THE SUSTAINABLE SITING, DESIGN AND CONSTRUCTION OF TOURISM FACILITIES

UNIT 5

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The tourism and hospitality industry invests heavily in building new structures and renovating and converting existing ones. This unit introduces the key features of sustainable building siting, design and construction. They make buildings more durable, comfortable, and cheaper to operate and maintain, while facilitating the implementation of EMS during occupation.

Unit Outline

The unit is organised as follows:

Section 1

What is sustainable design?

Why is sustainable design important in tourism and hospitality?

The benefits of sustainable design

Section 2
Sustainable siting of buildings

- 2.1 Site selection;
- 2.2 Carrying capacity;
- 2.3 Environment impact assessment;
- 2.4 Building placement.

Section 3
Sustainable design of buildings

- 3.1 Architectural features: including passive solar design, day lighting, renewable energy, reducing and reusing water, and landscaping;
- 3.2 Environment considerations for the building 'shell': including windows, insulation, and environment-friendly building materials;
- 3.3 Providing for the use of resource-efficient technologies and appliances during occupation.

Section 4
Reuse of existing buildings

Section 5
Sustainable construction of buildings

Section 6
Case studies on environmentally-sound siting, design and construction of buildings

Section 7
Case studies

Learning Objectives

At the end of this unit, students should be able to:

- Appreciate the importance and benefits of sustainable building siting, design and construction;
- Identify some features of sustainable design;
- Appreciate how sustainable siting and design will facilitate the implementation of EMS;
- Discuss the potential for incorporating sustainable design features into existing buildings and how it will facilitate EMS;
- Discuss sustainable siting and design for new buildings and how it will facilitate EMS.

SECTION 1

What is Sustainable Design?

Sustainable design involves buildings that need fewer resources and materials to build, occupy and maintain, and are more comfortable and healthy to live and work in.

'Sustainable design is not a new building style. Instead, it represents a revolution in how we think about, design, construct and operate buildings. Sustainable design aims to lessen the harm caused by poorly designed buildings by using the best of ancient building approaches in a logical combination with the best of new technological advances. Its ultimate goal is to go even further and build offices, homes, even entire subdivisions, that are net producers of energy, food, clean water and air, beauty and healthy human and biological communities.'

The Rocky Mountain Institute, USA

Buildings have significant impacts on the environment. In most industrialised countries, carbon-dioxide emissions from buildings account for half of total national carbon emissions, while construction waste amounts to 35-40% of national annual waste output. In the UK, each person uses over 6,000kg of building materials every year.

The 1960s was the most notorious era for the construction of uneconomical and uncomfortable buildings which, as described by the celebrated architect Lewis Mumford, can "only be inhabited with the aid of the most expensive devices of heating and refrigeration." Admittedly, modern buildings are much more resource- and energy-efficient than those built 30 years ago, but they are still far from sustainable, and continue to be designed with little regard for climate, improved comfort, or reduction of water, energy and waste during construction and occupation.

We all pay the costs of unsustainable buildings. Employees working in badly ventilated and illuminated offices perform poorly and register high levels of occupational illness. Companies and homeowners face rising bills for heating damp, draughty buildings. Multiplier effects go even further – tropical forests are logged to provide timber for buildings in Europe, Japan and North America, and large rivers are being dammed to generate hydro-electricity for energy-intensive homes, business and other sites.

Why is Sustainable Design Important in the Tourism and Hospitality Industry?

The tourism industry, notorious for erecting buildings that ruin the beauty and integrity of their surroundings, ironically spends around US$701 billion a year on capital investments, which include hospitality businesses, airports, visitor centres and offices.

With the expansion of the nature, adventure and rural tourism markets, more and more structures are being built in remote and fragile environments where it is vital that impacts be kept to a minimum. Tourism buildings, due to the intensity of use, need to be regularly repaired and refurbished, which involves further impacts.

Tourists are also responding to good design. According to a 1996 study by the Travel Industry Association of America, some 43 million Americans are willing to pay an 8.5% premium to stay in what they perceive to be an environmentally sensitive property.

The Benefits of Sustainable Design

- **FACILITATES ENVIRONMENT MANAGEMENT**

  Sustainable design greatly facilitates the implementation of EMS. Some of the greatest challenges for EMS are finding ways to reduce resource use and waste output in buildings that offer very little scope for low and medium cost improvements. But a building constructed to maximise day lighting, lower heat loss or gain, use renewable energy, provide plumbing for the reuse of grey water, and lower watering needs through thoughtful landscaping, makes the implementation of EMS much easier.

- **LOWER ENERGY USE**

  As discussed in Unit 4, repair and retrofit options can reduce energy consumption by 30-50% in most buildings. This can be increased to 80% if coupled with sustainable design features.

- **PEOPLE PREFER 'GREEN'**

  There is an increasing demand for airy, comfortable homes and offices in neighbourhoods with open spaces, parks, trees and greenery. Sustainable design demonstration projects show that people are willing to pay a premium for 'green' homes and buildings.

- **IMPROVES PRODUCTIVITY AND ENHANCES CORPORATE IMAGE**

  Improving employee productivity is a strong incentive for 'green' offices. As salaries account for the highest proportion of operating costs, the business benefits of increased productivity can make a substantial contribution towards offsetting payback periods for building improvements. 'Green' buildings can also improve corporate image.

Sustainable design results in durable, attractive buildings, reduced operating and maintenance costs, improved comfort and convenience and low environment impact.

2.1 *Site Selection*

Site selection is the first step in the sustainable design process. The site must be compatible with the purpose of the proposed development and be suitable for building.

A site selection checklist for hospitality and tourism businesses is given below. The developer alone will not be able to provide all the answers. A pluri-disciplinary approach with input from ecologists, architects, construction engineers and environment specialists will be needed to determine the appropriateness of the site.

Site Selection Checklist

1. WHAT ARE THE ECOLOGICAL CHARACTERISTICS OF THE SITE?

- An overview of the hydrology and geology of the site is needed to determine the rate of erosion and if soils are stable enough for building;
- How fragile and valuable is the topography? To what extent will it be disturbed or destroyed by the proposed development?
- Has the site been degraded by previous building, industrial or agricultural uses? To what extent can the proposed development restore the productivity and biodiversity of the site?

2. DOES THE SITE HAVE SPECIAL CULTURAL SIGNIFICANCE?

- Is the site of cultural, religious or archaeological significance?
- Are there structures on the site that are of cultural, religious or historical importance?
- Will there be social conflicts if the land is used for the proposed development?
- To what extent can existing structures be preserved and enhanced by the proposed development?

3. ARE THERE BETTER USES FOR THE SITE?

- Given the ecological and cultural significance of the site, should it be used for the proposed development?

4. IS THE SITE NEAR EXISTING INFRASTRUCTURE SUCH AS ROADS, POWER LINES, WATER SUPPLY AND WASTE DISPOSAL SITES?

- This question is crucial to determine the multiplier impacts. If the site is remote from existing infrastructure, what will be the impacts of extending essential infrastructure to it?
- Will the proposed development contribute to the expansion of urban sprawl?
- Can the proposed development be built as a self-contained unit in terms of water, energy and waste disposal?

5. **WHAT IS THE STATE OF THE ENVIRONMENT OF THE SITE?**

- **Has it been used for industrial purposes?**
- **Have water and soil contamination tests been carried out?**
- **Are strong electromagnetic fields present?**
- **Is the site clear of deposition from surrounding industrial sites?**
- **Does the vegetation on the site show any signs of stress?**
- **What is the potential for passive solar design and renewable energy? This is especially important if the site is far from the grid.**

6. **REUSE OF EXISTING STRUCTURES:**

- **Can existing structures be reused or upgraded as part of the development?**
- **If the structures are beyond repair, can some building materials be recovered and reused for the new development?**

7. **HOW WILL FUTURE LAND-USE PLANS FOR THE AREAS SURROUNDING THE SITE INFLUENCE THE PROPOSED DEVELOPMENT?**

- **Are industrial and commercial developments planned for surrounding areas? Will this increase or decrease the value and aesthetics of the site?**
- **Will these developments affect the site's access to sunlight, water or power?**
- **Might these developments cause air and water pollution, or increase noise levels or congestion?**

2.2 Carrying Capacity Considerations

In tourism, carrying capacity is the maximum number of visitors and supporting infrastructure, that can be maintained in a given site or destination before environment damage occurs. When the threshold is exceeded, the resources required and pollution generated by tourism begins to degrade the natural environment.

Carrying capacity is important in site selection, because it encourages developers to consider

- **Capacity thresholds for buildings and visitor numbers right from the start;**
- **A range of alternative sites;**
- **The human and financial resources needed for environment impact mitigation before the final choice of site is made.**

Calculating Tourism Carrying Capacity

Ecological sensitivity differs from ecosystem to ecosystem. Coastal areas and wetlands are, for example, more dynamic and fragile than prairies. Likewise, rocky cliffs are more resistant and less dynamic than mountain forests. Furthermore, tourism is a dynamic business and visitor numbers fluctuate greatly from season to season. Given these factors, the carrying capacity of a site will depend on:

- **Number of tourist arrivals;**
- **Patterns of visitor arrivals and length of stay;**
- **Tourist activities;**
- **Number of local people living in the area;**
- **Facility design;**
- **Destination management strategies;**
- **Characteristics and quality of the surrounding environment.**

While the concept of carrying capacity works well in theory, its practical application can be challenging. When determining the levels at which the threshold should be set, it is necessary to consider what level of activity can be considered too much, and what level of environment modification can be regarded as acceptable. Natural resource management researchers often use the 'Limits of Acceptable Change' principle, which attempts to set measurable limits to human-activity-induced changes in natural areas. This principle is widely used in the management of natural parks and protected areas.

2.3 Environment Impact Assessment (EIA)

The next step is to study the potential impacts on the environment of the proposed development, and how they could be avoided or reduced. The method used for this is known as the Environment Impact Assessment (EIA).

EIA is a procedure to forecast and assess the environment implications of proposed developments. It provides the opportunity for:

- **Identification and accounting for direct and indirect[1] environment impacts before a decision is made as to whether the proposed development is to proceed as planned;**
- **Modification of development proposals in order to avoid and reduce the potential environment impacts.**

EIA is about identifying environment impact, that is the change in environment conditions that will be induced by the proposed development. This change is compared with the environment situation as it would be if the development did not occur. The natural environment is not static: there are different processes and rates of change in all ecosystems, and assumptions must be made as to the natural changes of the site. For example, in an EIA of a beach resort, it would be necessary to study the rate of natural change of the shoreline, the ecological succession of the coastal vegetation, patterns of erosion and deposit, etc. In contrast, in an EIA for a visitor centre on a rocky cliff, generally a far less dynamic ecosystem than a coastline, a description of the present state of the environment may be sufficient.

The EIA Process

The main stages of the fully-fledged EIA process are:

1. **Screening: Establishing the need for an EIA.**

2. **Scoping: Determining the scope of the EIA.**

[1] An EIA asseses both direct and indirect impacts of a proposed project. For example, when building a beach resort, the clearing of costal vegetation on the immediate hinterland can have direct impacts on the beach ecosystems. It can change the natural patterns of deposit and erosion, and increase the silting of shallow waters. This may in turn increase silting in nearby lagoons and estuaries that will reduce the growth of fish and shellfish. An indirect impact of the proposed development could therefore be the losses encountered by the local coastal fisheries industry.

3. Conducting the EIA, which includes:
- Identifying direct impacts;
- Forecasting indirect impacts;
- Assessing the significance of direct and indirect impacts;
- Identifying measures to avoid and reduce impacts;
- Outlining strategies to monitor the success of impact avoidance and reduction measures.

4. Preparing the environment impact statement, which reports on the findings and recommendations of the EIA.

5. The environment impact statement is submitted together with the overall building application to the building authorising agency for review and approval. Simultaneously, the environment impact statement is also:
- Subject to external checks by experts commissioned by the authorising agency;
- Made available for public consultation.

6. The environment impact statement is finalised on the basis of the outcome of point 5.

7. The final version of the environment impact statement is then re-reviewed by the authorising agency.

8. The development application is approved or rejected.

9. If the application is approved, environment impact avoidance and reduction measures are implemented and monitored during specification and construction.

10. Periodic environment impact audits are conducted to verify that impacts are being minimised as planned.

Most countries require the developer to conduct the EIA and submit the environment impact statement as part of the overall application for building authorisation. Questions arise as to how objective the EIA will be if it is conducted by the developer, who will have every interest in ensuring that the proposal is authorised. The issue is that if external experts or the authorising agency conducted the EIA, it would remove the EIA process from the conception and formulation of the project. But since it is unrealistic to expect the developer to be completely objective, an external review is required to ensure that the environment impact statement does not become a means to obtain authorisation by presenting only the positive findings.

Common Question *What is public consultation?*

Development proposals cannot fully succeed if those who are most likely to be affected by them do not support them. Following the principle of public participation, discussed in Unit 3, public consultation means that all interest groups, local communities, environment groups, non-government organisations, etc can review the environment impact statement and officially record their comments.

For tourism, public consultation is perhaps the most critical component of the EIA process. Local communities and businesses are an integral part of the tourism experience. They are also likely to know the local environment better than the developer or the authorising agency. Co-operating with them may greatly facilitate forecasting impacts and selecting measures to mitigate them. It is therefore useful to involve the local public and learn about their concerns as early as possible. Some concerns may well be ill-founded but, if not identified at the start, they could present serious and expensive difficulties later on.

The procedures for public consultation (sometimes called public participation) differ from country to country. National legislation on EIA should be consulted for further information.

Conducting an EIA

An EIA can be conducted through a range of methods, including:

- **IMPACT CHECKLISTS:**

  The simplest approach. The disadvantage is that checklists must be exhaustive to ensure that no impact is overlooked, and an exhaustive checklist with 45-50 sub-categories can be cumbersome to work with.
- **NETWORK AND SYSTEM FLOW DIAGRAMS:**

  Useful for revealing indirect impacts, and those that can occur through more than one pathway.
- **IMPACT MATRIXES:**

  One is the commonly used 'Leopold Matrix', designed to identify around 8,800 impacts, although only 25-30 would apply to any one project.
- **THE 'QUANTITATIVE INDEX METHOD':**

  Involves the weighting, standardising and aggregating of impacts to obtain a composite score index of positive and negative impacts. Long-term irreversible impacts are given a greater weighting coefficient than short-term reversible ones.
- **Other pluri-disciplinary approaches involving geographical information systems, mathematical and computer models, pollution studies and land suitability analysis.**

Quick-Track EIA

For smaller-scale projects the 'conventional' EIA process is often condensed. This so-called 'Quick-Track' EIA is conducted using currently available information and uses checklist methodologies with some input from impact matrixes and simple network flow diagrams. Quick-Track EIA also makes substantial reference to carrying capacity studies. In the case of tourism, carrying capacity studies are a prerequisite for Quick-Track EIA.

SECTION 2

Good Practice Tips

- *EIA is a combination of science and judgement: it is all about asking the 'right' questions;*
- *Asking the right questions requires a good understanding of the natural environment;*
- *Public consultation can be invaluable to bridge the gap between science and judgement.*

2.4 Building Placement

Once the site has been selected and ways to minimise environment impacts have been identified, the developer needs to determine where on the site the buildings should be placed:

- **They should be placed on the ecologically and culturally least interesting part of the site;**
- **They can be placed and oriented according to annual sun cycles and shadow patterns from surrounding buildings, to optimise passive solar design potential;**
- **They can be placed to maximise aesthetic views, but still provide privacy and security;**
- **Placing should take advantage of natural land formations. For example:**

  - Existing trees might be used to provide cooling and reduce solar gain in summer and increase it in winter;

  - The building might be terraced to suit natural grading patterns, rather than having the site flattened and levelled; an earth berm can be a valuable buffer against winds and facilitate passive solar design.

The sustainable design of buildings will be discussed under three broad, interdependent areas:

3.1 Architectural features

3.2 The 'building shell'

3.3 Providing for the use of resource-efficient technology, fittings and appliances during occupation

3.1 Architectural Features of Buildings

3.1.1 Passive Solar Design

Passive solar design means designing a building to take the best advantage of natural sunlight and airflow in order to create a comfortable, energy-efficient indoor environment. The idea is to plan the shape, interior, and layout of the building around the sun's daily and seasonal cycles. Passive solar techniques that collect, move, and store or reduce light and heat through natural heat-transfer mechanisms like conduction and convection are not new, and have been used in vernacular architectural techniques all over the world.

Building Orientation

In cold climates, it is important to maximise heat gain. A building should be elongated on its east-west axis, with glazing and the areas needing the most heating facing south when in the Northern hemisphere, and facing north when in the Southern hemisphere. Areas that need less heating can be located on the other side. Overshadowing from surrounding buildings should be avoided to benefit from mid-winter sunshine.

In hot climates, the goal is to reduce heat gain and increase airflow and cooling. The building should be elongated on an axis perpendicular to prevailing wind. Cross-ventilation can be maximised through the alignment of doors and windows. U-shaped buildings and interior courtyards greatly facilitate air movement. Broad-leaf trees provide shading and reduce solar gain, as well as improving air quality and aesthetics.

In temperate climes, solar gain needs be reduced in summer and increased in winter. An east-west elongated, rectangular building, with well-calculated roof overhangings (based on latitude, sun patterns, and climate) is the most suitable.

Note: Inexpert passive solar design can make a building too hot or too cold, which can result in significant energy waste.

Direct Gain

Direct gain means allowing sunlight to penetrate a building to provide light and heat. The most essential requirement for direct gain is that the building be sufficiently 'thermally massive' to provide storage and to avoid overheating in the summer. If the building is thermally lightweight, the internal temperature will rise too high and the sunlight will be will be more of a nuisance than a gain.

For example, it takes more time for heat to move through brick than fibreboard. So a brick house with more thermal mass will yield more moderate changes in indoor temperature compared to the outside air, thus remaining cooler during the daytime and warmer at night, than a lightweight structure of fibreboard, which heats up and cools down more quickly.

Thermal mass materials have the ability to conduct, store and release energy back into the living space when it is needed. Ideal mass materials for floors and walls include clay, adobe, concrete, brick, and rock. The ideal thickness for mass materials is 10-12cm.

Heat always moves from a point of high temperature to a point of low temperature. During winter, sunlight first heats up the air. Since the mass floors and walls are cooler, the heat is absorbed and conducted into these materials. Later, when the sun has set and the room air temperature falls, the mass materials will be warmer than the room air temperature and stored heat will return to the room.

During warmer periods it is important to reduce heat gain and increase ventilation. This can be done by employing various techniques such as:

- **Installing insulating curtains, moveable insulation , shutters and curtains in glass areas;**
- **Landscaping with deciduous trees and vegetation to provide shading**
- **Using light coloured low mass constructions such as ceilings and partition walls;**
- **Installing overhangings on the south or north side (according to latitudes).**

3.1.2 Daylighting

Daylighting is a combination of energy conservation and passive solar design. It means making the best use of natural daylight to illuminate interiors. While all forms of vernacular architecture incorporate daylighting, most modern office buildings are deep-planned and rely heavily on electricity which can account for 30-40% of total delivered energy used. Although in winter heat from artificial lighting can contribute towards space heating, in summer it can cause overheating and increase the demand for air conditioning.

Traditional daylighting techniques include:

- **Shallow plan design which allows light to penetrate all rooms and corridors;**
- **Light wells in the centre of the building;**
- **Roof lights;**
- **Courtyards;**
- **Tall windows which allow light to penetrate deep inside rooms;**
- **The use of task lighting directly over the workplace instead of lighting the entire interior;**
- **Deep window reveals and light room surfaces to decrease glare.**

Modern variants on these include:

- **Glass panels;**
- **Steerable mirrors and light shelves, which are reflective, horizontal shelves fixed along the inside or outside of windows, either along the windowsill or at the top. They reflect light inwards and upwards, enabling it to reach further inside the building;**
- **Optical fibres;**
- **Light monitors and light reflectors which can be used to operate skylights and window shades to increase or decrease the quantity of daylight entering the building.**

Admittedly, deep plan office buildings are advantageous in that they have a smaller surface area per unit volume than shallow-planed buildings and therefore require less energy to heat. Is this worth the sacrifice for the absence of daylight? There is no correct answer - compromises based on location specific conditions will have to be made.

It should also be noted that inexpert day lighting will increase glare or gloom. When artificial lighting is needed, however, it should be turned off when adequate natural light is available. Automatic lighting control systems can be extremely cost-effective and reduce lighting-related energy costs by over 50%.

Greenhouses, Conservatories and Atria

Incorporating greenhouses, conservatories and atria on the south side of buildings when in the Northern hemisphere, and on the north side of buildings when in the Southern hemisphere can provide a habitable solar collector space, as the heated air will be carried over to the building. The building itself acts as an energy store.

Adding such features to existing buildings can be expensive and difficult to justify in terms of energy savings alone. Rather, they should be incorporated as additional areas of unheated habitable space as these they only bring energy savings if they are unheated. In new buildings, however, they can be incorporated into the initial design at a significantly lower cost.

Trombe Walls

Named after their inventor Felix Trombe, Trombe walls consist of a glazing-encased thin airspace in front of a thermally massive wall. Sunlight first warms the air space and this heat is absorbed and conducted into the thermally massive wall. The heat in the wall is then radiated into the cooler building behind. Trombe wall are sometimes called ‘storage walls’, as they work as solar collectors with thermal storage areas immediately behind.

Trombe Walls should be built on the angle of maximum solar exposure. They work best in sunnier climates. Since a larger part of the building needs to be hidden from the sun behind the thermally massive wall, careful design is needed to make sure that direct heat and daylight gains are not blocked out.

Windows and Vents

Windows and vents can be used in combination with insulation and direct gain to direct natural ventilation, heating and cooling as required.

Examples of Good Practice

An example of the use of passive solar in a large commercial building is the 250,000 square foot Codex World Headquarters building in Canton, Massachusetts, USA:

- **The building is lit by natural daylight year round, through a range of passive daylighting devices including the extensive use of windows and skylights, as well as a high central garden with a large glass roof supported by slender white columns.**
- **The garden is landscaped with date palms and fig creepers, all drought-resistant plant varieties.**
- **The garden provides natural light to the office floors that are served by windows opening to the garden on three sides.**

In Santa Fe, New Mexico, a series of 'solar clay' homes demonstrate passive solar design principles for the region's mix of hot summer days, cool nights and cold winters.

- **All public rooms, including the dining/kitchen area, have at least one window and sometimes a door leading to a greenhouse. In winter, the windows are opened to allow the heated greenhouse air to circulate through the house.**
- **The concrete-block and clay walls between the greenhouse and the house can prolong the sun's radiated heat for up to five overcast winter days (a rare occurrence). Since by natural convection hot air rises and cool air sinks, the greenhouse is placed lower. The heated greenhouse air circulates through the house, falling as it cools. Solar engineers refer to this natural movement as a 'thermosiphon'. No fan or other mechanical device is needed.**
- **In summer, the greenhouse is isolated from the house, and is shaded and vented to keep it cool. On summer nights, windows to the house are opened.**
- **A solar water-heater on the south face of the greenhouse provides hot water.**
- **The house requires no back-up heating.**

3.1.3 Renewable Energy Use

Renewable energy is energy that can be produced at the same rate as or faster than it is consumed. It therefore does not contribute towards the depletion of natural resources. It also avoids carbon dioxide and other greenhouse-gas emissions. Renewable energy sources include solar, hydro, wind, bio-fuels and geothermal energy.

'Renewables technology' has gained much ground in the last ten years:

- **There have been significant improvements in the efficiency of renewable-energy technology;**
- **Related capital costs have dropped;**

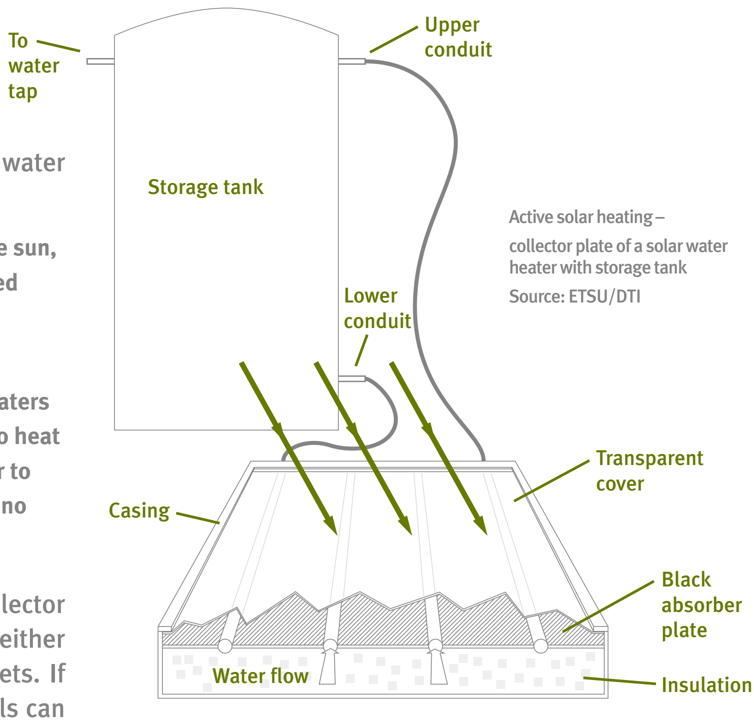
- **The deregulation of energy markets gives renewables open access to national electricity grids. Power companies are offering businesses and homes the choice of using 'green' electricity generated from renewables;**
- **Equipment and appliances are becoming ever more energy-efficient. This makes the use of renewable energy increasingly feasible;**
- **Concerns about air quality, global warming and climate change provide added impetus to reducing both our dependence on fossil fuels and greenhouse-gas emissions. This is increasing the focus on renewable energy sources.**

Many governments and power companies provide loans, grants and subsidies to promote the use of renewable energy. For tourism and hospitality businesses in rural areas, including those more than a kilometre away from the national grid, renewable energy is usually a good cost-efficient alternative, especially in view of the financial and environment costs of extending the grid.

Solar Water-Heating

Solar water-heating is well established as a cost-effective and sustainable energy source for hot water supply. The technology consists of:

- **A collector surface heated by the sun, over which the water to be heated passes;**
- **A heat-transfer medium;**
- **A storage tankback-up water heaters to meet peak demand periods, to heat water to higher temperatures, or to provide hot water when there is no sun.**



Active solar heating – collector plate of a solar water heater with storage tank
Source: ETSU/DTI

To optimise exposure to sunlight, collector panels are usually put on the roof, either flush on the surface or up on brackets. If roof space is not available, the panels can also be installed at ground level, with the disadvantage that if the building is more than one storey high, the hot water will have to be pumped to higher levels, using additional energy (e.g. an electric pump).

For best performance, collector plates should face north when in the southern hemisphere and south when in the northern hemisphere. They should be inclined at an angle from the horizontal equal to the latitude, although this may vary with latitude. The most efficient systems include collector panels with special coatings which absorb direct solar radiation (visible light) and radiate little direct heat (infrared radiation) back into the surrounding air. This enables the collector to reach much higher temperatures, meaning smaller collectors to heat larger amounts of water, which in turn can greatly reduce the space required.

In colder climates, it is necessary to have a freeze protection on the panels to prevent damage from the expansion of water in the collector pipes. Anti-freeze solar technology includes cells with anti-freeze liquid, panels fitted with small electric heaters, or anti-freeze valves.

Experience in Australia, the Mediterranean and the Caribbean show that the payback period for solar water heaters is usually 2-5 years. An important consideration is the price of the fuel-powered backup water heaters. Solar water heating systems are generally guaranteed for 10 years.

Examples of Good Practice

A solar thermal water-heating system provides St. Rose Hospital in San Antonio, Texas with up to 90% of its hot water needs, by using 5,000 square feet of flat-plate solar collectors. The system can hold 9,000 gallons of heated water at once. It is estimated to save the hospital close to $17,000 a year compared to the alternative of using a steam boiler fired by fuel oil.

The residents of a 20-storey condominium in Honolulu, Hawaii opted in 1984 to use solar energy to provide hot water because of the high price of oil. The system uses some fifty 48-square-inch flat-plate collectors to meet 70% of the hot water needs of the building.

At the Youth Club in Hilo, Hawaii, 54 flat-plate 4-by-10-inch collectors covering the south roof of the building maintain the water in the swimming pool at 80°F. This is the largest system of its kind on the island. The system also supplies hot water to the locker-room showers.

Photovoltaics (PV)

As the name suggests, photovoltaic cells convert light into electricity. They are made of a semi-conductor material, typically crystalline silicon[2], formed into thin wafers or ribbons. One side of the cell has a positive charge, the other side a negative. When sunlight hits the cell, the electrons on the positive side activate those on the negative side to produce an electric current.

PV cells are electrically connected to each other, packaged in a transparent cover (usually glass or plastic), and encased in a watertight seal to form a panel or module. The panels are wired together to form a larger array, the size of which will depend on the power requirements of the user.

PV can be used as a stand-alone system or a grid interface system. A stand-alone system consists of:

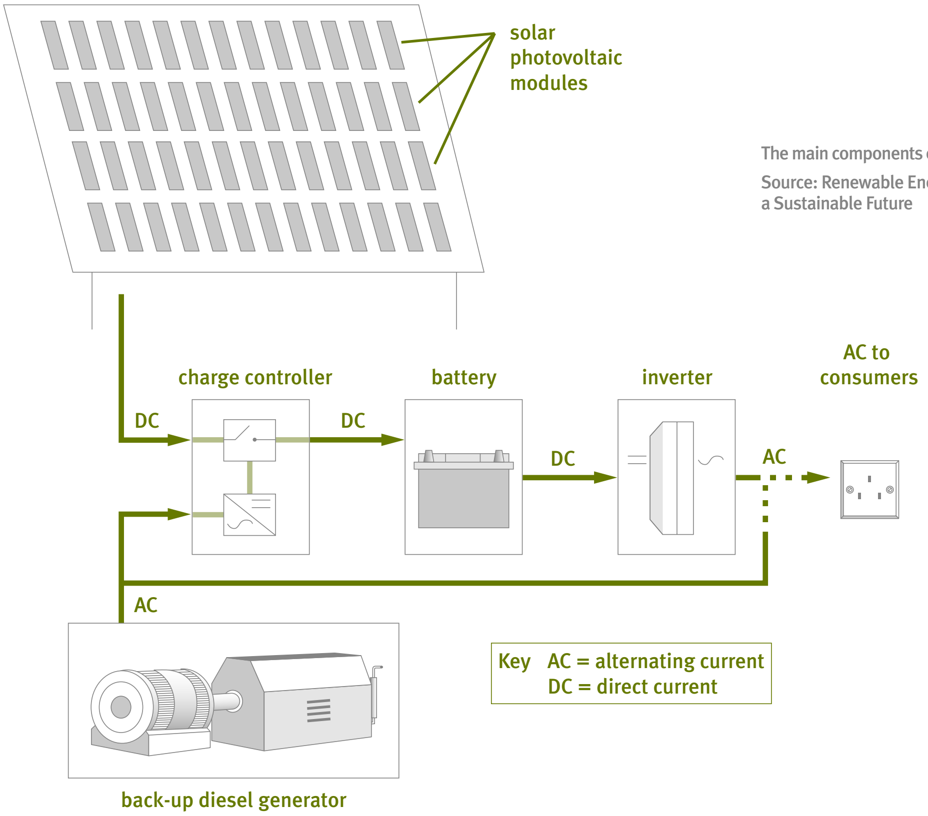
- **PV array;**
- **Structure to mount the array;**
- **Batteries to store power;**
- **Converter to turn the stored direct current (DC) into alternating current (AC) - most household appliances work on AC;**
- **Electric cables that enable electricity to move between cells, batteries and usage points;**
- **Backup diesel generators to ensure a reliable supply of energy when there is no sunlight.**

Grid interface systems do not store energy. Instead they supply PV-generated power to the grid when excess power is being produced (i.e. when the sun is shining), and use power from the grid when no energy is being produced. The interface between the PV system and the grid can be metered in such a way that when power is being supplied to the grid the meter will run backwards. When power is drawn from the grid, the meter will move forward in the usual manner.

[2] Other types of semiconductor materials such as amorphous silicon and cadmium telluride may also be used.

Mounting PV Cells

PV only works when the sun is shining, so optimal exposure is crucial. The panels should face north when in the southern hemisphere and south when in the northern hemisphere, at about the angle of the latitude. The minimum angle is 20° from the north horizon (this will also enable the panels to be cleaned when it rains). For large installations it may be wise to invest in a tracker, which will move the panels according to sun patterns throughout the day.



The main components of the PV system

Source: Renewable Energy: Power for a Sustainable Future

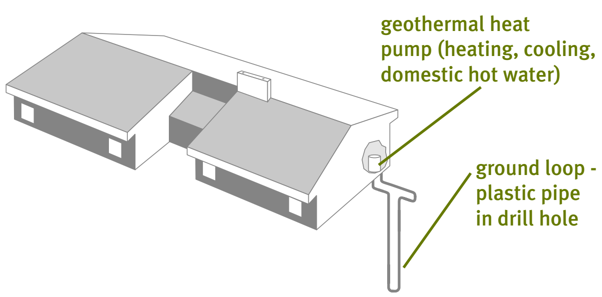
> ### Example of Good Practice
>
> *On Coconut Island, near Australia, the only electricity available to the 135 inhabitants came from diesel generators scattered throughout the community. But since 1987 a hybrid PV-diesel generating system has provided power at a level of quality and availability that rivals or exceeds that on the mainland.*

Geothermal Heat Pumps

The Earth absorbs almost 50% of all solar energy, and maintains relatively cinstant temperatures of 50°F to 70°F depending on geographic location. GHP work by using the earth's interior as a heat resource in the winter and a heat sink in the summer. The pumps are located inside the building, with its essential components - sealed plastic pipes - installed vertically in boreholes (30-100m deep) or horizontally in trenches, in which water or a refrigerant solution circulates. In winter, the heat pump extracts heat from the hot water or steam in the interior of the earth, brings it up through the water or antifreeze liquid that circulates inside the plastic pipes sunk in the ground, and transfers it inside the building. In summer, the pumps move heat from the building into the earth. The same plastic loop is used as in winter, but the direction of flow is reversed. This technology takes advantage of the fact that the temperature in the ground varies less with the seasons than does the temperature of the atmosphere.

As geothermal heat pumps use electricity to move heat and not generate it, they are extremely efficient and generate three to four times the amount of energy they consume. Buildings using this technology have lowered heating/cooling-related electricity consumption by 50-80%.

Geothermal resources with temperatures as high as 648°F can be used to heat water as well as produce electricity. Large resources can be used to produce district heating. In Iceland for example, the entire city of Reykjavik is heated by geothermal energy. The USA, Switzerland, Austria, Germany, Sweden and Canada are pioneers in geothermal technology. Many hotels in these countries operate individual geothermal wells, and even use them to melt ice on driveways. In Sweden, the construction of two nuclear power plants has been abandoned in favour of geothermal technology.



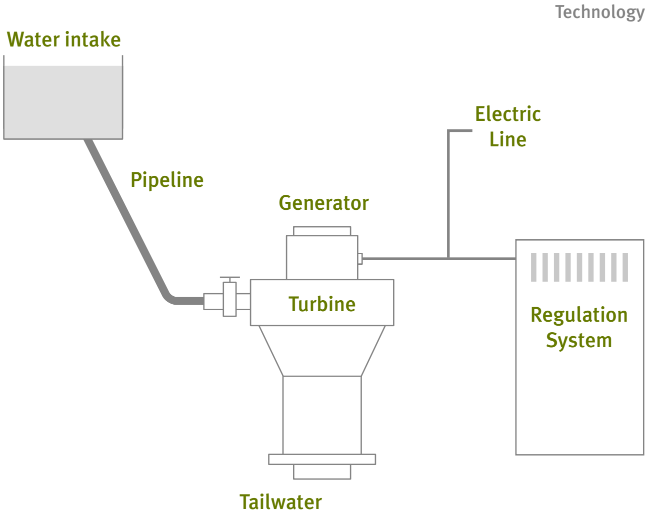
The geothermal heat pump (GHP) concept used to extract heat from the ground to supply a building. In the winter heat is removed from the earth and delivered in a concentrated form via the heat pump. Because electricity is used, in effect, to increase the temperature of the heat, not to produce it, the GHP can deliver three to four times more energy than it consumes.

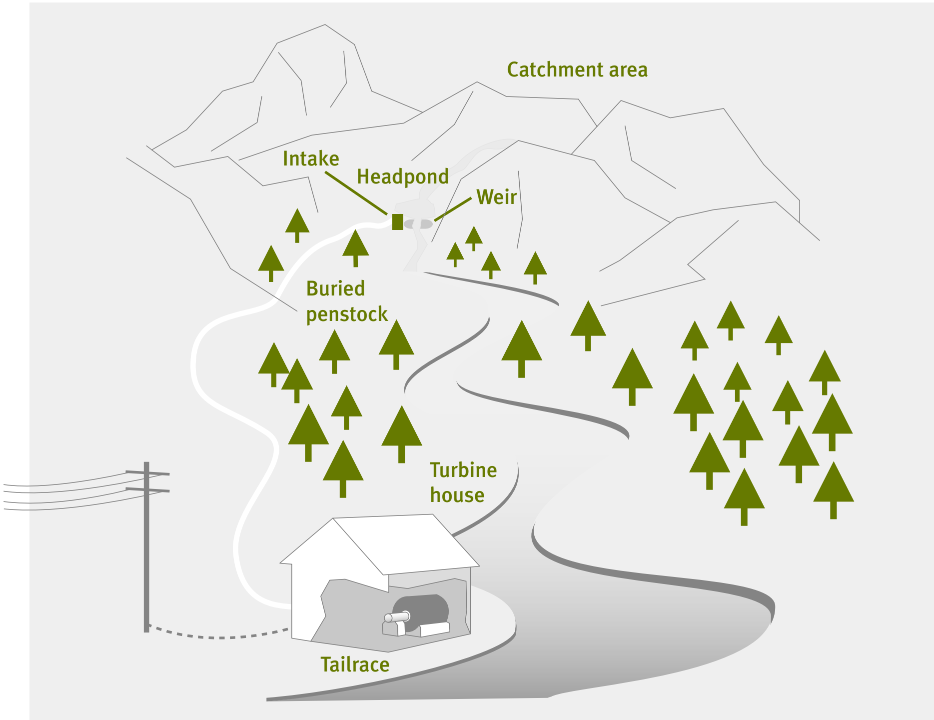
Source: Renewable Energy

Small Hydro Power Systems

Ecowatt micro hydro-electric system

Source: Working Group on Technology





How a small-scale hydro system works
Source: EDSU/DTI

Water flows from high to low points by the force of gravity. There is energy embodied in this flow of water, which hydroelectric power systems capture to produce electricity. Small hydropower systems produce less than 20 megawatts of electricity, while micro-hydro systems typically generate less than one megawatt of electricity. This technology is best used in tourism facilities in mountainous regions where gradient rivers and streams provide a continuous source of flowing water.

The components of small hydro systems are the:

- **Dam or weir to block the flow of water in a stream and create a reservoir;**
- **Feeder canal to allow water to flow from the source stream into the reservoir;**
- **Reservoir, which holds the water between the feeder canal and the intake pipe;**
- **Intake pipe connecting the reservoir and the powerhouse;**
- **Powerhouse, which houses the turbine and other power producing and controlling equipment;**
- **Outflow canal, which allows water to flow from the powerhouse and back into the source stream.**

Hydro-electricity is generated by water entering the intake at a higher level, and falling through a pipeline onto blades/buckets of a turbine located lower. The water (with most of its energy removed) then flows away from the turbine and is returned to the source stream.

The power available from flowing water depends on the:

- **Vertical distance over which the water 'falls';**
- **Volumes of water flow;**
- **Pressure of the water entering the power plant via the inset pipe;**
- **Efficiency of the turbine and generator equipment.**

The basic small hydropower equation therefore is:

Power (kilowatts) = 10 x flow (m3) x fall (m) x turbine efficiency

Friction losses can be accounted for by decreasing the fall variable by an appropriate amount.

In terms of design, small-scale hydro systems can be run-of-the-river or water storage developments. As the name implies, run-of-the-river developments use water that is available in the natural flow of the waterway, and does not involve water storage lakes or flooding. The power output, therefore, fluctuates with the availability of water, and during dry seasons power production may have to cease altogether. A dam or weir may, however, still be required if the waterway needs to be diverted, especially if the diversion is to take advantage of existing downward gradients in the waterway.

Water storage developments involve the construction of dams or weirs to divert water, as well as the construction of new reservoirs or ponds to store water. The benefit of such systems is that they can generate electricity on demand.

Good Practice Tip

Except in very remote areas where the price of energy is high, creating lakes and reservoirs will be too costly (both in economic and environmental terms) for most small-scale hydro developments.

The drawbacks are significant environment impacts. The construction of dams, weirs and canals alters the nature of streams and causes erosion, while the diversion of water into the turbine affects volume and flow of water downstream.

Run-of-the-river-system plants offer some possibilities of minimising impacts. As the system uses the embodied power in the river water as it flows through the plant without causing appreciable changes in the river flow.

Example of Good Practice

A micro-hydropower system provides reliable electricity supply while being economically compatible with the location of the Lemonthyme Lodge, between the Lemonthyme Valley and Cradle Mountain in the forest above Lake Cethana, in Northwest Tasmania.

The complex has an open living area, a restaurant, conference facilities, 18 self-contained cabins, a craft shop, guest and staff laundries, and staff accommodation.

Water from a stream which passes close to the Lodge enters an intake pipe and flows down a steel pipeline, falling over 200m to attain the water pressure necessary to run the 52-kilowatt turbine. The turbine, located near the Lodge, provides electricity 24 hours a day for lighting, refrigeration and some heating.

The total power requirement of all lighting is approximately 6 kilowatts with an average of 70 lights on during the evening. The system also supplies the Lodge with drinking water and serves as a fire-fighting facility.

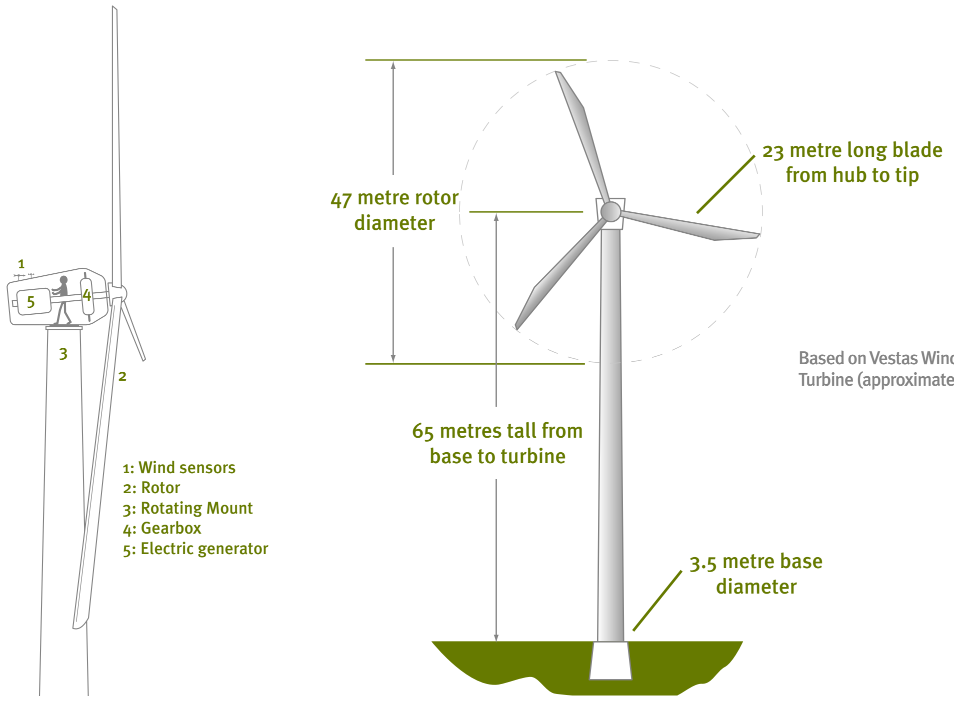
The micro-hydro system was selected because the closest power lines were about 2km away through forest and the connection costs would have been over A$40,000. In addition, the two options for grid connection would have caused major impacts on the landscape. The shortest and cheapest option, from the grid through the forest to the Lodge, would have had the greatest environment and aesthetic impact, as it required repeated clearing under the power lines. Following the road would have had the least impact, but increased connection costs due to the greater distance. A diesel generator was considered but was rejected as the potential noise and emissions from its operation were incompatible with the wilderness experience.

The 'essential ingredients' for the successful installation and operation of the system include:

- **The possibility of collecting water in the intake pipe;**
- **Suitable fall: the water effectively falls the net equivalent of 142m with a flow rate of 46 litres per second;**
- **Turbine location at the Lodge, where it provides a rated maximum of 52 kw of power and operates at around 48 kw capacity. The noise level immediately outside the turbine is low, and is inaudible at short distances.**

The cost of the micro-hydro system was A$130,000.

Wind



Based on Vestas Wind Systems A/S, Wind Turbine (approximate dimensions).

Wind is air in motion, caused by the uneven heating of the earth's surface. Wind turbines capture the solar energy stored in the wind and convert it into electricity. They can be used as remote power systems or as grid-connected applications.

The basic components of a wind system are:

- **THE BLADES OR ROTORS**

  Blades are required to 'catch' the wind. When the wind blows against the blades, they change the horizontal movement of the air into a rotational force which turns a shaft. The generator then turns this movement into electricity. There are many blade designs and sizes; the largest blades used today are over 50m long.

- **THE GENERATOR**

  The generator turns the mechanical energy into electrical energy. In some countries, the generator and the gearbox are referred to as 'drive train equipment'.

- **THE TOWER**

  The tower is needed to lift the turbine so that it can take advantage of the stronger and more consistent winds which blow higher up. The optimum height is 60m where 'free-standing' winds blow at maximum speed. Height consideration however will differ according to the power rating of the turbine and the surrounding topography.

- **BATTERIES AND BACKUP POWER SYSTEMS:**

  These are critical for remote systems to ensure a continued power supply whatever the variations in wind speed. Backup systems can be either diesel generators or PV arrays.

Wind Power Evaluation

Evaluating the feasibility of wind applications is not simple. A few initial considerations are given below:

- **WIND FLOW**

  For maximum efficiency, the wind flow should be reasonably constant and smooth. Turbines are best sited in windy locations with level ground, away from obstructions such as buildings, trees and mountains. Ideal sites for wind turbines are flat open plains, mountain passes and coastlines. Steep slopes and urban areas are not suitable, as obstructions such as mountains and buildings may cause winds that are too strong or turbulent for energy generation.

- **WIND SPEED**

  The energy available in the wind is proportionate to the cube of its speed, which means that the doubling of the wind speed will increase the availability of energy by a factor of eight.

  Wind turbines have a minimum speed at which they begin to rotate and generate electricity, called the 'cut-in' speed. The power production increases as the wind gets stronger and the blades rotate faster, and levels off when the system reaches maximum efficiency. Some of the increasing power will not be captured owing to design constraints.

  Grid connection applications require a minimum cut-in wind speed of 5 metres a second (18kph), while remote systems require a minimum speed of 3-4 metres a second (11-15kph).

  The cut-out wind speed is the speed at which the turbine will shut down to prevent self-destruction of the blades, gearbox and generator.

- **CAPACITY FACTOR**

  This refers to the expected energy output of a wind turbine per year.

$$\text{Capacity Factor} = \frac{\text{Actual energy produced}}{\text{Energy produced if the turbine operates at 'rated power output'}}$$

The ‘rated power output’ is the maximum amount of power that can be produced from a turbine. A reasonable capacity factor would be 0.25 to 0.3. A very good capacity factor would be 0.4. It is important to note that the capacity factor depends entirely on wind speed.

- BLADE AIRFOIL SHAPE AND DIAMETER

  The best rough estimate of a wind turbine’s energy production capability is the diameter of the blade, which determines the area ‘swept’ or ‘captured’. The turbine may have a good rated power, but if its blade diameter is too small, it will not be able to capture that power until wind speed increases, and little or no power will be produced during moderate winds. Blade foil shapes are primary factors in determining power production at moderate wind speeds.

- BATTERY BANKS

  Battery banks must be housed in a dry, warm and well-ventilated area and be well maintained to allow maximum efficiency. Anti-freeze and anti-boiling liquids may be required for batteries in extreme temperatures.

Examples of Good Practice

At the New Haven Residential Village, 20 km north west of Adelaide, Australia, wind turbines were installed to reduce the diesel fuel consumed by the power station by 10% or 360,000 litres a year. This represented a reduction of greenhouse-gas emissions of 1,000 tonnes a year.

The wind turbines performed better than expected. After ten months of operation they produced 1.276 gigawatt-hours, which was the figure expected for twelve months. The system consists of two 225-kilowatt turbines, and monitoring devices. The turbines start to generate power at a wind speed of 3 metres a second (11kph). Optimum performance is 22 metres a second (80kph), and if wind speed exceeds 45 metres a second (160kph), the turbines automatically shut down.

The Yumi-Ha Village Resort, South of Cancun, Mexico, operates on wind and PV-generated power and treats its sewage at an on-site treatment plant. The cabana cabins and bar-restaurant palagas are designed using traditional Mayan village building techniques – open plans, stone walls, and wood framing,

The Cousteau’s Fiji Island Resort, a 20-room hotel on Vanua Levu, the second largest island of Fiji, operates at night on PV and wind-generated power with battery storage.

Bio-fuels

Bio-fuels include a wide range of energy resources derived from biomass – all the earth’s living matter and the many products and by-products that are derived from it. The main sources of bio-fuels are:

- Energy crops such a copping plantations and rapeseed for the extraction of rape seed oil;
- Crop residues such as rice husks and straw;

- Crop wastes such as potato and beetroot tops;
- Animal agricultural waste, such as slurry and dung;
- Household waste;
- Industrial waste.

The most widely used bio-fuels are discussed below:

- STRAW AND CORN WASTE

  Straw and corn waste burning systems can be used for cooking and space and water heating. The only processing required is drying and shredding the waste. It is critical that the waste is dried, as burning wet plant residues releases nitrous oxide - a major contributor to acid rain.

  In some countries these wastes are available as dried, shredded and compressed briquettes, which offer the added advantages of being easier to package, transport, and use, especially in smaller domestic heating systems.

  As wet waste, straw and corn residues can also be digested to produce biogas.

- NURSERY, GARDEN AND KITCHEN WASTE, DAMAGED AND SURPLUS FOOD

  These wet wastes are good fuels for digestion and biogas production. They are an interesting fuel option for tourism, as kitchen and garden wastes can make up almost half the volume of a business' waste output. Note: Many hospitality businesses compost kitchen and garden waste and use the resulting residue as fertiliser.

- RICE HUSKS

  Rice is the staple diet of vast number of countries and rice husks account for over 1/5 of the dry weight of un-milled rice. Husks can be dried and burnt in stoves for cooking or space and water heating. Rice husk stoves are widely used in small and medium-sized tourism business in Mali, China, Indonesia and India.

- SLURRY

  Slurry (a mixture of animal bedding, urine, faeces and water) is an excellent fuel for anaerobic digestion as it is wet and rich in nutrients. However, as slurry is wet, contains a lot of liquid, and carries a strong and unpleasant odour, it is difficult to collect, transport and handle. If not managed carefully, slurry can run into surface water bodies and percolate into aquifers where the groundwater table is high.

- POULTRY LITTER

  Poultry litter, unlike slurry, is a relatively dry waste and can therefore be burnt directly. The disadvantages with this fuel are, again, its unpleasant smell and the fact that it is usually available only in small quantities. Collection and direct burning systems can only be successful in large poultry farming areas.

- FOREST RESIDUES

  The large volumes of waste created when plantations are thinned and when the felled trees are trimmed can be dried and chipped for direct burning or be turned into charcoal. Wood chips can be directly burnt for cooking and space and water heating.

- **TIMBER PROCESSING WASTE**

  Sawdust and off-cuts can be burnt for space and water heating and cooking.

- **INCINERATION WITH ENERGY RECOVERY**

  Large-scale municipal waste incineration with heat recovery is becoming a valuable 'waste to energy' option for many countries. The heat generated by the incineration process is used for district heating to generate electricity. The residue ash is used in road building.

  The advantage of incineration is that it reduces the demand for landfill sites and landfill related environment issues. The disadvantages of incineration is that modern state-of-the-art incinerators are very expensive, and their operation needs to be very carefully managed to avoid harmful emissions of acids, metals, organic compounds and particles. Environment experts also oppose incineration as a sustainable waste and energy option, as it drives down the impetus and viability of recycling.

- **LANDFILL GAS**

  The anaerobic digestion of wastes in landfill sites generates landfill gas, which contains around 50% methane. This gas can be captured and used for heating and cooking.

- **REFUSE DRIVEN FUELS**

  Municipal waste such as paper and cardboard can be sorted, shredded, dried and formed into briquettes and pellets to be used for direct burning in stoves and boilers.

- **ENERGY CROPS**

  Energy crops are plantations that are grown specifically to be used as fuels. In environment terms they are attractive as they bring a net reduction in carbon dioxide emissions, offer an alternative to fossil fuels, and reduce dependence on fossil fuels. In industrialised countries, energy crops are also becoming an attractive alternative crop for surplus agricultural land.

  - Wood is certainly the most widely used energy crop. Alternative methods of forestry are now used to provide wood as a fuel source and combat deforestation in a singular effort.

  - Ethanol is produced through the fermentation of starch crops such as sugar cane, maize, sorghum, corn, cassava, sweet potatoes and wood. It used blended with gasoline to increase octane and improve the quality of combustion emissions. A few years ago, the most widely used ethanol bled was E10 (10% ethanol and 90% gasoline), though higher concentrations such as E85 (85% ethanol and 15% gasoline), and pure ethanol are now commercially viable

  Various plant oils, after being esterified - a chemical process through which the oils are combined with ethanol or methanol - result in bio diesel[3], which is blended with diesel in a similar manner that ethanol is blended with gasoline. Bio diesel is typically used as B20 and B30 (20% or 30% bio diesel and 80% or 70% diesel), although other blends can be used based on the type of combustion engine and the benefits desired. Rapeseed oil is the foremost plant oil grown for energy in Europe; the blend is usually referred to as 'rape methyl ester' or 'RME'. Similarly, soya bean and rapeseed are used in the USA, coconut oil in the Philippines, castor oil in Brazil and sunflower oil in South Africa

[3] Ethanol is an alcohol and bio diesel is an ester - similar to vinegar.

Examples of Good Practice

At the Sånga Säby Hotel, Study and Conference Centre, Svartsjö, Sweden, since early 1996 all vehicles and boilers have been powered with rapeseed oil. In addition, all gardening equipment operates on rapeseed oil, apart from one lawnmower that is solar-powered. The objective is to replace bio-fuels with renewable energy in the long term.

At the Central Romana Sugar Mill in the Dominican Republic, bagasse (the waste by-product left over after processing sugar-cane) is burnt in a large-scale cogeneration operation to produce more than 20 million watts of power for on-site energy needs and for nearby industries, hotels and residences.

3.1.4 Architectural Features to Reduce and Reuse Water

This sub-section will consider:

- **Collection and use of rainwater;**
- **Grey and black water (sewage) treatment and reuse;**
- **Composting toilets.**

Rainwater Collection

Rainwater from roofs, patios, driveways and other paved areas can be collected through a network of gutters and pipes and channelled into a cistern or a catchment basin. In larger buildings and areas where there is much rainfall, downspouts in gutters should be located every 20 feet (instead of the usual 40 feet) to ensure that they do not overflow. Catchment areas can be landscaped to look like ponds or marshes, which will increase the aesthetics of the landscaping effort.

Rainwater can be used for irrigation as well as a number of in-house uses such as washing and flushing, in evaporative cooling equipment and, after purification, in swimming pools.

Good Practice Tip

Rainwater can contain many forms of impurities, especially in areas where rainfall is not frequent. If it is used for purposes other than irrigation, the quality of the water may need to be monitored.

Grey Water Reuse

The first consideration is to distinguish between grey water and black water. In hotels, grey water is wastewater from bathrooms, laundries and kitchens; black water is wastewater from toilets. Black water contains pathogens and almost 10 times more nitrogen than grey water. It therefore needs to go through a two-or-three-stage biological treatment process before it can be reused. Grey water treatment is less intensive and can safely be conducted on-site. The treated water can be used for irrigation, toilet flushing and other non-drinking uses.

Over the last 10 years, a number of national water supply and plumbing regulations have been modified to accommodate the reuse of grey water. A suitable system is most easily incorporated into the initial design of properties, as separate drains and septic tanks have to be built. In the case of existing buildings, the feasibility and costs of retrofitting drainage systems and tanks within the existing structure must be studied closely. Lower water bills and effluent disposal charges will offset investments.

The level to which grey water needs to be treated will depend on the level of biological oxygen demand (BOD) of the wastewater and the purpose for which the water is to be reused. The level of BOD refers to n the level of oxygen extracted from the water by bacteria when the pollutants decompose. The more organic materials present in the wastewater, the higher the amount of oxygen needed to support the decomposition of the pollutants.

In most hospitality businesses, grey water is reused for irrigation or flushing toilets. In this case, passing the wastewater through a sand filter may be sufficient. To maximise the efficiency of sand filters, it is important to minimise the suspended solids in the wastewater. Bathroom and laundry outlets should therefore be fitted with filters and grease traps should be added to kitchen outlets. But if the grey water is to be used for drinking purposes, it must go through a complete biological treatment process.

Black Water or Sewage Treatment

Hospitality businesses, especially in remote areas, coastal regions and on small islands, are sometimes required by law to build sewage-treatment facilities.

Sewage is a mixture of suspended and dissolved organic matter. The strength of sewage effluent is described in terms of suspended solids (SS) and biochemical oxygen demand (BOD). Conventional sewage treatment is a 3-stage process: preliminary treatment, primary sedimentation and secondary (biological) treatment[4].

- **During preliminary treatment, the effluent is passed through large screens which filter out the larger floating particles and objects. This does not significantly reduce the pollution load of the effluent, but makes it easier to treat, as the large particles, which can block and damage equipment, have been removed.**
- **The next step is primary sedimentation. The effluent is piped into specially designed sedimentation tanks where the suspended solids are allowed to settle. The floating scum and the settled sludge is then removed. Over 55% of suspended solids are removed during primary sedimentation.**
- **The effluent goes through a secondary biological treatment process, which involves a reactor containing micro-organisms which oxidise the pollutants. The effluent is then pumped into a secondary sedimentation tank in which the micro-organisms are separated from the final effluent. The treated effluent is then discharged into a watercourse.**

The treatment of sewage sludge (from the primary sedimentation and secondary biological treatment process) is an integral part of sewage treatment. Sewage sludge has an offensive odour and is a health hazard as it contains bacteria and pathogens. It requires anaerobic digestion treatment during which the organic matter present in the sludge is converted into methane (70%) and carbon dioxide. Anaerobically digested sludge is often further de-watered in lagoons prior to disposal at sea or as fertiliser on land.

[4] Different terms may be used to describe the stages of wastewater treatment in different countries

Alternative Sewage Treatments

These systems are designed to mimic natural wetland ecosystems. The wastewater is passed through a series of plants and micro-organisms to remove solids, bacteria and pathogens present in the sewage. Traditionally such systems required a fair amount of land, but modern technology enables the wastewater to pass through a series of ponds and tanks where plants, invertebrates, fish and sunlight are used to clean it.

Examples of Good Practice

A successful wetland wastewater treatment system, the Splash Carnivore, has been constructed on the edge of Nairobi National Park, Kenya. The construction of the wetland was completed in mid-1994, and its performance has continuously improved with the biological maturity of the wetland.

The wastewater first passes into a settling pond where the solid particles are allowed to settle to the bottom. The water then passes through beds of gravel where bacteria and aquatic plants such as bulrushes, sedges and reeds act together to break down sewage. The water then passes through a series of terraced ponds where other plants further purify the water. The water is now clear and odourless and when it reaches the subsequent open ponds the sun's UV-C rays effectively eliminate remaining pathogens. The sewage nutrient-rich bacteria falls prey to small crustaceans. Green algae and the absorption of oxygen from the surrounding air also play important roles in purifying the water.

This mini-ecosystem is now attracting numerous species of birds and other aquatic wildlife.

The only maintenance required is to consistently clear away the excess vegetation, for vegetation falling and rotting in the waterways increases the nutrient levels in the water, and this interferes with the effectiveness of the natural water purification process. The removed vegetation is composted or laid on access footpaths to buffer the impact of foot traffic.

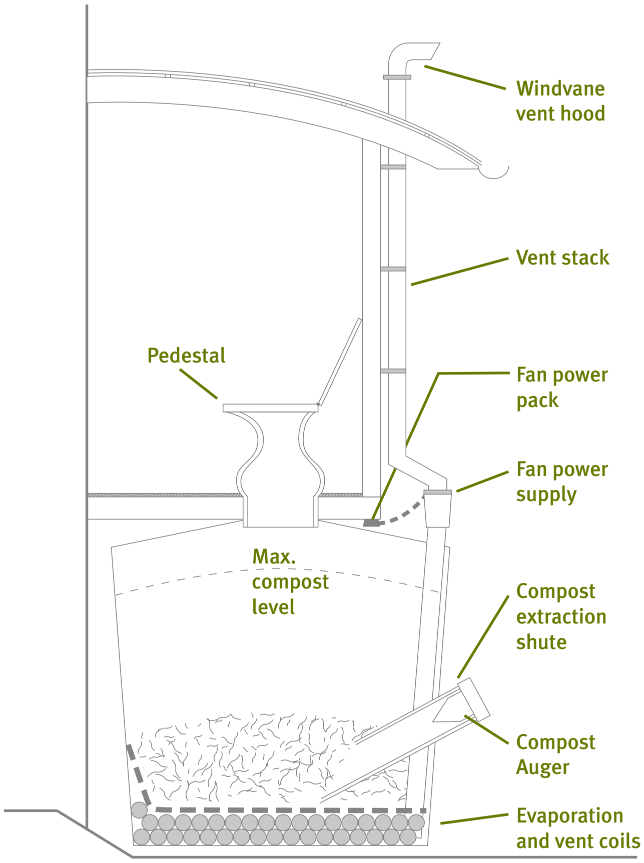
The Carnivore Restaurant actively participates in the project by channelling its wastewater to the wetland for treatment. At first, the high level of fat in the restaurant wastewater caused problems. This has now been rectified through the separate collection of waste oils and fats, the fitting of grease traps to the kitchen's wastewater outlets and the introduction of selectively bred bacteria in the gravel beds. The restaurant further ensures that all cleaning materials are free from phosphates and chlorine.

Composting Toilets

Composting toilets allow for the composting of waste in the toilet structure itself and do not require water for flushing. As with all composting practices, bulking material (hay, sawdust, wood shavings etc.) need to be added as regularly as the toilet is used to maintain the carbon and nitrogen balance, and the pile needs to be turned regularly. In cold climates, the toilet chamber needs to be insulated and heated.

The heat generated from the composting process causes the moisture from the waste to evaporate. Therefore the toilet needs to be aerated through a vent and/or mechanical aerator. If the pile is well maintained, no odours will arise.

In areas where water is scarce and water treatment is difficult, composting toilets can be an ideal alternative. Even when water is available, composting toilets will eliminate black water, which will greatly facilitate on-site wastewater treatment.



Composting Toilet
Source: A Guide to Innovative Technology for Sustainable Tourism

3.1.5 Landscaping

Landscaping greatly improves aesthetics, and can be used to increase and decrease heating and cooling loads, improve air quality, provide a 'sense of place', and keep the occupants 'in touch with nature'.

The need to air out buildings through the provision of open spaces is now widely accepted, but is all too rarely given consideration until the site has been cleared and the buildings erected. Sustainable design encourages developers to consider landscaping when the buildings are being designed, and to use the existing physical features of the site to enhance and improve the efficiency of sustainable design. For example, large deciduous trees can be used to reduce cooling loads in the summer and increase solar gain in the winter. Natural gradients can be used to facilitate the collection of rainwater and the landscaping of ponds, mini-wetlands and other features.

Landscaping checklist for tourism facilities:

- **Open spaces, gardens and outdoor swimming-pools should be considered as 'outdoor rooms'. They should be as comfortable and relaxing as the interiors.**
- **During building and excavation, preserve as much of the original vegetation as possible. Give special attention to mature trees that take years to grow and rare species that may be difficult to regenerate.**

- Select new plants that are native species and will blend in with the existing ecosystem.
- Design to promote the composting of kitchen and garden waste, dispensing with chemical fertilisers.
- Make provisions for edible landscaping. Vegetable plots and orchards can be interesting and innovative landscape features; produce can be offered on the menu (as seasonal or home-grown specialities) and used for preserves and marmalades.
- Experiment with permaculture, the growth of different types of fruit trees, vines and ground crops that support each other in a symbiotic manner.
- Water in the evening or morning to reduce evaporation. Where water is scarce, use drought-resistant plant species.
- Collect and use rainwater and grey water for irrigation.
- Resist the temptation to create lawns on parts of the site where the natural vegetation was destroyed. Preserving and restoring vegetation will add landscape features and provide for a series of small lawns that are less resource-intensive to maintain.

Xeriscaping®[5]

'Xeriscaping' means saving water through landscaping. It involves a range of techniques including soil improvement, plant selection and lawn areas that allow irrigation water requirements to be met by rainwater and natural water percolation in soils.

[5] Xeriscaping is a registered trademark of the National Xeriscaping Council Inc. of Austin, Texas, USA.

Some Xeriscaping tips:

- Plants with similar water requirements can be planted in groups or beds, and not scattered all over the area. This allows irrigation to be zoned according to the plants' needs.
- Slopes can be terraced to allow water to soak into the soil. Plants with the most water needs should be placed on gradients, which receive the most water. Raised beds should be avoided as they can dry out very quickly.
- Plants that need a lot of water can be placed near buildings where they can be supplemented with wastewater from vehicle washing, kitchens or run-off from paved areas.
- Stronger and more drought-tolerant plants should be exposed to prevailing winds: they will provide a buffer for more fragile species.

3.2 Environment Considerations for the 'Building Shell'

3.2.1 Windows

Windows can be used to enhance day lighting, control ventilation and humidity, provide pleasant views and make the building more attractive from the outside.

There has been great improvement in the design of windows. Among the latest innovations are the diverse models of triple-paned windows, usually made of argon or krypton glass. Some models have low emissivity coatings, which allow varying levels of natural light (short-wave radiation) to enter, and prevent heat (long- wave infra-red radiation) from entering and leaving. It is therefore possible to select window models based on the orientation of buildings as well as the lighting, heating and cooling loads required. Windows with integrated PV cells are also available.

Architects are working on varying the functions of windows through increasing use of skylights, vents, and glass roofing features, and on the innovative placement of windows in balance with interior and exterior doorways.

3.2.2 Insulation

Heat transfer through walls, floor and roof occurs through infiltration, conduction and radiation. Insulation is essential to minimise heat loss. Different types of insulation are discussed in Unit 4. Two points need to be reiterated:

1. The thickness of the insulation is crucial. Ensure at least 200mm for maximum efficiency.
2. The R-values should be a key consideration in the selection of insulation material. The R-value is a measure of thermal resistance. The higher the R-value, the greater the insulating properties.

3.2.3 Environment-Preferable Building Materials

Environment-preferable building materials include:

- Products that are stronger and more durable;
- Environmentally-certified materials, such as timber carrying a 'sustainable-felling stamp';
- Products with reduced toxicity such as low VOC[6] paints;
- Materials made of recycled materials such as recycled glass insulation and roof systems;
- Products with improved efficiency such as double-glazed and triple-glazed windows;
- locally produced building materials, which are likely to have lower life cycle impacts owing to considerably shorter transport distances; 'buying local' also helps promote local industries;
- Materials with a lower embodied energy; embodied energy is the total amount of energy needed to produce a given material - the energy needed to grow, log and shape timber, to mine, extract, refine and produce copper, aluminium, steel and concrete, to polymerise and manufacture plastics from petroleum, etc;
- The American Institute of Architects provides the following recommendations:

[6] VOCs are volatile organic compounds that can vaporise into the atmosphere. Examples include chlorine, vinyl chloride, benzine, lindane, dieldrin, and DDT. In Europe and North America, the emission of many VOCs is now regulated with guidelines and maximum-concentration-admissible values.

Coefficient of Embodied Energy of Building Materials[7]

COEFFICIENTS OF EMBODIED ENERGY

MATERIAL	COEFFICIENT
Wood	1
Brick	2
Cement	3
Glass	4
Fibre Glass	7
Steel	8
Plastic	30
Aluminium	80

[7] Great care must be taken when interpreting these numbers, as they vary from country to country based on the source of raw materials, production processes and transport distances.

3.3 *The Use of Environment Management During Occupation*

Sustainable building design is not the end, just the beginning. Buildings have to be used and maintained to optimise the benefits of the sustainable features incorporated in them. Lower energy use, material use and waste output during occupation also facilitates the implementation of EMS.

A few examples of environment management technologies, fittings and appliances are given below. Many of them have been discussed earlier in this Unit and in Unit 4:

WATER RELATED TECHNOLOGIES

- Grey water reuse systems;
- Water-saving products such as low-flow showerheads and tap aerators;
- Low-flush toilets and vacuum toilets;
- Waterless urinals;
- Alternative sewage treatment systems;
- Dishwashers that operate on 5.3 gallons (as opposed to 12.5 gallons) and 40% less energy than conventional models;
- Washing machines and dryers that use 14 gallons per full cycle; conventional models use 50 gallons of water and 50% more energy.

HEATING AND COOLING EQUIPMENT

- Renewable-energy systems;
- Solar-powered fans, cooling systems and refrigerators;
- Solar space heaters;
- Hydraulic space heating systems;
- Heat-recovery systems;
- Building management systems;
- Combined heat and power systems.

ENERGY-EFFICIENT LIGHTING:

- Low-energy lighting fixtures;
- Control systems such as dimmers, timers and photoelectric cells;
- Solar-power DC exterior lighting.

WASTE MANAGEMENT TECHNIQUES:

- Paper and plastic compactors;
- Composting vessels;
- Paper and plastic bailing equipment;
- Composting toilets.

Sustainable design recommends, as far as possible, retrofitting and repairing existing buildings, instead of continuing to build new structures. If existing structures are beyond salvation, it is important to see if any of the materials can be reused in the new buildings.

Examples of Good Practice

The Narayani Safari Lodge and Hotel, Nepal was built on low-value agricultural land. Wooden beams, doors and window-frames from the old houses on the site were reused for building the single-storey cottages of the hotel and lodge. Elephant-grass was initially used to thatch the cottage roofs. However, because these tended to leak slightly, locally-made clay tiles replaced the grass.

The US company Brennan Beer Gorman Architects is in the process of redesigning a 100,000-square-foot office building in Washington DC, into an eight-storey, 158-room Marriott Hotel. The company suggests the following considerations for office-to-hotel conversions:

- **BUILDING SHAPE**

  Does the building have a workable floor plate with column spacing that accommodates an optimum room width of 12 to 15 feet? Does the building have a core-façade dimension of 30 to 40 feet? Unusual L, T or W shapes hinder efficient and flexible office layouts but can work well for guest room modules.

- **WINDOWS**

  Are existing windows openable? Many codes require openable windows in guest rooms while many office buildings have fixed windows. Does the existing window module align with the proposed guest-room module inside, or will the façade need extensive reworking?

- **FLOOR-TO-CEILING HEIGHT**

  Office buildings with ceilings that are too low for today's market may work well as hotels with eight-foot guest room ceilings.

- **STRUCTURAL CONSIDERATIONS**

  Can the structure easily and economically accommodate stair relocations and the tremendous number of floor penetrations that hotels require for ductwork and piping?

If the full benefits of sustainable site selection and building design are to be realised, the construction phase must also be planned and conducted with environment consideration.

In the run-up to the construction phase, it is common practice for some design and material specifications to be revised and alternatives considered. Care must be taken to ensure that the chosen alternatives do not impair the sustainable design features, reduce the energy and material efficiency of the building, or compromise on the use of environment-friendly building materials.

The environment integrity of the site must be preserved at all costs. Bulldozing is to be avoided, vegetation cleared only where buildings are to be erected.

The recommendations of the EIA should provide valuable guidance throughout construction, especially in identifying vegetation that needs to be protected, reducing waste and emissions, the use of prevailing vegetation in landscaping, and preventing the erosion of topsoil and the silting of nearby waterways.

Sustainable construction is also about making the construction site a cleaner and safer workplace:

- **Separate areas should be provided for the storage of hazardous and toxic materials;**
- **Recycling collection points for construction debris, food waste and packaging waste need to be set up;**
- **Safety equipment and protective clothing should be provided;**
- **Safety standards on the use of construction equipment and exposure to toxic materials should never be compromised;**
- **Procedures and safety measures in the case of fire, spills and accidents should be clearly understood and respected.**

These criteria also apply to the refurbishment of existing buildings.

Environmentally-sound Siting, Design And Construction Of Buildings

Since the early 1990s, there has been a tremendous increase in the application of sustainable design. In many countries, EIA legislation is now mandatory for large and medium scale tourism developments, while passive solar design and energy-efficiency considerations has been incorporated into building codes.

In June 1993, the International Union of Architects and the American Institute of Architects signed a joint Declaration of Interdependence for a Sustainable Future. This declaration makes a formal commitment to place environment and social sustainability at the core of architectural and building design considerations.

Developers should not be discouraged if sustainable design requires extensive budgeting at the onset, for it will bring considerable overall savings later. For example, PV roofing and double-glazed windows may be more expensive to purchase, but these costs will certainly be absorbed by the energy savings made when the building is in operation.

Case Studies on Environmentally-Sound Siting and Design

1. ING Bank, The Netherlands

(Source: Rocky Mountain Institute, Canada, and ING Bank, The Netherlands)

In 1978, the leading Dutch and European Bank ING (then known as Nederlandsche Middenstandsbank, NMB) was considered stodgy and conservative. Needing a new image and a new headquarters, the bank's employees and board of directors voted for constructing a building that was 'organic, with the criteria to integrate art, natural materials, sunlight, plants, energy conservation, low noise, and water'.

A multi-disciplinary team of architects, construction engineers, landscape architects, energy experts and artists were commissioned to design the building. They worked for three years on the design with ongoing input from the future users. Construction began in 1983 and was completed in 1987.

ING Bank's new head office, south of Amsterdam, is considered even today as an important example of sustainable design. The Bank's 2,400 head office employees now work in a 50,000m^2- building, broken up into a series of ten slanting, brick-faced, precast-concrete towers. The ground plan is an irregular S-curve, with gardens and courtyards interspersed over the top of 28,000 m2 of structured parking and service areas. Restaurants and meeting rooms line the internal street that connects the ten towers. The high-density residential, office, and retail development surrounding the bank reinforces the image of a medieval castle with its surrounding village.

Maximum floor depth was determined by the criteria that no desk could be located more than about 7 metres from a window, and is directly related to the day lighting design. Interior louvers are used to bounce daylight from the top third of exterior windows onto the ceiling of office spaces. This design, in combination with window-lined interior atriums that penetrate through the towers to the mezzanine level internal street, provides a significant portion of the building's lighting.

Additional lighting needs are provided by task lighting, custom decorative wall lustre, and limited overhead fixtures.

With regard to the building's thermal design, double-glazing is a feature, as it was built before the time of high-efficiency windows. A sheath of insulation separates the outer brick layer from the precast-concrete structure. The structure itself is used to store heat from simple passive solar measures and from internal gains such as lighting, equipment and people. Additional heat is supplied through radiators connected to a 100m3 hot-water storage system in the basement. This water is heated by a combined heat and power facility located within the structure and by heat recovery from the elevator motors and computer rooms. The building also makes use of air-to-air heat-exchangers, which capture heat from outgoing exhaust air and transfer the heat into intake air.

The building is not air-conditioned, relying instead on the thermal storage capacity of the building fabric, mechanical ventilation, natural ventilation through openable windows, and a back-up absorption cooling system powered by waste heat from the combined heating and power system.

Design integration extends into interior decoration through artwork, plants and water. Circulation spaces throughout the bank are filled with artworks. For example, pieces of coloured metal in the top of the tower atriums reflect coloured light down to light sculptures in the base of the atriums, which then bathe the surrounding plastered walls with coloured light. In keeping with the desire for natural materials, interiors are finished with a simple palette of materials - texture paint over the precast concrete, wood trim, with wood-slat and some drop ceilings. In addition, where the brass plate covering an expansion joint in a major corridor travels up a wall, it becomes a piece of relief sculpture by being recessed into the wall and surrounded by a fan of coloured marble and cove lights.

Rooftops, courtyards, atriums and other interior spaces are landscaped using a variety of garden styles. Cisterns capture rainwater for use in fountains and landscaping. Flow sculptures that maintain a pulsing stream from a constant flow of water are used extensively, even as handrails for multi-story ramps. Beyond their visual appeal, the water features serve to add moisture to the air.

ING Bank reports that construction costs for the building were 3,000 Dutch gilders per square metre of land, structure, landscaping, art, furniture and equipment. In the mid-1980s, this was comparable to or cheaper than, other office buildings in the Netherlands. In terms of energy savings, the building consumes 0.4 gigajoules/m2 annually. (ING Bank's former head office building consumed 4.8 gigajoules/m2 of energy annually). The additional construction costs attributed to the building's energy systems was around $700,000, however the annual energy savings are estimated at $2.6 million (Vale, 1991, and Olivier, 1992).

Other benefits of the better work environment are a drop in employee absenteeism and a great improvement in the bank's corporate image.

2. Plymouth College of Further Education, UK

Plymouth College of Further Education (PCFE) provides a range of degree programmes, 300 vocational courses, 30 different General National Vocational Qualifications, over 20 A Levels and GCSEs and several 'return to learn' programmes. The entire college has over 20,000 students. The Department of Hotel, Leisure and Beauty, is one the largest departments of PCFE, with over 2,000 students, offering degree-level and vocational programmes.

Environment action at the PCFE began in 1997 with the primary objectives of:

- **Developing an 'environment culture' – making resource-efficiency and waste minimisation a part of the daily activities of staff and students;**
- **Proving that environment improvement costs need not be higher than similar, lesser environment- friendly alternatives;**
- **Demonstrating that environment management is good business.**

In 1997, PCFE commissioned a feasibility study to assess the interest of industry, especially small and medium-sized enterprises (SMEs), in the establishment of a centre for environment excellence and/or an environment-management advisory bureau to provide guidance on environment management. Manadon Associates, a local consultant with a strong environment bias, carried out the study. The results showed that an environment advisory bureau would receive strong support across all industry sectors.

"The role of the bureau will develop with time, but it needs to provide a high-quality, professional and independent service that responds to the needs of SMEs. The bureau should be housed in a purpose-built unit which should incorporate examples of good practice relevant to SMEs."

Paul Barton, Manadon Associates.

Following further consultations within PCFE, as well as with industry, local government and other organisations, PCFE decided to construct an environment-exemplary building to house the environment advisory bureau as well as a number of existing departments with space constraints. Funding for the new building is being provided by PCFE, with additional support from the European Union and the Further Education Funding Council.

Kay Elliott Architects and Hoare Lea & Partners, Consulting Engineers, were selected to design the building.

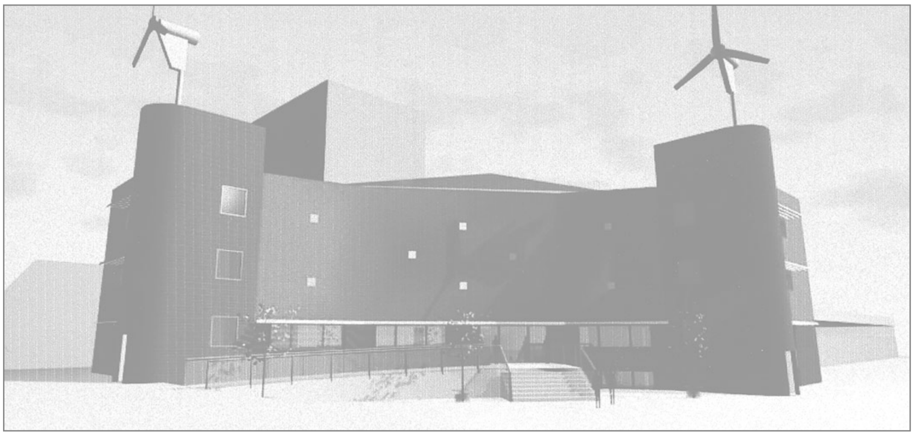
The building will consist of 2,000m2 of teaching, exhibition, office and refectory areas and associated ancillary space. It is to be sited in an existing car park and linked to surrounding buildings at the ground and first-floor levels.

The design objectives are to:

- **Develop a low-maintenance but usable and comfortable building that provides for the flexible use of space;**
- **Achieve low-energy consumption and low/zero emissions;**
- **Provide environment conditions within acceptable tolerance levels for each activity to be undertaken within the building;**
- **Apply cutting-edge technology to provide low-complexity design solutions;**
- **Use current building materials and construction techniques;**
- **Produce replicable concepts for small businesses;**
- **Achieve all of the above within the cost limit for equivalent comparable buildings: £850 per square metre.**

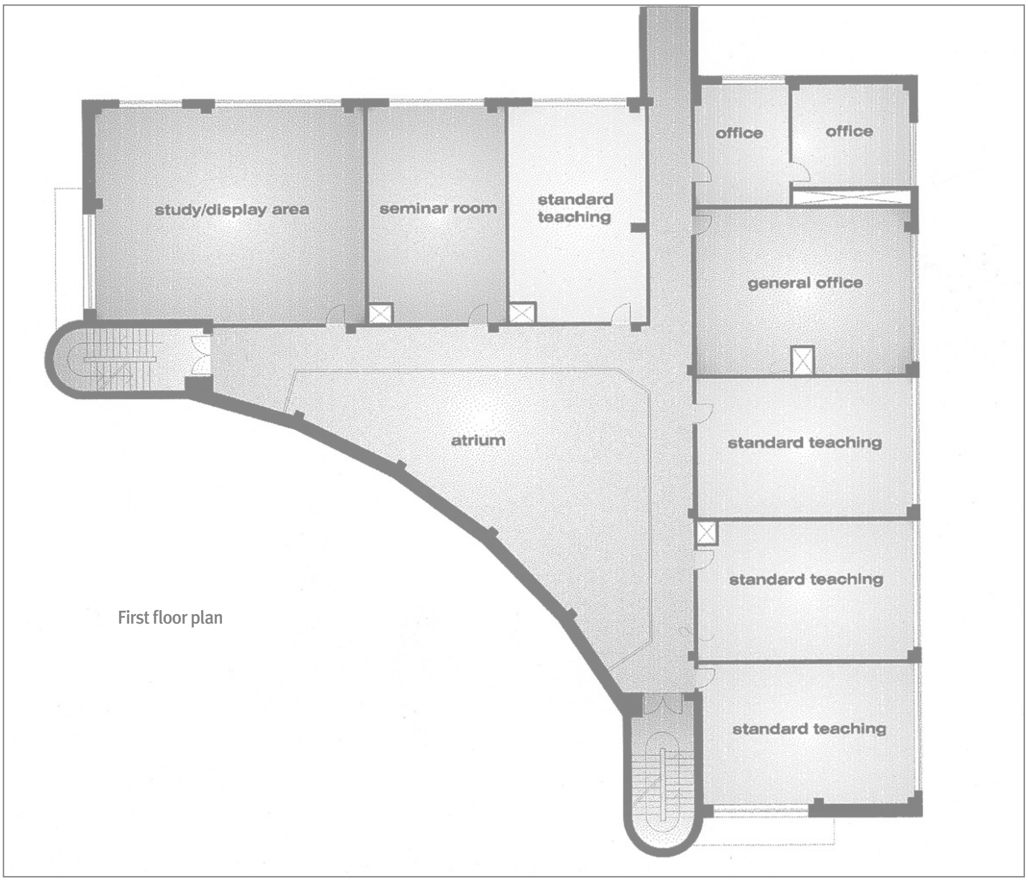
Some of the key 'green' design features are listed below:

- **The south-facing facade will be maximised, with minimum facades facing the southeast and southwest. Such a building orientation is needed to maximise the control of solar gain. It was designed based on a number of studies including the annual/daily sun path at the latitude of the site, 51.7°N.**
- **At the core of the design is a south-facing facade; a massive heavyweight structure which will act as a thermal storage unit for heat or cold depending on the season. It will slow down the transfer of heat from outside to inside and help moderate temperature fluctuations inside the building.**

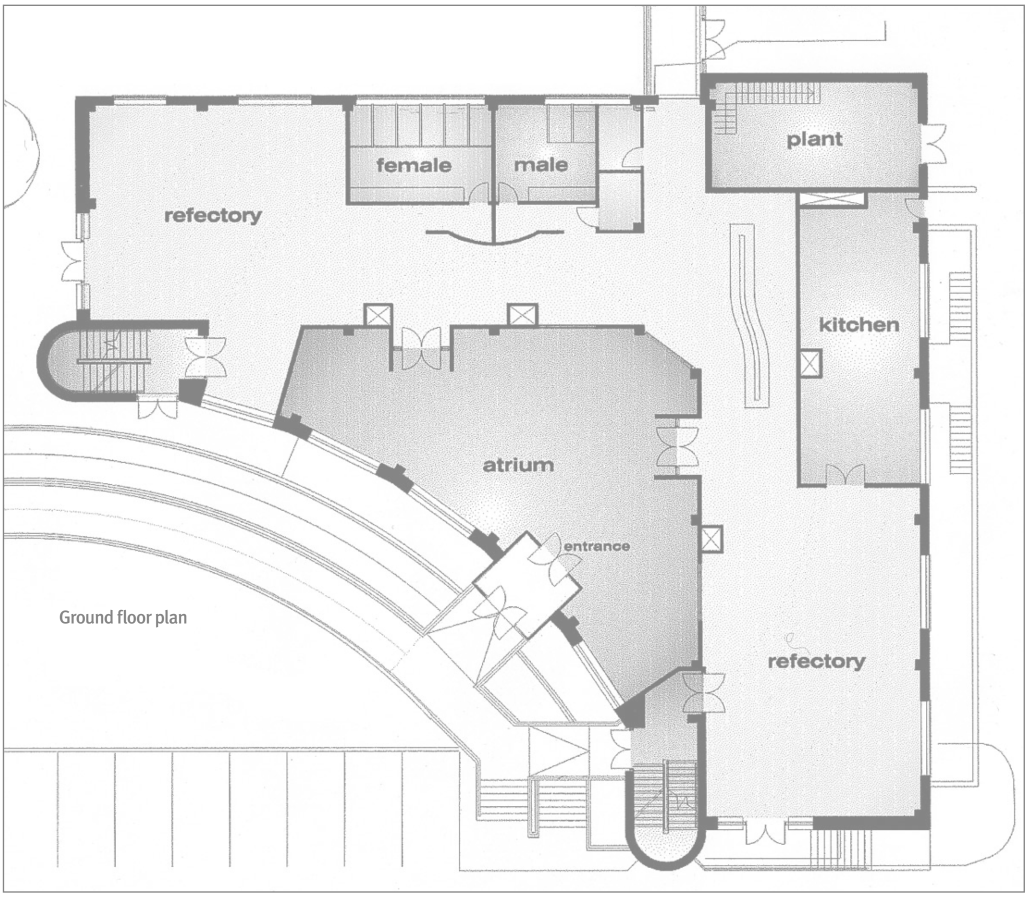


Visualisation –
View towards courtyard and entrance

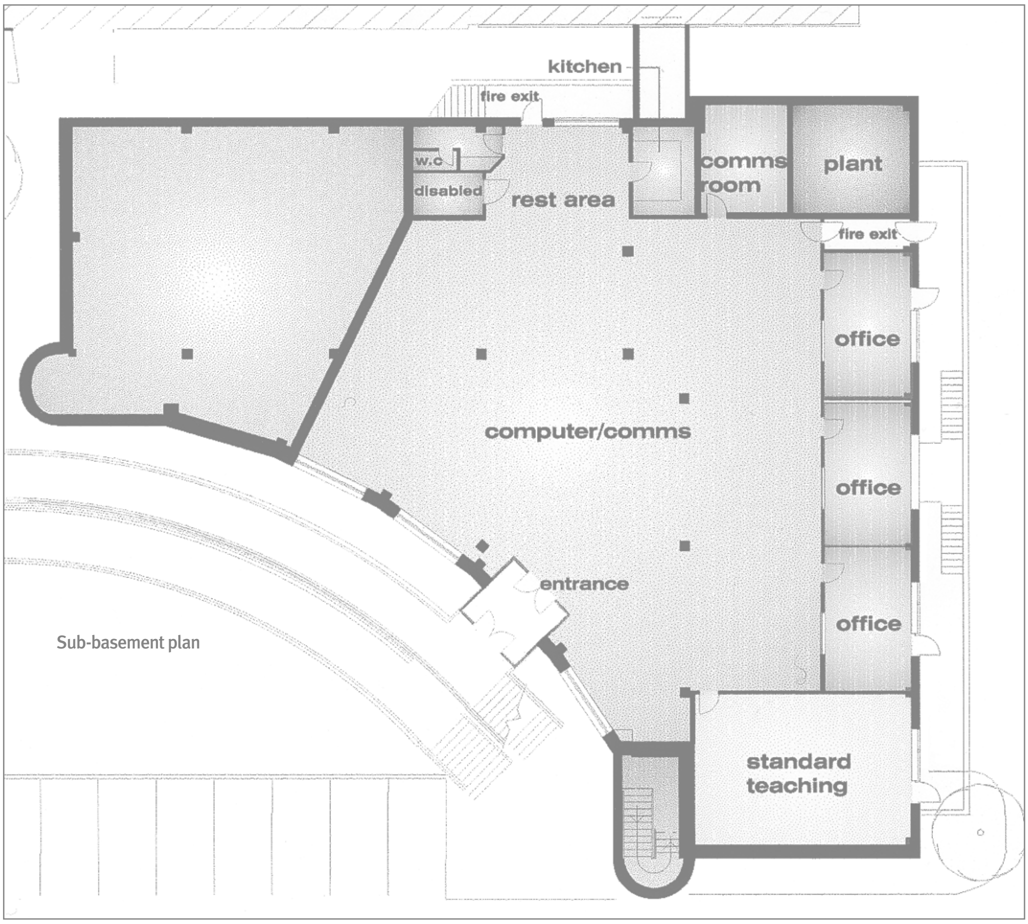
Second floor plan



First floor plan



Ground floor plan



- A building-management system will be used to automatically control heat, ventilation and air-conditioning (only when and where needed), operate the automatic windows and vents, and monitor and record data on systems and equipment. It will comply with existing control and fire alarm systems.
- The atrium will be designed to draw fresh air through the refectory space on the ground floor from outside the building, and emit used air to the exterior via the windows and roof vents.
- Large floor-to-ceiling heights, as well as automatic (linked to the building-management system) and manually operated high-and low-level windows/vents on each floor; the roof will be designed to ensure adequate cross-ventilation and maximise natural lighting.
- To further facilitate natural ventilation and free cooling through cross-ventilation, the distance between the exterior walls and the internal atrium will be below 10 metres.
- The penetration of north-light natural lighting into the building will be maximised through the north facing roof-light glazing, the atrium, translucent interior walls and windows with solar shading (when needed). This will be supplemented with artificial lighting when external conditions provide insufficient natural lighting. The design aims to achieve power consumption of less than 12 watts/m2 with all light fittings in use. Daylighting has been designed to achieve a daylight factor of 4% in most areas except toilets, plant rooms and the sub-basement computer rooms.

- **The vents in the north-facing roof will also provide automated night ventilation to cool the building, especially in summer.**
- **Existing energy utilities will be extended into the new building and new contracts will be set up to provide green electricity produced by renewable sources. The building will therefore have low/zero carbon-dioxide emissions. Current best practice in carbon-dioxide emissions from buildings in the UK is 12-34 kg/m².**
- **The building aims to operate on an energy target of less than 83kWh/m2/annum. Current best practice in building energy efficiency in the UK is 83-100 kWh/m²/year.**
- **The following areas will be naturally ventilated by means of openable windows/vents: teaching areas, labs, interview room, refectory, study/display area, seminar room, general office, toilets and atrium link corridors.**

The toilets and atrium will include a supplementary extract vent to assist natural ventilation if required.

- **The following areas will be mechanically ventilated: sub-basement area (computer rooms), kitchen/servery, internal offices and fileserver/communication rooms.**
- **Solar water-heaters located on the south facade shading panels will heat the hot-water storage cylinders.**
- **Two wind turbines will be installed to supplement electricity supply to the building.**
- **Both the physical location and the use of the massive structure will separate acoustically-sensitive areas from noisy areas.**
- **The computer rooms will be located in the sub-basement to allow the heat gain in the area to rise naturally and be exhausted (via an air-handling unit) into the atrium.**
- **Radiators and heating/cooling circuits will be weather-compensated and fitted with thermostatic radio valves to allow the temperature to be regulated by occupants.**
- **Lighting will be controlled via manual light switches. Some fittings on the ground, first and second floors will have additional photocell controls to dim lighting, depending on daylight level. Occupancy sensors will be installed in the sub-basement computer rooms.**
- **External lighting will be minimised and controlled by photocells and time switches.**
- **Electricity, gas and water supplies to the building will be metered.**

Staff and Student Travel and Parking Plan

To complement the new building, PCFE has commissioned Manadon Associates to develop a sustainable travel and parking strategy for staff and students. (PCFE already offers a subsidised bus service to all students and operates a free college shuttle.)

"It is our intention to produce a building that will influence future building design and demonstrate that environment-intelligent initiatives are cost-effective and good for business. We are also in the process of developing an environment management programme, following a preliminary environment review, which was completed in May 1999. A lot of planning goes into our work, for we want to be absolutely certain that it will result in genuine environment improvement. Environment stewardship is not about piece-meal efforts and short terms gains, but longer-term accountability."

J. Gilbert Snook, Head of Estates

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UNIT 5: EXERCISES

1. GROUP PROJECT

Develop checklists for environmentally-sound:

- **Siting;**
- **Building design and orientation;**
- **Renewable energy use;**
- **Construction and selection of building materials.**

for each of the following hospitality businesses:

- **A1,000-room city hotel;**
- **A 25-room mountain guest house;**
- **A 100-room beach hotel;**
- **A 15-room holiday village bordering a rainforest;**
- **A desert campsite for approximately 35 people on desert safari, located a 500 metres from an oasis.**

2. GROUP PROJECT OR WRITTEN ASSIGNMENT

Develop guidance notes on 'energy sources and energy efficiency' for hospitality developers in:

- **The northern hemisphere;**
- **The southern hemisphere.**

3. WRITTEN ASSIGNMENT

Are there trials and demonstration projects for environment-friendly building design in your country or region? (These need not be tourism or hospitality businesses). Arrange a field visit to one of these properties. Include a question-and-answer session with the developers and managers.

Write a report of 1,500 words on the sustainable design features used and the benefits they are bringing to the property.

4. GROUP PROJECT OR WRITTEN ASSIGNMENT

Using materials produced within your region/country, and in keeping with your region/country's typical and traditional designs and styles, develop an interior decorating and furnishing checklist for:

- **A 500-room city hotel;**
- **A 25-room rural guest house.**

5. WRITTEN ASSIGNMENT

Critically discuss the following statement:

"Just as hospitality developers as a group are becoming more sophisticated, travellers are seeking to transform their lives in some sort of way, through education, culture, and recreation. The designing of the resort can enhance this kind of experience. Travellers know the difference between a well designed and a poorly designed resort. As a result, it is much easier now to appeal to the conscience of the developer and explain why an environment-sensitive design makes sense – because 'eco' also stands for economics."

Howard J. Wolfe

Vice President and Principal

Wimberly, Alison, Tong and Goo (WATG), a resort design firm, Honolulu, Hawaii.

GLOSSARY OF TERMS AND ABBREVIATIONS

AC	alternating current (electricity)
anaerobic	not containing oxygen
BOD	biological oxygen demand
coefficient	a number that expresses a measurement or quantity of a given substance
conduction	process by which heat or electricity passes through or along something
convection	process by which heat travels through air, water and other gases and liquids
DC	direct current (electricity)
EIA	environment impact assessment
EIS	environment impact statement
embodied energy	total amount of energy needed to produce a given material
EMS	environment management system
energy efficiency	rational use of energy
greenhouse gas	gas that causes global warming and climate change, discussed in Unit 1

infiltrate	enter gradually
ion	atom which possesses an electric charge
organic	carbon-containing material derived from plant and animal material
oxidise	when a substance oxidises, it changes chemically because of the effect of oxygen on it
PV	photovoltaic
radiation	energy, especially heat that comes from a given source
remote power system	power system that functions independently of the grid electricity supply
resource efficiency	rational use of resources
SS	suspended solids
sedimentation	the settling of solid materials at the bottom of a liquid
VOC	volatile organic compound which can vaporise in the atmosphere

PARTING THOUGHTS

"Expand your vision until it includes the whole earth as your home, and recognise and respect life in all its forms."
Stephan C. Paul, psychologist

According to a new index from Dow Jones and Sustainable Asset Management, companies with an eye on their 'triple bottom line' - economic, environment and social sustainability - are outperforming their less fastidious peers on the stock market. The world's top 200 sustainable firms listed in the index outperformed the rest, particularly those in technology and energy.

A great many tourism and hospitality businesses are responding to the environment challenge with the same bottom line, that environment management is critical to maintaining business success. Many businesses find that after an initial period of success, it can be difficult to maintain enthusiasm and continue the effort. At such times, systematic performance monitoring becomes even more important, for it provides the data and encouragement to work towards increasingly higher levels of environment-related achievement. For if one business does not, its competitors will.

Action by a handful of companies, however, is not sufficient. All tourism and hospitality businesses and institutions have to accept responsibility and take action towards improving the environment. It is not just good business and good citizenship; it will also ensure that our children and grandchildren have spectacular and inspiring destinations to visit in the years to come.

Drivers that will continue to forward the environment and business agenda include:

1. The expanding body of environment legislation that is not only becoming more stringent but is also being increasingly enforced. The challenge is to be a step ahead of legislation, rather than merely complying with it.

   "It is always better to act before we are told - especially by regulators – that we have to do it."
   Gilbert Snook, Head of Estates,
   Plymouth College of Higher Education, UK

2. Both governments and industries are realising that technology and trade are a double-edged knife. While technology has enabled us to maximise output from each resource unit, be it a hectare of land, a litre of fuel oil, a cubic metre of water or a kilo of wood, this same technology has degraded lands, contaminated water, poisoned wildlife and people, and polluted the surrounding air. Similarly, trade practices that farm products in one part of the world, then process them for final consumption in another, are extremely profitable in our market system. This is because we fail to recognise and account for the environment costs incurred in the process – wasteful resource use and pollution at all processing points, transport-related emissions, health risks, etc.

   Many environment sceptics see no reason to worry. They argue that the invisible hand of the market will take care of environment problems when the time arises. As forests, clean water and agricultural land become scarce, their prices will rise and that will provide the necessary incentives for using resources more carefully and managing pollution. What such sceptics fail to realise is that once a forest is turned into an industrial estate, or a mangrove has been reclaimed for resort development, it cannot easily be returned to its original state and made to produce timber or fisheries again. There are limits to the carrying capacities of the earth's resource base, and once these limits have been surpassed there will be rapid declines in all natural, economic and social systems. Herman Daly, a former senior executive of the World Bank, best sums this up through the following often-used analogy:

"Ship captains continuously monitor the Plimsoll line indication of their boats. For if water rises above the Plimsoll line, it is a sign that the boat is too heavy and is in danger of sinking. At this point, there is little choice but to reduce the weight of the cargo and crew on the ship – simply rearranging items will not prevent the ship from sinking. The problem is the total weight, which is over and above the carrying capacity of the ship."

3. Many governments are now working on national environment accounts and adjustments to gross domestic product calculations to reflect environment losses and gains. The objective is to produce a more accurate picture of national production and consumption costs and revenues.
4. Companies are experimenting with a variety of methods to evaluate not simply resource inputs, waste and emission outputs, but also their 'environment burden' - their actual contribution to environment change and degradation.
5. As the power and size of companies grow, their consumers, competitors and investors no longer judge them by profits and product quality alone, but also on their overall contribution to society. Companies today are expected to be socially and environmentally accountable and play a leading role in improving the environment and the quality of life of their host. The 1998 GlobeScan Survey on Sustainable Development Trends states that 'corporate reporting on social performance is predicted to be more common in five years than is corporate environment reporting today'.
6. There is also increasing focus on environment defence expenditure – the costs of anticipating and avoiding environment damage as well as pollution clean-up and regeneration costs - and ways and means to incorporate them into market prices. We cannot begin to work towards improving the environment if it is more cost effective to waste, contaminate and pollute than it is to anticipate, avoid, manage and regenerate.

This manual, which has discussed the tourism and hospitality industry's environment agenda, environment management systems and sustainable siting, design and construction, is only the beginning. It is all too important to bear in mind that to overcome environment challenges, we need not only conciseness and expertise, but also persistence, courage and vision.

"We have to acknowledge the facts. We cannot create a sustainable future if we keep dragging a veil over reality, not only ignoring depletions and the collapse of life support systems, but actually counting this as progress. The limits to growth will then hit us even faster."
Dr. Alexander King, Member of the Club of Rome

RESOURCES

The following is a limited list of further resources on the environment.

Unit 1

GEO 2000
Published by Earthscan Publications Ltd (www.earthscan@co.uk) for and on behalf of UNEP (1999)
ISBN: 1 85383 588 9 (paperback), 1 85383 587 0 (hardback), ISSN: 0 1366 8080
Website: www.unep.org/Geo2000/

The Economist, published every week by The Economist Newspaper Limited
Website: www.economist.com

Climate Change and its Impacts on Tourism
Worldwide Fund for Nature (WWF) publication, 1999
Website: www.panda.org

Global Warming: Health and Disease
Paul R. Epstein
Website: www.panda.org/climate/climate_docs/health_factsheet/preface.htm

IUCN World Conservation Union
Website: www.IUCN.org

International Institute for Sustainable Development (IISD)
Website: www.iisd.ca/linkages/

Living Planet Report 1999
Worldwide Fund for Nature
Website: www.panda.org/livingplanet/lpr99/index.html

World Resources Institute
Website: www.wri.org

World Watch Institue
Website: www.worldwatch.org

Unit 2

Friends of the Earth
Website: www.foe.co.uk

Responsible Tourism Institute
Website: www.sustainable tourism.com

The Earthscan Reader in Sustainable Tourism
Edited by Leslie France
Earthscan Publications, 1997, ISBN 1 85383 408 4
Website: www.earthscan@co.uk

The Green House Effect – An Integrated Approach to Sustainable Tourism and Resort Development
Conservation International Publication
Website: www.conservation.org

Tourism Development and Community Issues
By C. Cooper, S, Wanhill
John Wiley & Sons, 1997, ISBN 0 47197 116 2

Unit 3

Awards for Improving the Coastal Environment
UNEP Industry and Environment, World Tourism Organisation, Foundation for Environment Education in Europe, 1997
ISBN 9 28071 625 5
Fax: +33 1 44 37 14 74
Website: www.unep.org

EMAS legislation
Website: http://europa.eu.int/eur-lex/en/lif/dat/1993/en_393R1836.html

European Environment Law
Website: www.eel.nl

International Organization for Standardization (ISO)
Website: www.iso.ch

International Environment Law and Treaties
Website: www.globallaw.com

US Environment Protection Agency
Industry Partnerships
Website: www.epa.gov/epahome/industry.htm

Eco Labels in the Tourism Industry
UNEP Industry and Environment, 1998, ISBN 9 28071 708 1
Website: www.unep.org

Unit 4

Being Green Keeps You Out of the Red
Published by the Tourism Council of Australia
Fax: +61 2 9358 6055
Website: www.tourism.org.au

Corporate Environment Management I (2nd Edition)
Edited by R. Welford
Earthscan Publications, 1998, ISBN 1 85383 559 5
Website: www.earthscan@co.uk

Green Hotelier
International Hotels Environment Initiative magazine, published quarterly
Compiled and edited for IHEI by Claire Baker Corporate Communications
Website: www.ihei.org

Environment Action Pack for Hotels
UNEP Industry and Environment, International Hotels and Restaurants Association, International Hotels Environment Initiative publication, 1995, ISBN 1 899155 901 0
Website: www.ihei.org / www.ih-ra.com

Environment Good Practice in Hotels
UNEP Industry and Environment, International Hotel & Restaurant Association publication (Out of print; available in pdf format to hotel schools buying this pack. Contact infos@ih-ra.com)
ISBN 9 28071 623 9
Website: www.ih-ra.com

Environment Management Training Resource Kit
UNEP Industry and Environment, International Chamber of Commerce, FIDIC publication, 1997
ISBN 9 2807 147 9
Website: www.unep.org

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Our natural ecologies today are in a state of crisis. Healthy economies and societies cannot continue to develop in a world with so much degradation of the environment and such large inequalities in the distribution of wealth and resources. Today, nations, businesses and humans worldwide need to respond to these complex and far-reaching challenges. An unprecedented challenge is posed Ð ensuring that economic development continues and expands, while at the same time dramatically reducing the environmental impact of that development.

In this context, the hospitality and tourism industries face a particular challenge. A clean and healthy environment is critical to their continued prosperity, and these industries have a leadership role to play in husbanding environmental resources and in recognising that environmental management is product stewardship. In fact, in order to really ensure that sustainable tourism development can be achieved, the need for good practice extends beyond natural heritage to include cultural heritage issues.

Sowing the Seeds of Change

Ð An Environmental Teaching Pack for the Hospitality Industry

has been developed in response to this challenge, when the partner organisations IH&RA, UNEP DTIE and EUHOFA identiÞed a lack of information, expertise and practical teaching tools as the major concern when introducing environmental issues into the hospitality curricula.

This publication is a complete information pack for developing and expanding environment curricula in hotel schools. It enables hospitality education professionals to develop tailor-made environment curricula to suit the needs and objectives of each school and education system. The content is most suitable for developing syllabuses at the degree and postgraduate levels. This Pack can be used to develop stand-alone environment curricula or incorporate environmental information to existing subject areas such as front ofÞce and rooms, back ofÞce and administration, food and beverage, kitchen and tourism management. For students of hospitality management it will serve as an environment information and resource handbook. For hospitality professionals, it provides all necessary information for raising environment awareness and developing and implementing environment management systems.

The IH&RA, UNEP DTIE and EUHOFA are delighted to have joined together in producing this publication, and warmly thank the many sponsors that have made this initiative possible.

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