A wind turbine is comprised of 3 propeller-like blades called a rotor that is attached to a tall tower. These towers are usually 20m high or more due to the fact that winds are usually stronger higher from the ground.  Wind power is a clean energy source that can be relied on for the long term. The energy it creates is reliable, cost-effective and, most importantly, pollution free. |  |

There are certain things that should be considered before making a decision to install wind turbines to provide electricity at your club. The two most important of these are;

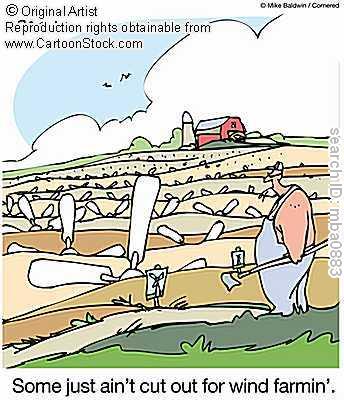
* The location of your club and
* The availability of high winds.

###### Location

As built-up areas tend to block winds, the ideal locations for wind turbines are in the country, on farms or on the coast. There are some clubs located in isolated areas where wind turbines may be a viable option for them but careful research should be undertaken as they are quite expensive to install.

###### High winds

An average wind speed of 5m/s (18km/h) or higher is required to make installing a wind turbine viable. One way to identify whether your area receives enough wind is to visit the Bureau of Meteorology’s website <http://www.bom.gov.au/climate/averages/>. Here you will find a recorded series of wind data for most of Australia.



# Geothermal (or ground source) energy

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| The earth just below the surface maintains a relatively stable temperature of about 18-21°C all year round, irrespective of seasonal temperature changes. This provides an ideal medium for temperature conditioning.  A geothermal heat pump utilises this constant temperature by piping water underground which is heated to 18-21°C and returned to the building to maintain the internal temperature within this range.  The major advantage is that it can reduce the heating and cooling requirements of an air conditioner. For example, if the outside air is 35°C in summer and an internal temperature of 21°C is required, the air conditioning unit needs to expend energy to provide 14° of cooling. However, if the ground-pump brings water at a constant 18-21°C that need can be negated. | Horizontal and vertical geothermal heat pump systems. |

A geothermal heat pump can have a coefficient of performance (COP) of 6 (6kW produced for every 1 kW of electrical input) compared to a COP of 3 for an air conditioner.

These pumps are not easily retrofitted and are more suited to being considered into the design of new buildings and the life of the system can last up to 50 years.

## Case Study 3: Macquarie University geothermal heat pump

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| In 1997, design began for the building of a new administration building at Macquarie University, North Ryde, NSW.  As a part of the building design, an economic feasibility study was carried out to compare the merit of roof mounted air cooled packaged air conditioning units against one using a geothermal loop. |  |

The following results were found:

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| --- | --- | --- |
| **System Characteristics** | **Water-cooled package air conditioning units – cooling tower** | **Water-cooled air conditioning units – geothermal loop** |
| Budget capital cost | $482,000 | $596,000 |
| Central plant location | Roof plant room and enclosure | Low level pump room |
| COP | 1.5 – 3.0 | 4.0 – 6.0 |
| Plant area | 18m2 x 3.5m high | 25m2 internal |
| Maintenance cost | High | Medium |
| Maintenance access | Roof and cupboards | AC cupboards in building |
| Life expectancy | 10-15 years | 15+ years |
| Visual impact | Medium | None |
| Acoustic impact | High | Low |

Energy costs were then calculated for each system to determine the payback period for the difference in budget capital cost between the two options:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Year** | **With cooling tower** | **With geothermal** | **Annual cost savings of geothermal** | **Cumulative cost savings of geothermal** |
| 0 | $482,000 | $596,000 | $114,000 | -$9,000 |
| 1 | $29,210 | $16,139 | $13,071 | $4,071 |
| 2 | $30,671 | $16,946 | $13,725 | $17,796 |
| 5 | $36,605 | $19,617 | $16,682 | $79,908 |
| 10 | $45,314 | $25,037 | $20,277 | $155,816 |
| 15 | $58,002 | $32,047 | $25,955 | $181,361 |

# Co-generation

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| Co-generation, also referred to as combined heat and power or CHP, is the simultaneous production of electricity and heat using a single fuel such as natural gas. The heat produced from the electricity generating process from the exhaust systems of a gas turbine is captured and utilised to produce high and low level steam. |  |

Only 33-35% of the energy from coal in traditional coal-fired power stations is converted to electricity. This is where Co-generation demonstrates its worth. The diagram above displays the efficiency of a Co-generation system in comparison with separate production of electricity and heat.

The greater the use of waste heat the more efficient the co-generation system. Waste heat usage can be used in the generation of hot water for cooking, cleaning, swimming pools and space heating.

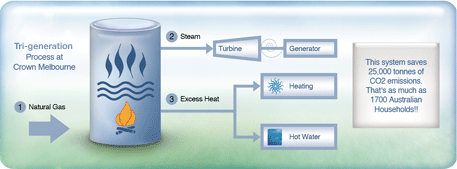
|  |  |
| --- | --- |
| Co-generation plants are expensive so a full audit of a club’s heating, cooling and power requirements should be undertaken and other options evaluated before deciding upon the installation of such systems. If taken in conjunction with other energy efficiency programs, installation of such a system may make it possible to become self-sufficient in power requirements. |  |

# Tri-generation

Tri-generation is the simultaneous production of three forms of energyfrom a single system; electricity, heating and cooling. A tri-generation power plant captures waste heat from electricity production and uses it to heat and cool buildings, improve energy efficiency and reduce greenhouse gas emissions. It is claimed to be nearly three times more energy efficient than a coal-fired power station.

Tri-generation is an option that is not viable for a lot of clubs due to cost; the recent development at Rooty Hill RSL cost around $4.5million.

Another business that has successfully installed tri-generation is Crown Melbourne. This plant uses natural gas, a much cleaner fuel source than traditional brown coal, and as a result Crown Melbourne has reduced its carbon emissions by 25,000 tonnes per year. Below is a diagram of how the Crown Melbourne tri-generation plant operates.



## Case Study 4: Rooty Hill RSL

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| Rooty Hill RSL completed the commissioning of a $4.5 million 1MW tri-generation plant at the club’s premises in September 2010. This involved the installation of;   * Generator powered by gas located in the basement of the club and * Absorption chiller powered by waste heat located on the roof.   The chiller is connected to the current refrigeration plant to provide cooled water. | Tom Russell, Richard Errington and Darren Turner at the unveiling of Rooty Hill RSL tri-generation power plant. |

The club financed the plant entirely and, with electricity prices, it is anticipated the payback will be 4–7 years. The largest saving will be for air conditioning with costs reduced by around 50% with the installation of the new chiller. It is expected the plant will reduce peak power consumption by 25% and CO2 emissions by 50%. Any unused power will be sold back to the grid, further reducing the club’s power bills.

# Biodiesel

Traditional electrical supply can be interrupted from time to time so the need for back-up power is often part of a disaster recovery plan. A period with an absence of electricity supply is known as a black-out. A brown-out is a period when a reduced supply of electricity is available.

Generating power on site, independent of grid supplied electricity, is the objective of back-up power systems. Traditionally, back-up power is usually provided by a diesel powered generator.

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| A good option for clubs to investigate is operating a generator on **biodiesel**. Biodiesel generators are currently being used to meet the needs of outdoor festivals such as the annual Peats Ridge Sustainable Arts and Music Festival.  The fuel provided is from a secondary source such as the waste products of sugar cane (Bagasse), leaves and cooking oil. A back-up generator needs to be sized according to what facilities are required to be operated when black-outs occur. | Peats Ridge Sustainable Arts and Music Festival |

# Unit 5: References

Begert, C. (2007).Ground-Source heat pumps – more than hot air?in*ReNew,* 99, Apr-June, pp.56-57. Retrieved 20 Nov 2010.<http://www.ata.org.au>

Clean Energy Council. (2010). *Cogeneration*. Retrieved 20 Nov 2010. [www.cleanenergycouncil.org.au](http://www.cleanenergycouncil.org.au).

Commonwealth of Australia. (2010). *Clean Coal*. Retrieved 20 Nov 2010. [www.aph.gov.au](http://www.aph.gov.au).

Conergy. (2008). *Proven 2.5*. Retrieved 19 Nov 2010. [www.conergy.com.au](http://www.conergy.com.au).

Crown Casino. (No date). *Trigeneration*. Retrieved 21 Nov 2010. [www.crownenvironment.com.au](http://www.crownenvironment.com.au)

Geo Climate Systems. (2010). What is Geo-Exchange? Retrieved 20 Nov 2010. [www.geoclimate.com.au](http://www.geoclimate.com.au).

Geothermal Australia. (2008). *Macquarie University Case Study – Air Conditioning the Natural Way*. Retrieved 21 Nov 2010. [www.geothermalaustralia.com.au](http://www.geothermalaustralia.com.au)

Home Improvement Pages. (2009). *Ground Source Heat Pumps*. Retrieved 20 Nov 2010. <http://www.homeimprovementpages.com.au>.

Peats Ridge Sustainable Arts and Music Festival. (2010). Powering Your Event. Retrieved 21 Nov 2010. [www.peatsridgefestival.com.au](http://www.peatsridgefestival.com.au).

Pichon, M. (2010). Trigeneration Nation in *Buildings and Facilities Management – WME Report* p.40. Retrieved 21 Nov 2010. [www.wme.com.au](http://www.wme.com.au)

Puncochar, J. (2008). Evaluating cogeneration for your facility: A look at the potential energy-efficiency, economic and environmental benefits Cummins Power Generation White paper. Retrieved 20 Nov 2010. [www.cumminspower.com](http://www.cumminspower.com).

Stapleton, G., Milne, G., Reardon, C. &Riedy, C. (2008).Photovoltaic Systems in *Your Home Technical Guide* (4th ed.). Retrieved 19 Nov 2010. [www.yourhome.gov.au](http://www.yourhome.gov.au)

Stapleton, G., Milne, G. &Riedy, C. (2008). Wind Systems in*Your Home Technical Guide* (4th ed.). Retrieved 19 Nov 2010. [www.yourhome.gov.au](http://www.yourhome.gov.au)

UNIT 6: EQUIPMENT EFFICIENCY

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| “We don’t have energy-efficient appliances but the  food in the ‘fridge has gone green...” |

UNIT 6: EQUIPMENT EFFICIENCY

Equipment use accounts for 70% of energy use as audited by the Cool Clubs Program and therefore greenhouse emissions in NSW clubs. Clubs have the opportunity to play a major part in reducing greenhouse gas emissions by installing energy efficient equipment as well as monitoring to promote and ensure the efficiency of that equipment.

In this unit, we will look at energy rating and labelling, hot water systems, building management systems, power factor correction and submetering.

# Energy rating &labelling

The Federal Government’s energy rating label scheme for dishwashers, commercial fridges and freezers, TVs, computers and other office equipment provides a straightforward method to compare different goods’ energy efficiency. It is important that purchasing staff are aware of what to look for when buying new equipment.

There are currently six electrical products offered for sale in Australia that are required to carry an approved energy label;

* Refrigerators and freezers
* Clothes washers
* Clothes dryers
* Dishwashers
* Air conditioners
* Televisions.

###### Benefits of the energy rating label

Energy rating labels are there to help us select appliances which use the least amount of energy. They provide information to analyse the annual operating cost as well as the proposed lifetime cost. For further information on energy ratings visit [www.energyratings.gov.au](http://www.energyratings.gov.au).

###### Interpreting the energy rating label

The two most important things to look at are:

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| --- | --- |
| **Star rating** | More stars indicate that the appliance model is more energy efficient. |
| **Energy consumption box** | A lower number indicates that the appliance model will cost less to run and will have a lower environmental impact. |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Stars rate the energy efficiency on a scale from 1 to 6 |  |  |  |  |
| Appliance type and model number |  |  |  |
| Energy consumption box |  |  | The Australian Standard under which the appliance was tested |

###### Energy saving features to look for

The table below describes a number of features of common electrical appliances that will help to increase efficiency and save energy.

| **Appliance** | **Recommended features** |
| --- | --- |
| **Refrigerators and freezers** | Easy to read and use thermostat controls  Top opening chest freezers more economical to run  Inverter technology; speed and output are automatically matched to fridge load for a significant reduction in energy use |
| **Clothes washers** | Front loaders generally use less energy than top loaders  Wide range of settings so can match cycle to load size  Delay-start functions to utilise cheaper off-peak electricity |
| **Clothes dryers** | Heat pump dryers use approx. half energy of conventional dryers |
| **Dishwashers** | Delay-start functions to utilise cheaper off-peak electricity  Load capacity to suit needs; partly loaded washers waste energy |
| **Air conditioners** | Economy settings  Programmable timer and thermostat controls  Set-back and sleep modes |
| **Televisions** | Timer function so that TV is not running after hours  The larger the TV, the more energy it uses  LCD is the most energy efficient option |

Clubs utilise a vast range of equipment to help them complete their core functions. The table below describes a number of features of some of this additional equipment that will help to increase efficiency and save energy.

| **Equipment** | **Efficiency measures** |
| --- | --- |
| **Glass washers** | New glass washers can recycle final rinse water as part of a new wash cycle |
| **Microwave ovens** | Microwave ovens use only 30%-50% of the energy of conventional stoves |
| **Ovens, stoves & range hoods** | Ensure equipment is switched off when not being used, particularly with contract caterers |
| **Icemakers** | Icemakers need to be located in an area that provides good ventilation so that the compressor and condenser are not exposed to unnecessarily high ambient air conditions |
| **Steamers** | Ideal for cooking rice, vegetables, fish and shellfish; improves taste and appearance of food |
| **Urns, kettles, instant boiling water units** | Ensure equipment is switched off when not being used, including instant boiling water units particularly in function kitchens |
| **Space heaters (outdoor)** | Preferable to use gas-radiant heaters; good design should ensure that occupants feel the radiant heat, rather than rely on heating the surrounding air |
| **Vending machines** | Simple timers should be used to switch off these devices after hours provided the stock is not reliant on continuous operation (e.g. refrigerated product) |
| **Poker machines** | These should not be left on outside of operating hours; timers and power up/down scheduling can assist here |
| **Lifts/escalators** | New escalators are capable of a quiet mode function whereby the escalator stops operating when not required; the escalator restarts on approach by a person activating an infra-red sensor. |

###### Additional factors to increase equipment energy efficiency

Apart from the electricity used to power the equipment, increasing energy efficiency should consider the heat load caused by the operation of equipment and the subsequent requirement for air conditioning.

In addition, ensuring the equipment is maintained and operating properly is important. For example, repairing leaking seals on refrigeration equipment increases the energy required to maintain an appropriate temperature.



Appropriate placement of equipment is also important. Ensuring appropriate ventilation and space for fridges and not placing them next to stoves, attaching range hoods to stoves to siphon heat away all assist in reducing energy requirements for air conditioning and equipment operation. The dramatic increase in energy efficient technology and the willingness of suppliers to incorporate new technology in their products to help capture the sustainability market has resulted in a much wider range of choice for energy efficient equipment.

## Activity 11: Rating and maintenance audit

Conduct a review of your club’s kitchen and dining areas (if you have more than one, please complete this activity for each area).

Describe the rating of equipment in the following areas and suggestion for short term and long term energy efficiency improvement.

| **Equipment** | **Condition** | **Improvement** |
| --- | --- | --- |
| Refrigerators and freezers |  |  |
| Televisions |  |  |
| Dishwashers |  |  |
| Glass washers |  |  |
| Microwave ovens |  |  |
| Ovens and stoves |  |  |
| Instant boiling water units |  |  |
| Vending machines |  |  |

# Hot water systems

Hot water is used in clubs for air conditioning, cooking and cleaning and in swimming pools and saunas where such facilities are provided. There are various ways in which water can be heated and importantly the various methods differ in terms of energy use.

In this section, we look at electric, gas and solar hot water systems. We will also take a brief look at renewable energy certificates.

###### Electric

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| Electric systems are the least efficient of all hot water systems.  These units use an electric powered resistance circuit is to heat water. They come in varying sizes and can incorporate a storage tank for pre-heated water so that hot water is on hand when it is needed.  The electric system efficiency can be improved by insulating the existing hot water pipes with either a foam or fibreglass product.  Ensure you engage a professional to carry out the insulation. Doing it yourself may save money but you may also make the mistake of insulating something you shouldn’t, like the pressure relief valve. | Diagrammatic representation of electric hot water system |
| Example of foam insulation of hot water piping. | |

###### Gas

Natural gas or LPG (bottled) can both potentially be used as the energy source for heating water. Gas-fired hot water systems are more efficient than electric systems. Where larger quantities of hot water are required such as for air conditioning, larger gas-fired boilers are more appropriate.

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| Gas hot water storage tank | Gas-fired boiler |

Instantaneous gas hot water systems utilise natural gas to provide continuous hot water without the need for storage tanks resulting in greater energy efficiency. The advantage with these systems is water can be supplied at multiple points at a desired temperature.

###### Solar

Solar hot water systems operate by installing panels, generally on roof tops, to absorb heat from the sun to pre-heat the water. Water moves through pipes heated by the sun’s rays striking the glass. In some cases, the solar heating is adequate. In other cases where additional boosting of the water temperature is required, a secondary energy source is required. In these cases, an electric or gas system can be used as a booster. Gas boosted solar hot water is the most efficient system available.

Panels, such as PVs, should be true-north facing or up to 45° east or west of true north and angled appropriately to capture winter sun (refer to the earlier section on solar orientation). Installing a solar hot water system that *replaces* an electric hot water heater will attract a discount in the form of renewable energy certificates.

The different types of solar hot water systems include close-coupled thermosiphon and remote thermosiphon, spilt system and evacuated tube. Thermosiphon refers to a method of passive heat exchange based on natural convection which circulates liquid without the necessity of a mechanical pump.

**Close-coupled thermosiphon**

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| --- | --- |
| Close-coupled thermosiphon is where the water tank is mounted above the solar collector.  Water flows to the bottom of the solar collector where heating forces the water to rise and re-enter the tank whilst cooler denser water at the bottom then flows down to the base of the solar collector.  This cycle repeats whilst the sun is shining. |  |

**Remote thermosiphon**

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| --- | --- |
| A remote thermosiphon hot water system is similar to close-coupled thermosiphon except that the storage tank is positioned within the roof.  To supply the water, the tank’s base should be positioned above the solar collector. |  |

**Split system**

|  |  |
| --- | --- |
| In a split system hot water system the storage tank is positioned at ground level and water is pumped mechanically to the solar collector.  This system is an option that can be utilised where the current roof of a building is not robust enough to support a storage tank. The image (right) depicts a typical split system hot water system configuration. |  |

###### Evacuated tube

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| --- | --- |
| Evacuated tubes use a glass tube with a vacuum inside and copper pipes running through the centre. The copper pipes are all connected to a common manifold which is then connected to a slow flow circulation pump that pumps water to a storage tank below, thus heating the hot water during the day. The hot water can be used at night or the next day due to the insulation of the tank.  Evacuation tube systems are more efficient due to an ability to absorb heat on a humid day, even in absence of direct sunlight as the unique circular tube shape results in greater exposure to the sun. |  |

## Case study 5: Crescent Head Country Club

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| With funding assistance through the NSW Government’s Climate Change Fund, Crescent Head Country Club was able to replace some of its existing electric hot water units with an evacuated tube solar hot water system.  After some initial teething problems, including a cracked pipe under the club, the system is now operating efficiently. The club is eagerly awaiting the next electricity bill to confirm the savings in energy. |  |

###### Heat Pump

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| A heat pump operates by removing heat from ambient air to heat water. The water is then stored in a tank similar to an electric mains storage system.  This system is three times more efficient than a normal electric hot water system. To maximise the efficiency of the system, it should be placed on the warmest side of a club and near frequently used hot water outlets to minimise losses.  Because cool air is expelled by the fan sufficient space should be allowed to ensure an adequate ambient air flow to prevent the cooler expelled air from recirculating. | Heat pump hot water system |

The heat pump will require some operation during the day where heat availability is greater. However, the greater efficiency of the heat pump can offset this cost even if it occurs during peak loadwhen power is more expensive (power is normally more expensive between 2pm-8pm on working days).

Like solar hot water, installing a heat pump that *replaces* an electric hot water heater will attract a discount in the form of renewable energy certificates.

###### Renewable energy certificates

The Renewable Energy (Electricity) Act 2000 and the Renewable Energy (Electricity) Regulations 2001 allow owners of eligible solar water heaters, including heat pump water heaters, to create and trade renewable energy certificates (RECs).

For solar water heaters, each REC represents the equivalent of one megawatt hour of electricity generation from an accredited renewable energy source. Once RECs are validated and registered by the Office of the Renewable Energy Regulator (ORER), they can be sold in the REC market.

## Activity 12: Hot water heating systems

Conduct an audit of your club’s hot water heating systems. Describe the system the club uses and how might the system be improved, both short term and long term, to improve energy efficient outcomes.

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# Building management system (BMS)

As we have seen, there can be a large number of systems operating in a club at any one time. Typically, each of these systems has individual controls which operate independent of other systems.

BMS is a computer software management tool that can pull together the various independent systems so they can be centrally controlled. The benefits arising from this type of management is increased efficiency as the performance of a building is constantly being analysed by the BMS and the BMS automatically adjusts to suit changing conditions.

For example, a BMS would allow an air conditioning zone, perhaps serving a function room or auditorium, to commence 30 minutes prior to the event and shut down when the event has finished. It can also be used to control the lighting levels and security access at the same time. This avoids the need for staff to remember to switch off lights or activate security to the area.

# Power factor correction

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| The use of equipment in clubs that rely on electric motors and electro-magnetism to operate, such as air conditioners, fans and fridges, cause electric current (amps) and voltage (volts)to become non-synchronised. Consequently, to produce the power required by the equipment to operate, the current increases by a ratio known as the power factor. A poor power factor results in an increased current load placing additional stress on electrical infrastructure. |  |

The solution is to install devices that create better synchronicity between current and voltage. In this way the power factor is corrected.

Power factor is a dimensionless number between 0 and 1. Power factor correction equipment brings the power factor of an AC power circuit closer to 1. In effect, power factor correction equipment ensures that the power drawn from the grid is more efficiently utilised. Clubs that draw a certain quantity of power from the grid are penalised by the energy supply authority by way of additional charges for this additional stress on the system (check power bills for peak kVA demand).

## Case study 6: Cost savings of power factor correction equipment

Let’s assume that the penalty is $0.3757 per day per kVAr (measure of reactive power or ‘waste’ power) for the kVAr necessary to improve the power factor to 0.95.

**kVAr calculations**

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| 1,000kW load at a PF of | 0.75 | = | 882 kVAr |
| 1,000kW load at a PF of | 0.95 | = | 329kVAr |
| Subtract 882 kVAr - 329kVAr to calculate the extra kVAr |  |  | **553kVAr** |

**Penalty calculations**

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| The extra kVAr drawn from supply: | 553kVAr |
| Penalty rate: | $0.3757 |
| Multiply the two together to calculate penalty per day: | 553 x .3757  = **$207.76 penalty per day** |

**Payback period**

The approximate cost of installing power factor correction equipment equates to $60 per kVAr.

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| The extra kVAr drawn from supply: | 553kVAr |
| Cost per kVAr: | $60 |
| Multiply the two together to calculate cost of PF correction equipment: | 553 x $60  = $33,180 |
| Cost of equipment | $33,180 |
| Penalty per day | $207.76 |
| Divide the two to calculate days | $33,180 / 207.76  = 160 days or 5.3 months |
| Therefore, the initial outlay is recovered within six months and all future savings from penalties avoided can be added to the club’s bottom line as profit. | |

# Submetering

Submetering assists in understanding where energy is being used in a building so energy efficiency can be better managed. Energy intensive equipment should undergo submetering so that its performance and consumption levels can be tracked, recorded and compared over time.

Submetering can occur at an electrical distribution board if, for example, a separate board has been installed to serve the kitchen. The cables are simply looped by a device that can monitor how much electrical energy is being consumed. Individual equipment submetering is also available but likely to be very expensive.

The information gathered by submeterscan either be read at its location at set intervals or be connected to a computer for online monitoring and recording of performance. A fully integrated system can also be set so, if an unusual event should occur, an alarm is activated to alert personnel that investigation and corrective action is required.

###### Cost

Installing submeters can cost about $1,500-$3,000 and the costs to integrate to a computer for remote monitoring will vary according to the sophistication of the technology and the number of analytical functions in the software. When considering software, consider your reporting requirements so the system will provide appropriate data.

## Activity 13: Water systems at your club

These questions are not assessable

1a. What type of hot water system does your club have?

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b. How would an **electric hot water phase-out** affect your club?

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c. What is the age of your club’s hot water system?

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d. Can you identify if the outlet pipes are insulated?

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2a. Obtain the capacity of your current hot water system tanks and their heating capacity (you may need to ask maintenance staff to assist with this request)

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b. Calculate the energy required to heat water to 60°C for winter and summer. Assume the average water temperature in winter is 11°C and 23°C in summer. The formula is:

**Pt = 4.18 x L x (t2-t1)/3600**

Where: Pt = energy required in kW/h

L = tank capacity

t2= desired temperature(60°C)

t1 = initial temperature

**Total energy requirement calculation**

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| --- | --- | --- | --- |
| Pt | = |  | [Your answer from 2a] |
| Pt x 1.1 | = |  | [Multiply by 1.1 due to inefficiency in heating water; answer is your **total energy requirement**] |

* If your system is electric boosted divide by the kW capacity to obtain the number of hours required for heating.
* If your system is gas boosted divide the total energy requirement by 0.278. This will give you the equivalent amount of energy in MJ (1MJ = 0.278 kWh).

c. Assume the total capacity of your club’s tanks is the amount of hot water used each day. How much is this costing your club based on your club’s current electricity cost or gas for July and December? Make your calculations based on off peak (weekend hours) and peak loading (weekdays 2pm-8pm) rate for electricity.

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d. Now assume a solar hot water system with gas or electric booster of 1.8 kW capacitycan provide 50% of hot water needs in July and 90% in January (estimated industry calculation). Using the figure above what savings could be achieved on power costs for these months? Remember the balance will need to be provided by electricity (3.6kW booster element) or gas (MJ required).

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3. If your club has power correction equipment, locate it and observe the current power factor. What is this figure? A good indication is 0.95 or above.

Alternatively check your power bill for any charges relating to demand charge or peak charges measured in kVA (generally listed under network charges). Enquire with your electricity provider as to what this charge relates to. Do they suggest any ways to address it?

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# Unit 6: References

Blundell, L. (2010). *Apartment blocks the missing link in sustainability*. Retrieved 25 Nov 2010. [www.thefifthestate.com.au](http://www.thefifthestate.com.au).

Choice (2010).*Hot Water Options Buying Guide – Incentive for Solar*. Retrieved 25 Nov 2010. [www.choice.com.au](http://www.choice.com.au).

Commonwealth of Australia. (No date).Choosing Plumbing Products in *Your Home Renovator’s Guide*. Retrieved 25 Nov 2010. [www.yourhome.gov.au](http://www.yourhome.gov.au).

ClubsNSW. (2006).*10 Ways to Green Your Club.*Author.

Dept. Climate Change & Energy Efficiency. (2010). *Phase-out of Green House Intensive Hot Water Systems*. Retrieved 25 Nov 2010. [www.climatechange.gov.au](http://www.climatechange.gov.au).

Dux. (No date). *Airo Heat – Hot Water Heat Pump Manual*. Retrieved 25 Nov 2010. [www.enviro-friendly.com](http://www.enviro-friendly.com)

Energetics. (2010). *Electrical sub metering at defence*. Retrieved 25 Nov 2010. [www.energetics.com.au](http://www.energetics.com.au).

Energy Australia. (No date). Sailing into energy efficiency. Retrieved 25 Nov 2010. [www.energyaustralia.com.au](http://www.energyaustralia.com.au).

Energy Matter. (2005). *Evacuated Tube Solar Collectors*. Retrieved 25 Nov 2010. [www.energymatters.com.au](http://www.energymatters.com.au).

Commonwealth Government of Australia. (2010).*Energy Rating*.[www.energyratings.gov.au](http://www.energyratings.gov.au).

Aurora Energy. (2009).*Energy Saving Tips – Whitegoods.* Retrieved 25 Nov 2010.[www.auroraenergy.com.au](http://www.auroraenergy.com.au).

Milne, G. (2008). Energy Use in *Your Home Technical Manual*(4th ed.). Retrieved 25 Nov 2010. [www.yourhome.gov.au](http://www.yourhome.gov.au).

NHP. (2007). Power Correction Factor Catalogue. Retrieved 25 Nov 2010. [www.contactor.com.au](http://www.contactor.com.au)

Norman, Disney and Young. (2003). *Power Factor Correction Evaluation for Australian Building Code Board*. Retrieved 25 Nov 2010. [www.abcb.gov.au](http://www.abcb.gov.au).

Office of Renewable Energy Regulator. (2010). *RET process for owners of SWH and air-sourced heat pump water heaters.* Retrieved 25 Nov 2010. [www.orer.gov.au](http://www.orer.gov.au).

Riedy, C. (2008). Hot Water Service in *Your Home Technical Manual*(4th ed.). Retrieved 25 Nov 2010. [www.yourhome.gov.au](http://www.yourhome.gov.au).

Sustainability Victoria. (2005*). Solar Hot Water*. Retrieved 25 Nov 2010. [www.makeyourhomegreen.vic.gov.au](http://www.makeyourhomegreen.vic.gov.au)

UNIT 7: MONITORING AND EVALUATING PROJECT PERFORMANCE

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UNIT 7: MONITORING AND EVALUATING PROJECT PERFORMANCE

# Monitoring

Monitoring involves the collection and analysis of information and data to assist timely decision making, ensure accountability and provide the basis for evaluation and learning. Throughout your energy efficiency project, which is a key part of this course, continual monitoring and reporting on your project through the methodical collection of data is critical in order to address the key evaluation questions.

Principally during this course, you will be engaged in **program performance monitoring**. That is, monitoring your club’s systemsthat contribute to your energy efficiency outcomes; policies, strategies, programs, people and technologies.

# Evaluation

Whereas monitoring is a continual process through the life of the project, evaluation is an assessment at the close of the project or at set times during the life of a project. This assessment may be conducted through independent evaluations or self-evaluation processes.

Evaluations report on project outcomes and should be planned to inform at milestone points throughout the life of the program and at the end to collate learning and inform future programs.

# What data to report

To assist the process of monitoring and evaluation, study the table below and decide what reports you may need to plan as part of your project.

| **Questions** | **Method or data source** | **Report / documentation** |
| --- | --- | --- |
| **1. Appropriateness** |  |  |
| a. How is the project aligned with the club’s vision and strategic plan  b. To what extent is the project compliant with best practice processes in the field | Needs analysis and energy efficiency review  Research methodology  Plan (objective and actions)  Approach to monitoring and evaluation  Cultural integration; for example, communication with staff and members | Needs assessment  Efficiency targets  Performance data and change-over-time data  Budget |
| **2. Impact** |  |  |
| a. In what ways and to what extent has the project contributed to changing board and management practices  b. What, if any, unanticipated positive or negative changes or other outcomes have resulted | Club policy development  Qualitative data on staff and member change of attitude and behaviour | Club policy document including outline on process of development  Culture change of staff and members and outline on process of development |
| **3. Effectiveness** |  |  |
| a. To what extent have the planned activities and efficiency targets been achieved  b. What were the successes; what were the barriers to success | Quantitative data on efficiency target results and change-over-time data | Milestones and amended action plans |
| **4. Efficiency** |  |  |
| a. To what extent has the project attained value out of the available human and financial resources  b. How could resources be used more productively and efficiently | Financial audit on project spend  Human resource audit on project hours | Budget versus actual  Return on investment  Log of hours  Recommendations on resources (financial and human) |
| **5. Legacy** |  |  |
| a. How will the project’s objective or lessons learnt from the project be incorporated into club strategic planning after the project ceases  b. How will energy efficiency be continued to be managed throughout the organisation  c. How will energy efficiency measures be continued to be promoted and communicated to the organisation’s stakeholders | Incorporation into strategic plan including budget and resourcing  Culture change and education  Future monitoring and evaluation | Evaluation recommendations including new efficiency targets, culture change, communication, budget and resourcing |

### Assessment 8: Monitoring and evaluation

These questions are assessable: performance elements 4.1, 4.3, 4.4 and 4.5

###### Instructions

The work that you have completed in assessments 2 and 3 can be used in this question and the table provided in Unit 7 can be used as a guide to assist in your answers. This assessment must be answered in direct relationship with your energy efficiency project.

Although the outline below is one format to present your answers, please note that a different format will be accepted. However, all questions must be clearly answered or marks may be lost. Some questions required documented evidence to support your answer.

###### 1. Appropriateness

a. How is your project aligned with your club’s vision and strategic plan?

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b. To what extent is the project compliant with best practice processes in the field? For example, what research processes and sources did you use to set your objective, actions and targets?

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###### 2. Impact

a. In what ways and to what extent has the project contributed to changing board and management practices? Use documented evidence to support your answer such as a board or management meeting agenda and club policy document.

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b. In what ways and to what extent has the project contributed to changing staff and member attitudes and, importantly, behaviours? Use primary data to support your answer.

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###### 3. Effectiveness

a. To what extent have the planned activities and efficiency targets been achieved?

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b. What were the successes of the project; was the objective achieved?

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c. What were the barriers to success that you encountered and how did this affect your objective?

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###### 4. Efficiency

a. To what extent has the project attained value out of the available human and financial resources?

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b. Provide a recommendation on how resources could be used more productively and efficiently in future projects.

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###### 5. Legacy

a. How will the project’s objectiveor lessons learnt from the project be incorporated into club strategic planning after the project ceases?

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b. How will energy efficiency be continued to be managed throughout the organisation?

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c. How will energy efficiency measures be continued to be promoted and communicated to the organisation’s stakeholders; for example, staff and members?

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### Assessment 9: Final report to the board

This question is assessable: performance element 4.2

###### Instructions

Using your organisation’s standard reporting template or the suggested template from Assessment 4, write an information report for the board on the outcomes of your energy efficiency project.

Include in your report the following information;

* Project objective
* A summary of the efficiency targets, actual results and the reasons for the difference between targets and actual results
* A summary of evidence of cultural change throughout the organisation in relation to energy efficiency
* A summary of communication to staff and members in relation to energy efficiency activities
* Financial results; budget, actual spend and the reasons for the difference between budget and actual spend
* Recommendations to the board based on your experience.



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