IV. ENERGY SAVINGS IN COMMERCE

A. Energy Use in Commerce

The commercial sector uses less than 20% of the total final energy produced by society (see Figure 1.1). This is comprised of almost equal quantities of coal, gas, oil and electricity.

The primary uses of energy in commerce are:

- heating and cooling of buildings
- running appliances, particularly office machinery
- hot water
- lighting

Some of these uses resemble those in the domestic sector but the scale is often different and strategies need to account for the differences between home and work environments. Although the commercial sector is a relatively small user of total final energy it has been a leader in energy efficiency. Savings can often be made through changes to work practices or in conjunction with building renovations. Such changes can be cost effective in the short term. This is therefore a very attractive area for energy savings and one in which local government has a major role.

B. Strategies for Energy Savings in Commerce

For many businesses, environmental concerns such as global warming and air pollution are secondary to the financial benefits derived from reducing energy consumption. Substantial savings for both owners and occupiers of commercial buildings can be made through the introduction of energy management programmes involving some of the measures and approaches outlined in this Chapter.

1. Technical Approaches

There are a range of measures available to firms to reduce their energy consumption. Most of these have been discussed as they apply to the domestic sector in Chapter 2. The commercial sector is more diverse than the domestic sector and it is generally advisable to carry out an energy audit first to determine the major areas of energy use in the company and the opportunities for savings. This is discussed in Section C.

The technical options available to the commercial sector relate to the primary areas of use which are:

- climate sensitive building design

- retrofitting existing buildings with insulation, shading, day lighting (see Case Study 27 Energy Savings from Preventative Maintenance of small to medium sized ducted style air conditioner units)

- purchase of efficient lighting systems

- appropriate sizing and design of heavy use appliances such as air conditioners and water heating equipment (Case Study 28 Re-evaluating Energy Efficient Buildings for Continuous Savings)

- purchase of energy efficient office equipment (see Case Study 29 PowerSaver Energy Saving Device for Computers)

- the utilisation of energy management control systems

2. Educational Approaches

The largest potential for energy savings in commercial buildings is contained with its occupants. Technical solutions are usually only successful in producing financial savings where building occupants are an integral part of the energy management strategy.

For example, a building occupant who leaves the lights on all the time, regardless of whether the room is occupied, can quickly offset savings made through the installation of lower wattage lighting. In this situation, only awareness raising and behavioural change amongst the occupants will result in energy savings.

Essential to the success of any programme is the support of both management and employees. Management support can usually be obtained for the project champion, by highlighting the potential for cost savings to be made through the use of case studies or simple cost benefit analysis on one area, such as lighting. Employee support can be harder to obtain, particularly in businesses where staff are already overworked, or where there is no sense of ownership or responsibility for the energy conservation measures.

Two options for engaging employees or building occupants are available:

- staff training and incentives that encourage staff to be energy efficient through focussed conservation measures, such as ‘switch off when you leave’ stickers on light switches, and
- development of energy management teams with representation from all levels of the organisation and departments.

Whilst they are independent options, the greatest energy savings will arise from a combination of both methods.

An awareness-raising exercise should be implemented at the start of the energy management programme to promote the project and keep building occupants informed about the project and potential benefits of the activities. This can help avoid negative attitudes about the project and highlight the benefits of improved lighting, heating or cooling as well as provide an avenue for feedback between the project team and building occupants.

See Case Study 30 Awareness Raising and Motivation and 31 Computer Users Energy Management Behaviour.

3. Regulatory Approaches

There are several regulatory measures that can produce energy savings in the commercial sector. These include:

- compulsory or voluntary appliance labelling. This assists purchasers exercise their right to choose energy efficient appliances. Some office equipment, especially PCs, printers and window air conditioners are heavy users of energy
- minimum energy performance standards. Some countries have introduced regulations requiring office equipment to meet minimum standards of energy efficiency
- building codes can be used to ensure that new buildings meet minimum standards for passive solar design in order to reduce energy use

See the Environmental Energy Technologies Division of the Lawrence Berkeley National Laboratory on http://eetd.lbl.gov/EA/ecsw/ecsw.html, for examples of regulatory measures in energy management.

4. Economic Approaches

Economic approaches are similar to those offered to industry and the domestic sector and they include

- time of use tariffs
- subsidies for substitute fuels
- subsidies for use of renewable energy
- tax relief for investment in energy efficiency equipment
- levies on energy use (see Case Study 32 Funding Options for High Efficiency Lighting Programme for Public Buildings)

C. Energy Audits for Buildings

Reduced consumption of energy and hence reduced operating costs for businesses can be achieved through an analysis and review of the areas of energy consumption, selection of appropriate appliances and education of building owners and occupiers.

Various definitions of energy auditing and the energy audit process exist. However, it is principally involved with the evaluation of an energy system to determine the energy use of that system (i.e. a building) and potential areas for energy savings to be made. For simplicity, consider the approach suggested by the Center for the Analysis and Dissemination of Demonstrated Energy Technologies (Aronsson & Nilsson, 1996), which identifies three levels of energy auditing.

Whilst it is often advantageous to engage a consultant who specialises in energy auditing in commercial buildings, initial energy conservation programmes can be undertaken, including level one and two auditing, without the need for a specialist. The advantage of this is that a relatively small investment can be made in a feasibility study to determine the commitment to energy management from the building owner and occupants, before engaging a consultant.

1. Level One Energy Auditing

Level one audits usually produce the lowest cost measures and typically result in only small energy savings. They are usually based on a combination of a screening survey (walk through audit) and historical energy use data from energy bills for the preceding year or more.

The purpose of this level of audit is to:

- determine the energy consumption of a building, and the cost of this consumption, and
- identify major consumers of energy and obvious or priority areas for energy conservation measures.

Source	Date of Bill	Units Consumed	Total Cost of Bill	Number of Days	Cost per Day	Tariff
Electricity						
Gas						
Oil						

Table 4.1: Summaries of energy use can easily be generated in spreadsheet programmes for analysis.

Energy Use Analysis

A historical analysis of energy consumption is important as it can be used to identify the daily consumption pattern, where time of use tariffs exist, as well as seasonal fluctuations in energy use.
This simple analysis can help to identify low cost solutions such as changing electricity tariffs, which can result in cost savings from little or no investment in energy saving initiatives.

When commencing a level one audit, you will require energy consumption and cost details for the organisation or location under analysis for at least one year, but two or more years is preferable. This information is usually contained in the bills from your energy (electricity and gas) supplier. When determining your total energy consumption, you will need to consider the electricity, gas, oil, coal or coke consumption as well as the physical amount of each unit consumed, if this is not specified on your bill.

For example, electricity is usually sold in units, and each unit is the equivalent of one kilowatt hour (kWh). Gas is usually purchased in units, where one unit is equal to one Mega Joule (MJ). This information can assist you to identify each of the energy sources utilised in your building or organisation as well as the quantities of each used. Where billing is more frequent than yearly (i.e. bi-monthly), seasonal and annual trends in energy consumption can be identified.

The bill should also contain information on the tariff or tariffs at which the energy was consumed. You should also obtain, prior to the audit, details of other tariff structures applicable to your organisation for your existing energy retailer as well as any other energy retailer providing energy services in your area.

Historical energy use data will also be used when evaluating the effectiveness of energy conservation initiatives once measures have been introduced. In organisations or buildings where energy consumption is sub metered and charged to the appropriate department or company level, an evaluation should be undertaken at both levels.

Collating Information for Analysis

Once the energy bills have been located and tariff information obtained, it is advisable to store the information in a spreadsheet programme, such as Microsoft Excel, Quattro Pro, or Lotus 1,2,3. Alternatively, information can be recorded in a table, either electronically or hard copy. When you have at least twelve months worth of data, analysis can commence.

Evaluating Tariff Structure

The first stage of the energy audit should examine whether the current tariff structure for your energy supplier(s) is the most appropriate, given your energy use, and whether there are alternative energy suppliers who could service your company at a lower cost. This is a relatively easy process, especially when you have collated the historical use information electronically. The evaluation can also be undertaken manually, and the results recorded in hard copy.

Simple or Flat Tariffs

Where your energy supply is not based on time or season of use, the following example is used:
In this case, the existing supplier is the cheapest option.

Provider	Energy Consumption / Month	Tariff / kWh	Cost
Existing	1000 kWh	US $0.25	US $250
Option 1	1000 kWh	US $0.20	US $300
Option 2	1000 kWh	US $0.27	US $270

Example 1: Simple or flat tariff

Time of Use Tariff

Where energy consumption is based on the time or season (and occasionally both) a similar model can be used to evaluate the options.

Provider	Energy Consumption @ Tariff 1	Tariff / kWh	Cost	Energy Consumption @ Tariff 2	Tariff / kWh	Cost	Total Cost
Existing	750 kWh	$0.32	$240	250 kWh	$0.18	$45	$285
Option 1	750 kWh	$0.30	$225	250 kWh	$0.21	$53	$278
Option 2	1000 kWh	$0.26	$260				$260

Example 2: Time of use tariff

In this second example, both alternate providers are cheaper than the existing energy supplier. However, the provider who has only one tariff applicable to your organisation, offers the best potential for savings.

Mixed Tariff Options

Where your current provider has a flat tariff and alternate energy suppliers have time of use tariffs the analysis is more complex, and requires an estimation of the consumption during each of the tariff periods. The easiest way to determine this information is to read the meter or sub meter at the start and finish of the tariff periods for at least one month. Once you have obtained this information, example two above can be applied.

Seasonal Analysis

In regions where distinct climatic changes occur between summer and winter or the wet and dry seasons, the energy consumption profile between seasons can assist in estimating the heating and cooling component of consumption. At the simplest level, the seasonal analysis can identify fuel substitution, for example, where gas, wood or kerosene heating is used during cool seasons.

Specialist energy management consultants can also use the results of seasonal analysis in combination with temperature information in simulation software to predict the ideal mix of energy sources.

2. Level Two Energy Audits

At this level, in-house energy champions are still able to undertake many aspects of energy auditing and develop strategies, which result in energy savings for the organisation. Level two audits usually consist of a detailed examination of major energy consumers, in terms of departments or building floors as well as energy systems, through the use of screening surveys.

Screening Surveys

Preliminary, or walk through evaluations of a building can be used to produce an initial list of large consuming items as well as areas of energy wastage. During the visual investigation of the site, the energy champion or auditor should look for those areas with the greatest opportunity for savings, which are usually (but not exclusively) those with the largest energy consumption. These are typically:

- space heating and cooling
- office equipment and appliances, and
- lighting.

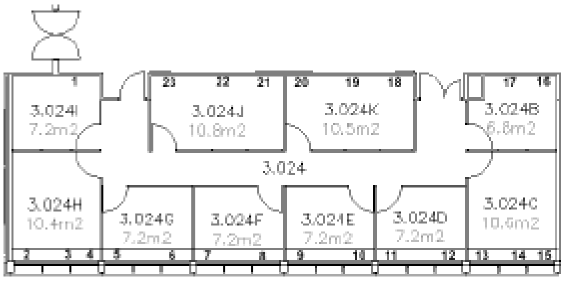

Figure 4.1: Floorplans can assist in the energy audit by providing a convienent reference to the building

When preparing for the screening survey, you will need to obtain an up-to-date floor plan for each floor of the building under investigation, which includes the locations of power and gas outlets as well as static energy appliances, such as water heating appliances, including hot water systems and urns.To commence your survey, locate the appropriate floor plan and begin walking through the floor, locating and identifying energy consuming items as shown in the example below. If possible you should also determine occupancy rates (ie used rarely or daily).

Appliances and Office Equipment

During your survey, you should identify the locations of power and gas outlets as this can provide information about the appliances and office equipment utilised in the building. Although the survey can be completed at any time of the day, an after hours survey will often provide the opportunity to uncover the greatest potential for savings in this area as a result of equipment left on after the user has gone home.

Number	Description
1	Double power outlet: Double adapter: computer, printer, radio on second plug
2	Double power outlet: Computer and printer
3	Double power outlet: Computer and printer
4	Single power outlet: Reverse Cycle (R/C) Air conditioner (off, fitted with timer switch)
5	Single power outlet: R/C Air conditioner (off)
6	Double power outlet: Computer and cooling fan
7	Double power outlet: Computer and printer
8	Single power outlet: R/C Air conditioner (off)
9	Single power outlet: R/C Air conditioner (off)
10	Double power outlet: 2 Computers and 1 printer
11	Double power outlet: Computer and printer
12	Single power outlet:R/C Air conditioner (off)
13	Double power outlet: No appliances
14	Double power outlet: Computer and printer
15	Single power outlet: R/C Air conditioner (off)
16	Double power outlet: Computer and internet hub
17	Double power outlet: Computer and printer
18	Double power outlet: Cooling fan (off)
19	Double power outlet: Heater (off, fitted with delay switch)
20	Double power outlet: No appliances
21	Double power outlet: Computer and printer
22	Double power outlet: Computer and printer
23	Double power outlet: Computer and printer

Occupancy: each room is occupied by at least one person, who utilises the space from Monday to Friday during business hours.

From this example, it can be seen that almost every computer has a printer attached to it. Immediately, it should be obvious that one possible energy saving measure from the screening survey of this section of the building would be to install a shared printer. A simple calculation of the savings associated with energy consumption for this initiative would result in at least a 50W saving, or approximately 1.2kWh per day, where printers are left on all day.

10 Inkjet style printers (consumption of ~20W each) = 200W

1 Workgroup laser printer (consumption ~150W) = 150W

Saving = 200 - 150 W
= 50W

$$\textbf{Consumption per day} = \frac{\text{saving}}{1000} \times 24 \text{ hrs}$$

$$= 1.2\text{kWh}$$

This represents a situation where only inkjet printers are utilised. In the above example, four of the printers were laser, thus increasing the potential for cost savings.

In most office environments, appliances are not utilised from about 7pm to 7am. Switching off computers, printers and other non-essential appliances and equipment can result in significant savings for the organisation. In the example above, switching each computer off when the user leaves for the day can represent an energy saving of around 2 kWh per machine per day. Whilst this does not sound like a significant amount, it can represent a considerable saving in organisations where there are large numbers of computers.

Where it is not practical, or possible to switch off computers, monitors should be switched off, as these represent the largest component of the energy consumed.

Although a voluntary programme, the energy efficient labelling system, known as EnergyStar, for computer equipment, introduced in 1992 has been widely accepted and now encompasses a variety of electronic equipment for both the home and small business. The EnergyStar website provides detailed information on the energy performance of common appliances and office equipment as well as a variety of tools for businesses and governments. Where possible, the purchase of energy efficient appliances that use less power for the same function should be encouraged. Higher initial costs for the capital purchase can usually be repaid in short time frames (compared with product life) and can represent considerable cost savings in the future.

Figure 4.3: Energy Star labelling scheme

Case studies 30 Computer Users Energy Management Behaviour and 31 PowerSaver Energy Saving Device for Computers provide details of energy management options for reducing energy consumption from personal computers.

Lighting

During the screening survey, you should also identify the lighting in the area under review, as savings can also be made in this area through the replacement of inefficient lighting and removal of unused fittings.

In this example, some cost savings have been implemented through the use of fluorescent lighting and the removal of the third fluorescent tube in most fittings. Lights numbered 2, 15 and 10 are on a separate switch and are usually switched off as sufficient lighting is provided in the corridor and the addition of a third tube in fitting 3 has provided enough light for the second occupant of the corner room.

Number	Description
1	Fluorescent 3 tube: Only 2 tubes fitted inner and outer.
2	Fluorescent 3 tube: Only 2 tubes fitted inner and outer.
3	Fluorescent 3 tube: All 3 tubes fitted.
4	Fluorescent 3 tube: Only 2 tubes fitted inner and outer.
5	Fluorescent 3 tube: Only 2 tubes fitted inner and outer.
6	Fluorescent 3 tube: Only 2 tubes fitted inner and outer.
7	Fluorescent 3 tube: Only 2 tubes fitted inner and outer.
8	Fluorescent 3 tube: Only 2 tubes fitted inner and outer.
9	Fluorescent 3 tube: Only 2 tubes fitted inner and outer.
10	Fluorescent 3 tube: Only 2 tubes fitted inner and outer.
11	Fluorescent 3 tube: Only 2 tubes fitted inner and outer.
12	Fluorescent 3 tube: Only 2 tubes fitted inner and outer.
13	Fluorescent 3 tube: Only 2 tubes fitted inner and outer.
14	Fluorescent 3 tube: Only 2 tubes fitted inner and outer.
15	Fluorescent 3 tube: Only 2 tubes fitted inner and outer.

All fixtures are fitted hanging 50cm down from the ceiling

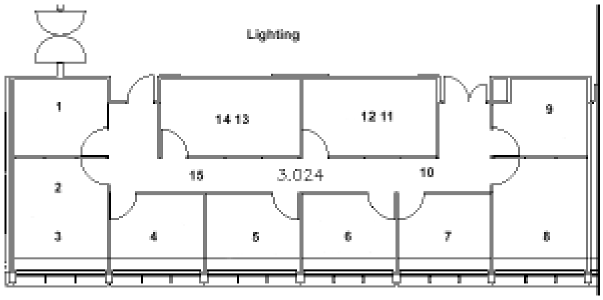

Figure 4.2: Floor plan of office area under audit

This example is similar to many commercial buildings, where incandescent lighting has been replaced by fluorescent lighting. In buildings where incandescent or filament type lighting still exists, consideration should be given to the installation of either compact fluorescent bulbs which can be fitted in existing sockets, or tube type fluorescent lighting. For example, for a given brightness of incandescent light, the compact fluorescent equivalent will typically use only 20% of the energy of the incandescent globe and will last approximately five to seven times longer.

Consideration should also be given to the fittings in fluorescent lights, especially the tube type as many are fitted with conventional electromagnetic ballasts. Replacement of this type of ballast with electronic ballast can represent a saving of 12 W per fitting (where only two lamps are fitted).

See Case Studies 32 and 33 on the New York Power Authority and the Asian Development Bank.

Space Heating and Cooling

In commercial buildings, the heating, ventilation and air conditioning (HVAC) systems will form the largest single component of energy consumption. HVAC systems can usually be characterised as:

- Air-conditioned: where air is distributed and exhausted either through a central ducted system, or a number of smaller, room sized conditioners. These systems can be refrigerative, absorptive or desiccant cooling, or reverse cycle systems where the unit can heat and cool the air.

- Mechanically ventilated: where air is exhausted through the use of fans.

- Naturally ventilated: where air is removed and supplied through the use of exhaust ducts (but not fans, except in toilets and food preparation areas), windows and doors.

Alternatives to Refrigerative Air Conditioning

When installing new cooling systems, careful consideration should be given to the selection of appliances, which are both suitable, and energy efficient as these will result in the greatest cost savings.

Refrigerative air conditioners are not suitable for use in all climates, and more appropriate alternatives include absorption, evaporative and desiccant cooling systems.

Absorption Cooling Systems

Very common in large commercial HVAC systems, absorption-cooling systems, in their simplest form, use chilled water, ice or other heat absorbent substance to remove heat from the circulated air.

Evaporative Cooling Systems

In hot dry climates, evaporative cooling systems, or Swamp coolers, can replace refrigerative systems, with energy savings of about 75%. In these systems, the evaporation of water into the hot dry air results in a cooling effect. Developments in evaporative technologies have resulted in both direct systems (where the humidity of the circulated air increases) and indirect systems (where the air remains dry).

Desiccant Cooling Systems

Ideal for humid climates, desiccant-cooling systems operate in three stages, they initially decrease the humidity of the air by passing it through a desiccant wheel which heats and dries the air. The dry air is then cooled by heat exchangers, where waste heat is exhausted. In the final stage, the air passes through an evaporative cooler prior to circulation.

HVAC in Large Buildings

In large commercial buildings, a central HVAC system will have been installed at the time of construction and is usually costly to replace with an energy efficient system, unless replacement is warranted. However, energy savings are still possible in these systems.

Savings from the operation of a HVAC system are most likely to occur by promoting the use of off peak power and thermal energy storage systems, such as ice, to cool the chiller water at times when power is cheapest. Although there are usually no energy savings, and it may result in slightly more energy being consumed, savings are made through the lower cost of electricity. Significant energy and cost savings are also more likely to be achieved where the system is maintained and serviced regularly. Consideration should also be given to recommissioning the HVAC system. The commissioning process will help to determine if the system is operating at optimal efficiency, whilst maintaining environmental conditions within the building envelope. Case Study XXX Re-evaluating Energy Efficient Buildings for Continuous Savings on the Asian Development Bank details their HVAC efficiency measures.

In buildings where split system air conditioning units have been installed, significant savings, through increased life span of equipment, easier maintenance and reduced energy consumption can be achieved through the retrofitting of central HVAC systems. Careful consideration and planning should be made as the retrofitting processes usually attracts a large capital cost associated with these solutions, and long payback periods, often longer than the life span of the new equipment. In these situations, the cost saving resulting from the easier maintenance should be included in the planning and evaluation prior to implementation.

Case Study 33 Energy Savings from Equipment Replacements: Water Chilled Air Conditioning Systems

In addition to these measures, consideration should be given to minimising the number of heat generating activities and processes. The three commonest areas, which are likely to result in savings through a reduced cooling load are:

Lighting

A significant amount of waste heat is generated by lighting, and reducing the lighting load as well as reducing the intensity of lighting can reduce the amount of waste heat generated and hence the cooling load.

Appliances

Reducing the heat generated by office equipment, through the selection of energy efficient devices or those which generate less heat as a result of technological innovation, such as inkjet printers and cost fusing photocopiers can significantly reduce the cooling load of HVAC systems.

Building Envelope
Reducing the amount of sunlight and external heat entering the building through windows, doors and open ductwork through shading, window treatments and insulation can also result in significant cost savings.

HVAC in Smaller Buildings
Buildings, which are not serviced by centrally ducted HVAC systems usually provide more opportunities for energy savings but tend to be more reliant on occupant behaviour for savings.

Air-conditioned Buildings
Buildings that are fitted with room-sized air conditioners (both single unit and split systems) can be difficult to manage, as the use of the system is usually the responsibility of the room occupant. In these cases, education and awareness raising activities with building occupants will provide the best savings potential.

Occupants can be encouraged to consider alternate heating and cooling methods, such as putting on, or removing layers of clothing to suit the conditions, prior to using the air conditioner.

From a technical perspective, the correct sizing of an air conditioning unit is an important aspect of overall energy management. As with other energy appliances, selection of energy efficient models will assist in reducing overall energy consumption as will ensuring that systems are serviced regularly - dust build up on the motor and heat pump reduces the efficiency of systems.

The financial savings of small business air conditioning is discussed in Case Study 37 Energy Savings from Preventative Maintenance of Small to Medium Sized Ducted Air Conditioning Units

Mechanically Ventilated Buildings
In small buildings where heat is extracted through the use of exhaust and ceiling fans, similar technical principles (selection, maintenance and operation) apply as to air-conditioned systems, although energy consumption is typically less than for a similarly sized air conditioned building.

The use of timer switches on exhaust fans can reduce the total overnight load of the building, for example the fan is switched off between the hours of 7pm and 3am. However, careful monitoring of the environmental conditions should be undertaken to ensure that this does not create an unpleasant environment for the building occupants.

As with any electric motor-based appliance, fans should be serviced and cleaned regularly by a qualified person to reduce dust build up and maintain efficiency. If units require replacing, consider energy efficient alternatives.

Naturally Ventilated Buildings
As these buildings do not rely on energy for the ventilation of the office space, only minor improvements to their energy efficiency can be made. These improvements usually focus around the draught proofing of windows and doors to prevent heat loss (or gain).

Water Heating
Water heating comprises only a minor component in commercial buildings unlike the domestic sector, where energy due to water heating is a large component of the total energy used. However, the heating of water for use in both hot and boiled water applications (ie washing versus drinking) is an additional area of potential energy savings.

In many commercial buildings, electric water heating units for supplying hot (not boiled) water are the only viable alternative. Although both gas (including natural and biogas) and solar offer the potential for cost savings, particularly in the case of solar heated units, they are often unsuitable either because gas is not distributed to the building or because access to the roof or other suitable location for solar water heating is unavailable. However, energy savings can be made through the selection of instantaneous electric water heating units, which heat the water at the time of supply, as opposed to storage systems which store pre heated water in a tank.

Units that supply boiled water, usually for consumption in hot drinks, such as coffee and tea, also offer energy savings. In rooms set aside for refreshments and breaks, water heating is usually by the use of an urn, or large capacity thermal element kettle. These appliances, especially portable types, are not fitted with timer switches and are frequently left on overnight, resulting in both energy consumption (at the rate of about 2 kW per hour) and potential damage to the appliance and fire.

Socket type timer devices, where available, offer a solution to both problems, although they themselves are small consumers of energy. In buildings where demand for boiled drinking water is low, an electric kettle may provide an alternate energy saving option to the large capacity urn.

3. Level Three Auditing
Level three energy auditing encompasses the systematic and detailed evaluation of energy consumption in buildings and building energy systems. Specialist energy management consultants usually undertake this level of audit using simulation software to determine minimum energy consumption for the building.

The simulation software usually incorporates thermal modelling of the building and energy services, occupancy and building use information and climatic information (or the ability to incorporate this type of information) to determine total energy consumption of the building. Energy management consultants should also be able to analyse components of the building environment such as the HVAC system and evaluate the energy performance of these systems.

Typically, the recommendations from energy management consultants are capital intensive and carry the greatest risk, due to their relatively long payback periods. Where level three auditing is utilised in a comprehensive energy management programme, incorporating levels one and two auditing, recommendations will usually involve detailed retrofitting of existing energy systems. This involves the replacement of HVAC and building wide lighting systems, appliance replacement and the upgrading of the thermal performance of the building envelope.

D. Energy Management Systems

In the last 25 years, much of the progress in energy management has been in the development and implementation of computer systems to control energy consuming devices, principally lighting and HVAC systems in commercial (and industrial) buildings, as a method for reducing energy consumption, and hence financial savings.

These systems are known by a variety of terms including:

- Energy Management Systems
- Energy Management Control Systems
- Building Energy Management Systems

Many Energy Management Systems are available commercially, and a valuable system will include the following aspects:

- Reporting of system parameters (including temperature, humidity and air flow associated with HVAC)
- Information summary of data at diurnal, weekly and monthly intervals, which are understandable to non-energy specialists
- Rapid response to changes within the system such as environmental conditions (i.e. sudden heat wave requiring lowering of temperature within the building envelope

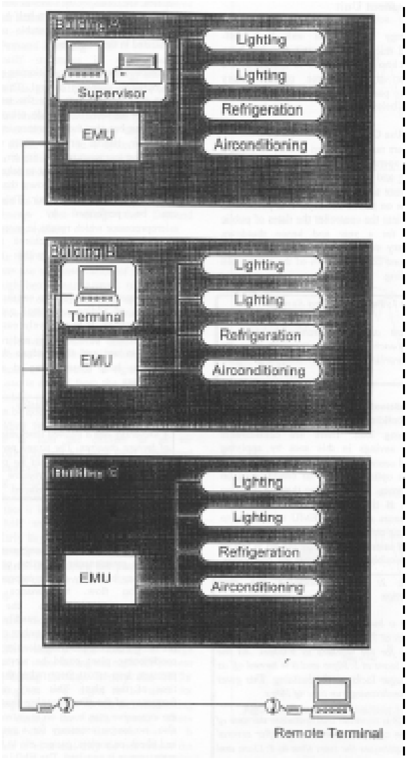

Figure 4.4: Schematic of an Energy Management Control System

Advanced systems may also provide additional building services, such as smoke/fire detection.

When selecting systems, it is essential to consider the main goals for these systems:

- Reduced energy costs: with each additional component or feature, incremental cost savings should be achieved
- User friendliness: the system should not require extensive technical knowledge of the system in order to be utilised.

The system should be able to provide a variety of information for different levels of users. The Energy Manager/ Facilities Manager should be able to extract technical data from the system and use it to reprogram control features whereas the Area Manager or Night Staff should be aware of using override controls after hours should the system need temperature changes to HVAC or lighting.

1. Components of Energy Management Control Systems

Energy Management Systems have 5 principal components (and any number of inputs, such as lighting, refrigeration or air conditioning may be managed by the system). In small buildings, only one of each component may be required, whereas in larger installations, such as multi-storey office buildings may have many.

Data Link

Like all communication networks, such as telephones and computer networks, Energy Management Control Systems require a data link for the exchange of information between components.

As with other information networks either copper or fibre optic cables may be used. Many buildings utilise existing telecommunication infra structure, thus reducing the installation cost of the system, and allowing remote access to the system.

Energy Management Unit

At the heart of an Energy Management Control System is the Energy Management Unit. The main function of the Energy Management Unit is to provide a direct interaction with the input devices (i.e. air conditioning) being controlled by the Energy Management Control System.

A self-contained unit, the Energy Management Unit can be programmed (usually by the Energy Manager/ Building Manager) to perform the desired management functions. It should be capable of measuring the environmental conditions as well as maintaining conditions programmed into it, or those programmed from the Supervisor Console.

Supervisor Console
In large buildings, several Energy Management Units may be integrated into a supervisor console, which can control the programming of all of the individual units. It is possible to change operational parameters from this location and the Supervisor Console will produce summary reports so that changes to the system can be evaluated and quantified.
Terminal
In most systems, there is normally the capacity for terminals to be connected into the network. The prime reason for this is to allow building users to have access to the Energy Management Systems, principally to allow for equipment shut downs or modify performance during maintenance or emergencies.

Remote Terminals
Growth in the internet and communication technologies has seen the integration of Remote Terminals with Energy Management Control Systems to allow access to the system via direct access modem or internet connections. With these advances it has become possible for diagnostic work on systems to be performed remotely (i.e. external to the Energy Management Control Systems location). It has also provided the opportunity for rapid response to emergency situations from the home of Energy Managers. The installation of an appropriate computer system in their homes alleviates the need for the person to attend to the problem on site, and reducing the time taken to respond to these situations.

Simple Control Systems
In addition to Energy Management Control Systems, which operate on a large scale, a number of smaller alternatives exist.

Timer Controls
These simple analogue (dial) or digital (display) (Figure 4.5) devices are designed to turn appliances on and off at a set time each day. Sophisticated versions may allow for multiple set points to be programmed (i.e. Monday, Tuesday, and Wednesday on at 9am, Thursday, Friday on at 8.30am) or include battery back up in case of power failure.

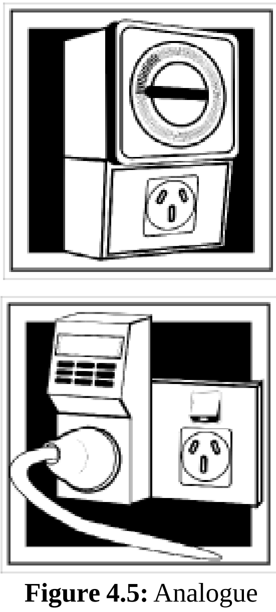

Figure 4.5: Analogue and Digital timer controls are suitable for small portable and fixed appliances.

Delay Switches
Delay switches are usually installed as override switches, and allow for appliances, including air conditioning to be turned on for a limited period of time, commonly for between 10 minutes and 3 hours.

After time has lapsed, the appliance is automatically turned off. To continue operation, the switch needs to be reactivated.

Motion Sensors/Light Detectors
Light and/or motion sensors have become commonplace in security applications where hight wattage lamps are activated by motion in the sensor range. They incorporate light detectors to ensure that movement during daylight (as would usually be expected) does not trigger the light. The main advantage of these systems is in the cost saving potential, as it reduces the amount of time the globe is illuminated.

Case Study 34 examines the energy saving potential of motion sensors in lighting applications.

E. References and Resources

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The handbook of Energy Management is a very comprehensive text on all aspects of energy management. Written from a technical perspective, it is ideal for managers with a science or engineering background. This text is available for purchase through many internet bookshops, and at time of print, the fourth edition was approximately US $150.