Sustainable Development Guidance for Estate Management

Prepared on behalf of the Scottish Funding Council by

Thirdwave
The Business Case for Sustainability

Thirdwave
8 Maritime Street
Leith
Edinburgh
EH6 6SB

0131 625 1470
info@thirdwave.org.uk
www.thirdwave.org.uk

Contents

1.0 Executive summary

Promoting sustainability through effective estate management guidance constitutes one element of an institution's wider strategic sustainability policy. Improvements in an institution's environmental performance should be mirrored by improvements in all its activities, including:

- developing sustainable skills, attitudes and behaviours through delivery of the curriculum;
- increasing sustainable development research capacity and embedding sustainability in undergraduate and postgraduate courses;
- supporting local communities, for example through community planning and sustainable procurement practices; and
- ensuring compliance with relevant environmental legislation.

In terms of estate and facilities management, sustainability is directly relevant to the strategic operation of institutions' buildings and estates. The key drivers for addressing this issue are:

- the Scottish Government's commitment to improving Scotland's natural and built environment;
- energy issues, including increasing costs and reliability of supply;
- recognising global warming as a real and genuine threat; and
- the UK Climate Change Bill.

The depth of knowledge and experience of sustainability issues across the sectors varies depending on the range of skills available to management teams. However, awareness amongst senior decision makers is rising as is reflected in the uptake of membership of the EAUC and participation in CaSPr and the growing presence of in-house environmental and sustainability experts and champions.

However, the SFC recognises that most institutions do not have in-house environmental or sustainability expertise and therefore the purpose of this document is to build upon the foundation of the previous *Sustainable Development Guidance* and help senior decision makers and estate professionals by:

- further developing the concept of sustainable development in relation to estate management;
- emphasising the relevance of sustainable development to colleges and universities;
- suggesting where to begin and what to consider;
- suggesting how an institution can embed sustainability within an estate strategy; and
- giving practical guidance on the main issues that are associated with the maintenance of existing buildings, refurbishments and new builds.

Much of the guidance and documentation that is currently available relates to new build construction. However, sustainable development is not limited to large scale new build capital projects. The principles also apply to smaller scale developments and routine operational estate and facilities management. Therefore, this document sets out the key issues that relate to operational maintenance of an existing estate as well as design and new build projects.

Institutions should use the guidance as a practical tool for integrating the principles of sustainability into all aspects of estate development and estate and facilities management. Sections 3 and 4 outline the key issues that senior management teams should be aware of when developing institutions' corporate plans and estate strategies, whilst sections 5, 6, 7 and 8 offer good practice guidelines and highlight the policies that estate professionals should be embracing as sustainability practitioners.

Adopting the principles of sustainability within estate strategies should form a significant part of an institution's corporate approach to the wider sustainability agenda, in line with the SFC's Corporate Plan aim of delivering highly effective, world-class organisations.

2.0 Introduction

The Stern Review on the Economics of Climate Change discusses the effect of climate change and global warming on the world economy. *The Stern Review*, written on behalf of the UK Government, argues that climate change threatens to be the greatest and widest ranging market failure ever seen. Stern states:

> …our actions over the coming few decades could create risks of major disruption to economic and social activity, later in this century and in the next, on a scale similar to those associated with the great wars and the economic depression of the first half of the 20th century.

The Scottish Government has signed up to *One Future – Different Paths: the UK's shared Framework for Sustainable Development* (2004). This sets out the following common goal for sustainable development across the UK:

> …to enable all people throughout the world to satisfy their basic needs and enjoy a better quality of life without compromising the quality of life of future generations.

Choosing Our Future: Scotland's Sustainable Development Strategy (2005) outlines the principles to achieving sustainable development as:

- living within environmental limits;
- ensuring a strong, healthy and just society;
- achieving a sustainable economy;
- using sound science responsibly; and
- promoting good governance.

In 2007, the new Scottish Government introduced five Strategic Policy Objectives to focus government and public services on creating a more successful Scotland through increasing sustainable economic growth. This new structure is intended to ensure the government exploits the links between different areas of the Scottish Government and develops more joined-up policies. In particular, Objective 5, *Greener Scotland*, sets out to improve Scotland's natural and built environment and the sustainable use and enjoyment of it and Ministers have identified colleges and universities as having a key role to play in achieving this goal.

2.1 Relevance to institutions

In terms of estate management, Scotland's colleges and universities play a significant role in promoting the national sustainability agenda by:

- serving as centres of excellence for intellectual and practical responses to the challenges of climate change from local to global levels;
- demonstrating through their actions, vision and leadership to their employees, students and surrounding communities;
- optimising utilisation of their estates and thereby reducing negative environmental costs and impacts; and
- using intelligent procurement to make positive environmental, social and economic impacts.

Colleges and universities procure, operate and occupy buildings as collected assets, maintaining direct control of their investments and surroundings. By considering efficiencies to be gained through looking at those assets in various groupings, a wide range of cost savings and benefits are available, particularly in terms of infrastructure and energy use.

Using a sustainable approach to estate development and estate and facilities management can offer a real contribution to institutions in terms of optimising their assets and reducing risks, costs and impacts.

2.2 Benefits and costs - financial, business, environmental, and social

Financial

There are many obvious financial benefits linked to sustainable buildings. These most closely relate to operational costs such as lower energy costs, lower maintenance costs, less complex building services, lower water consumption and lower generation of waste.

What is less well recognised are the direct cost savings for both new builds and refurbishments in designing for greater efficiency. Whether this relates to specifying smaller boilers, fewer radiators, ducts and pipes or avoiding the need for air conditioning, the cost savings are self-evident.

Business

Productivity and work place satisfaction are essential to the competitiveness of a business. A study by the Royal Academy of Engineering produced a rule of thumb which states that the lifetime costs of operating a building (mainly maintenance, utilities, and management) are five times greater than the initial design and construction costs.

A study of five new buildings and campuses, four of which had strong sustainability features, by the Commission for Architecture and the Built Environment (CABE) found that:

- 60% of students and staff said that the quality of the building design had a positive impact on their choice of university; and
- more than 70% of staff and students believed that the functions and facilities of the buildings they work in impact on the way they feel and behave.

Establishing sustainability is an integral feature of a college or university's corporate plan and 'brand' and reflects a commitment to both quality and responsible behaviour. Staff turnover can be significantly reduced if the quality of facilities and the working environment is high.

Environmental

There is now a global scientific consensus that the build-up of greenhouse gas emissions in our atmosphere, especially carbon dioxide, will lead to environmental devastation across the world if left unchecked. Furthermore, energy production and use has considerable local and regional impacts on air and water, community, and flora and fauna. The UK and Scottish Governments have therefore introduced ambitious targets to reduce carbon dioxide emissions below 1990 levels by 60% and 80% respectively by 2050.

The building and construction industry has a major impact on our environment, both directly and indirectly. The built environment in the UK is directly responsible for circa 50% of all UK emissions generated on an annual basis:

- beyond climate change, the built environment has a range of broader impacts on our environment through its high consumption of resources;
- around 30-40% of all raw materials consumed in the UK and other developed economies are used in buildings, leading to related energy and pollution impacts;
- buildings use 16% of global water withdrawals and 25% of annual global wood harvest is used for construction; and
- during the 20th century, chemically based and treated materials became widespread in the buildings industry, affecting the health of people, flora and fauna.

Colleges and universities contribute to these impacts at several levels; from the immediacy of their own direct surroundings and the area in which they are based to larger national and global environments. At each of these levels, activities, values and choices must be weighed and considered as to how the sector demonstrates its self-awareness and leadership.

Some of the immediate benefits to the environment of sustainable buildings include:

- substantially reducing energy demand at all points in the process;
- reducing a wide range of toxins and pollutants across our global environment;
- reducing water consumption and impacts in regard to water courses and flooding;
- optimising the capacity and flexibility of individual buildings and questioning the need for new buildings;
- making optimum use of materials which are renewable or recycled to help in reductions in unnecessary waste;
- making optimum use of materials produced locally so that transport impacts are reduced; and
- greater awareness of and respect for our natural environment.

Social

Colleges and universities impact on, as well as benefit, society and communities at many levels. Community in relation to sustainable buildings encompasses a range of different groups, particularly in the instance of colleges and universities, which by their very nature are both public and private buildings, work places and community and cultural symbols. Many different distinctions can be drawn but the following are examples of communities related to colleges and universities:

- internal - staff, students;
- visitors - citizens, professionals working with the college/university, foreign professional visitors, businesses linked to the college/university;
- neighbours - people residing or working near to the campus/buildings;
- construction teams - those who design, construct, refurbish and maintain the building;
- resource suppliers and their communities - local and beyond; and
- international academic community - observing and learning from peers and competitors.

Each of the above is impacted upon in some significant way by the presence and operation of facilities. Sustainable building can have a positive impact on every one of the above in terms of health, well-being, economy, community relations, livelihood, efficiency, safety and pleasure.

3.0 Sustainable development – estate implications

Introduction

This section outlines the issues which should be considered when developing and implementing an estate strategy and/or design process.

3.1 Assessing institutional impact

There are a range of tools, well tested across many sectors, which can assist in measuring and judging impacts. A tool may be as overarching as environmental foot printing, where all of an organisation's significant impacts are measured, or as focussed as an environmental management system for one key asset. Whatever is selected, it is important that this process is maintained over time and that drivers for change, whether they are resource availability or fiscal incentives, are taken into account.

There is an increased expectation for public reporting of institutional impacts to demonstrate good practice in environmental management. Just as other large businesses, and increasingly small and medium enterprises, are generating Environmental and Corporate Social Responsibility (CSR) reports, colleges and universities should also consider recording their environmental and social practices and impacts. Those who have already begun that process will find this new expectation easier to meet and will be better placed to potentially gain market advantage.

3.2 Developing a sustainability policy

At any given time, colleges and universities may be rationalising, developing or upgrading buildings or a series of buildings, often concurrently. Therefore, it is important to have a sustainability policy that supports the estate strategy to ensure that expectations are implemented from the start. Together with the estate strategy, the sustainability policy should:

- inform, involve, and build support amongst senior managers and academics, students and other key internal stakeholders;
- send unambiguous messages to both internal decision-makers and to design teams about the requirement for high performance buildings;
- avoid duplication of work between building projects, for example, setting environmental performance standards and detailed design guidance; and
- create a 'learning cycle' which enables new developments to learn lessons from their predecessors.

In practice, some institutions favour long documents containing detailed guidance on requirements, whereas others prefer two to three page general statements of intent.

The latter can be either stand alone or supported by detailed guidance on specific areas. Whatever the length it is vital that a policy spells out:

- a strong and unequivocal commitment from senior decision makers, for example, the Principal, governing body, etc.;
- the need for excellent environmental performance, including performance targets where appropriate;
- appropriate operations, maintenance and design standards and the principle of using whole-life costing;
- the need for rigorous commissioning and post occupancy evaluation; and
- that the standards required are embedded in all practical senior level statements, maintenance plans and contract documentation.

A three-fold approach can enhance the likelihood of realising sustainable estates by sharing out responsibility for success. This approach consists of:

1. ensuring that the project sponsor and/or client/user group fully understands and does not lose sight of the value that a sustainable building can bring to their own objectives;
2. ensuring that all participants are fully briefed on the institution's policies and agreed sustainability goals of the project; and
3. ensuring that project sponsors record and disseminate lessons learned from a project to the senior management team to inform future projects.

3.3 Benchmarking

The Estate Management Statistics (EMS) and Estate Management Data Exchange (eMandate) systems provide a comprehensive resource of college and university estate information, enabling institutions to compare their performance against similar institutions across a wide range of activities including operating costs, space efficiency, energy efficiency and estates' funding requirements.

Together with other UK funding councils, the SFC is reviewing the data collected to include more environmental indicators with the intention of promoting EMS and eMandate as effective sustainability reporting and benchmarking tools. Therefore, a comprehensive sustainability policy with tangible objectives will be necessary to inform data collection and support the development of EMS and eMandate.

Including additional indicators will help colleges and universities:

- develop internal estate management information;
- raise the profile of sustainable development within their institution;
- identify and support change and improvement in their estate; and
- understand, compare, modify and support their estate strategies.

3.4 CO_2 emission reduction - campus options

The Carbon Reduction Commitment (CRC) is a proposed mandatory cap and trade scheme that will apply to large non-energy intensive organisations in the public and private sectors. It is expected that the scheme will cut carbon emissions by 1.2 million tonnes of carbon per year by 2020.

Non-residential buildings are responsible for 18% of all CO_2 emissions within the UK. This figure is higher than cars, buses and motorcycles combined (15%) and not far short of that of the Domestic Sector (27%).

Campuses can most effectively minimise their carbon dioxide emissions by:

- measuring and monitoring how much energy is being consumed;
- reducing the energy needed to provide heating, cooling, and other services to occupants during the use phase;
- reducing materials consumption;
- reducing use of road transport by occupants through locations which enable alternative access;
- adopting low carbon construction materials; and
- promoting staff and student behavioural changes, such as turning off lights and computers at the end of the day.

3.5 Local environment and community

The natural and cultural heritage of Scotland is interwoven and forms an important part of regional identity and sense of place. This integration should exist for colleges and universities whether groupings of buildings are isolated in a rural setting or part of a larger urban fabric.

The same could be applied to the different communities within these institutions and how they relate to other local and regional stakeholders, including the local resident and professional populations. The form estates take and how assets are and will be used will have a direct impact on how beneficially these relationships are able to progress. Working within this context means:

- respecting existing landscape character;
- protecting cultural heritage by ensuring existing buildings are valued and respected;
- working within a sense of place and respecting the character of surrounding cities, towns and villages;
- having an open and positive relationship with neighbours and the broader community, including providing access to shared resources where possible;
- supporting the local community where possible through employment and procurement opportunities;

- supporting partnerships with local businesses through shared access to venues and resources;
- developing continuing professional development (CPD) opportunities in regard to estates and buildings by exploring placements and work exchanges as appropriate to share knowledge and expertise; and
- designing to cope with regional conditions, taking into account local climate.

Maintaining a clear and coherent visual identity which respects its surrounding landscape or built community is challenging in the context of operational, climatic and regulatory demands. The overall feel and look of a campus impacts on aspects of desirability in attracting both employees and students and should not be undervalued.

The direct impacts on the local environment and community of existing buildings, particularly when undertaking maintenance work, are many and varied. Before embarking upon any such work the following should be considered:

- ensure that the design, scale and materials of any extensions or adaptation of buildings complements neighbouring buildings;
- where existing buildings are being joined to make a larger space, maintain the character of the street frontage to avoid disruption to the original urban form;
- consider using traditional materials that are locally sourced as these require less energy for transport, contribute to the local economy and help to maintain cultural heritage;
- consider how to adapt aspects of building performance to higher sustainability while respecting existing fabric and surrounding sense of place;
- consider adapting the size of guttering and other rainwater collection goods to allow for higher rainfall than at the time of original design;
- projects that have been developed in consultation with Historic Scotland and other conservation bodies such as the Scottish Civic Trust or the Architectural Heritage Society of Scotland are more likely to go through the planning process smoothly with less likelihood of objections from statutory bodies;
- prioritise maintenance of traditional design features, for example, string courses, a valuable technique to keep lingering water off of building facades to reduce material deterioration; and
- consider how local and community groups may benefit from access to existing, perhaps under-utilised, buildings to support their activities and to reduce the need for new construction.

3*.6 Embedding sustainability within the estate strategy process*

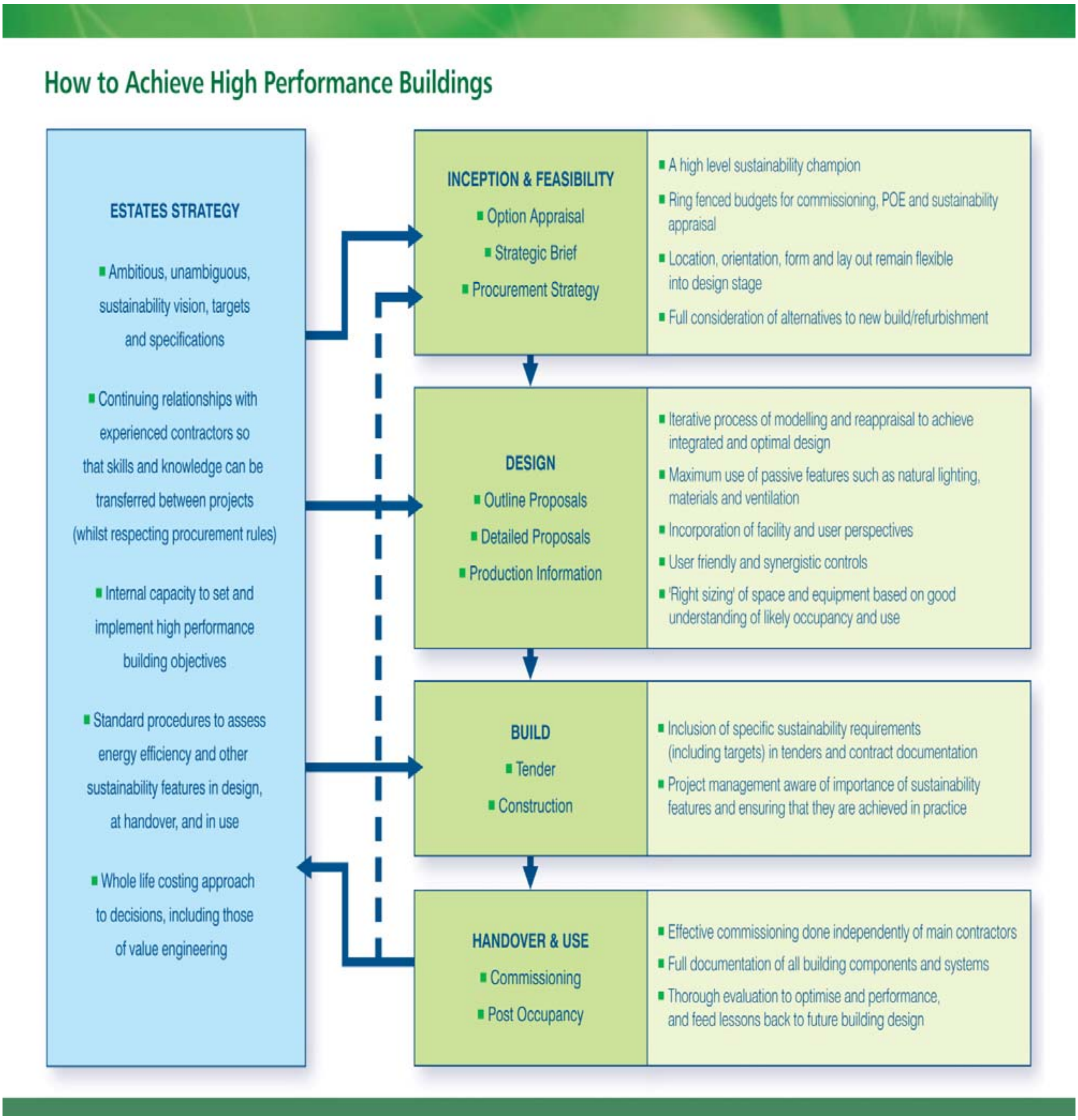
Sustainable development is not limited to large scale, new build capital projects. The principles also apply to the smaller scale developments that constitute routine estate and facilities management, such as maintenance, change of use or conversions, extensions, internal refit works or demolition.

The following should be considered when developing and implementing an estate strategy and planning estate maintenance, refurbishment or development projects:

- Biodiversity;
- Building layout and flexible design;
- Building materials, including reclamation and recycling and the re-use of buildings;
- Water management, including drainage;
- Pollution and toxicity;
- Energy performance certificates;
- Minimising energy consumption, including insulation and natural ventilation;
- Renewable energy sources, including passive solar energy;
- Waste management and recycling;
- Site waste and site management plans; and
- Transportation and travel plan development.

3.7 High performance buildings

The following table[1] provides an overview of the process for successfully procuring sustainable assets within further and higher education.



[1] *High Performance Buildings for Universities and Colleges* (Thirdwave, SUST: The Lighthouse on Sustainability and Higher Education Environmental Performance Improvement (HEEPI), 2007)

4.0 Assessing existing building stock

Introduction

This section outlines the key issues that are associated with existing buildings and in particular highlights the areas that should be considered when assessing the use of existing building stock.

4.1 Reuse of buildings

Considered reuse of a building is intrinsically a sustainable activity. Upgrading whilst converting existing buildings on campus reduces the environmental impact of using new resources and the need to dispose of demolition waste. It increases the building's asset value and improvements to insulation, lighting, and ventilation can bring better health and quality of life to the occupants.

Before considering the substantive re-use and upgrade of any building, a full survey should be undertaken. Once a survey has been conducted and the institution has decided to restore or refurbish the building, the institution should consider:

- using non-toxic methods to treat rot and other structural problems;
- designing to retain as much existing fabric as possible while reducing waste;
- retaining or selling components, such as doors and traditional fittings to salvage markets;
- whether the proposed changes, for example, altering internal layouts, are reversible and how they may affect potential uses of the building in the future;
- the benefits of restoring original systems and fabric, especially where original provision for natural lighting or ventilation has been undermined by later changes to the design, for example, where partitions have been added or windows sealed; and
- the desirability of traditional construction methods and materials that match the original fabric, balanced with any other environmental, social and financial implications such as toxicity, support for local business or transport costs.

4.2 Disposal of surplus buildings

Following the development of an estate strategy or an options appraisal, buildings may be declared surplus and should be considered for disposal in line with the *Scottish Public Finance Manual* (Scottish Government, 2007) (SPFM). Under the terms of the SPFM, holdings of land and buildings should be limited to the minimum needed to meet present and planned future requirements. Surplus properties should be disposed of within three years, subject to the need to obtain the best price reasonably available.

Buildings may lie empty whilst waiting for disposal. The key issues to address to safeguard a redundant building are:

- ensure that the disused building is kept weather-tight to limit the possibility of rot, damp and/or structural damage – particular attention should be paid to roofs and guttering; and
- ensure that the disused building is kept secure in the interests of safety and to limit the possibility of vandalism or arson – particular attention should be paid to securing all windows, skylights, doors, gates and boundary fences/walls.

The most important issue when safeguarding a building is to ensure that the length of time that the building is redundant is kept to an absolute minimum.

4.3 Historic buildings

Historic buildings are a limited resource and as such demolition should always be considered as a last resort. In many instances, particularly when they have received regular maintenance, historic buildings are highly adaptable and capable of being restored and reused. With a little thought and consideration many of the buildings can be altered to meet the requirements of modern day usage.

Wherever possible and where appropriate the historic character and features of a historic building should be respected and enhanced. Minimal intervention and care must be taken to preserve and enhance any historic and culturally significant features.

Where it is possible, traditional repair techniques and the use of natural or matching materials should be used. For example, repair mortars must be chemically compatible with any lime mortar present. In this instance, specialist advice may be required from bodies such as Historic Scotland. The compatibility of modern materials within the existing fabric must also be considered.

Consent from Local Authorities is required for any work that is to be carried out to a listed building or an unlisted building that is within a conservation area. It is therefore advisable to make contact at the earliest opportunity.

4.4 Demolition and deconstruction of buildings

Having decided upon demolition, there are several key issues that must be considered:

- is the building listed;
- can the building be reused or adapted to meet the requirements of the development or indeed any other relevant uses;
- are there opportunities for improving the energy efficiency of the building;
- what will the disruption and impact be on the local environment and community; and
- is there any contamination or hazardous materials that need to be removed?

Rather than completely demolishing a building, consideration should be given to careful deconstruction. In most cases, the deconstruction of a building for reuse is preferable. The main drivers for adopting this approach are:

- financial savings - the reduction in materials going to landfill, therefore saving on disposal and transportation costs;
- financial earnings - the resale of onsite salvaged materials;
- energy savings - vast amounts of energy is required and expended during the production and transportation of new materials; and
- reduced waste and reduced demand on finite resources - the reuse of building materials onsite.

Each component within a building has the potential to be recycled and re-used. It is recommended that a survey and full inventory is undertaken of the building and its materials in order to ascertain which components may be re-used, recycled or safely disposed of.

Steel formwork, concrete foundations, slates and tiles, timber floorboards and internal fittings are examples of materials that are commonly reused.

Plasterboard, timber, carpets and windows are examples of materials that are commonly recycled.

Asbestos is the most commonly hazardous material that must be safely disposed of.

In all cases, the careful segregation of materials is required to ensure that there is no cross-contamination.

5.0 Practical guidance for estate and facilities management

Introduction

This section focuses on the key issues of sustainable design and suggests methods to resolve them rather than detailed techniques. One of the most important principles of sustainable design is that these issues cannot be considered in isolation and many overlap.

However, not every aspect of the guidance applies in every case. It follows that the best solution in one instance might be quite unsuitable for another. It is up to each institution to assess what is appropriate in the context of their development, using this Guidance to assist. Less glamorous approaches might deliver better long-term performance in both energy consumption and long-term maintenance cost. Reliability and low maintenance costs are most likely to be achieved when simple, proven and passive technologies are favoured over more active ones which rely on mechanical equipment, electronic controls and other complex features to operate effectively.

Developments of different sizes and functions need to address different issues. Therefore, the types of development that individual guidelines apply are identified by the following symbols:

O = existing buildings	□ = extensions/conversions/refit	△ = new build

It is recognised that there is a particular need for Estate and Facilities Managers and personnel to have relevant and appropriate sustainable development advice that addresses issues that impact upon the day-to-day running of existing buildings. For these issues, the general text is followed on the facing page by a stand alone, boxed section highlighted in purple which underlines the key points for consideration.

Specific impact on existing buildings
•

Similarly, for those wishing to focus on the issues that may have a specific impact at an estate level, the facing page will have a stand alone, boxed section highlighted in blue which underlines the key points for consideration.

Specific impact at the estate level
•

5.1 Duty to promote biodiversity

Biodiversity, in Scotland and across the world, is under increasing pressure to survive.

In our countryside, hedgerows continue to be destroyed to permit more intensive agriculture, marshes are drained for development, water is polluted from a variety of sources and rivers are turned into tight drain-like channels. The effect is felt by many species of birds, plants and animals in the UK which are now in decline. Even the once plentiful sparrow is becoming an increasingly rare sight.

Furthermore, pressure on our flora and fauna is predicted to increase as more and more habitat is lost and southerly species begin to migrate northwards as global climate change bites.

Much can be done by individuals and organisations in towns as well as in the country to tackle these problems by providing suitable habitats for animals and plants, even on the smallest scale.

In doing so there can be many additional benefits, such as:

- positioning flora to improve the energy efficiency characteristics of a building;
- planting trees as part of a local and regional pollution reduction strategy; and
- creating a valued social amenity and enhancing community by providing trees, green spaces and water features.

As well as being valuable for its own sake, healthy plant and animal life is good for people. Not only does it provide an attractive and stimulating environment, it also underpins the economy by supplying essential services such as soil creation, biological control of pests, water purification and flood prevention.

Key steps in addressing biodiversity include:

O □ △

- identifying wildlife and plants on or near the site by carrying out an assessment of the site and identifying sensitive and protected areas;
- minimising disturbance to wildlife and plants; and
- enhancing biodiversity by designing landscape features that provide habitats to support a variety of wildlife and plant species.

Specific impact on existing buildings

When undertaking maintenance work the following should be considered:

- make sure any buildings likely to be affected by the development are surveyed for the presence of bats by a suitably a qualified person;
- remember that the species identified in a survey might be affected by the time of year when the survey is carried out, for example:
  - a site may be very important for migratory species that are not present year round;
  - different plant species come into leaf and flower at different times of the year;
  - some animals, bats for example, hibernate in winter; and
- in case of older or dying trees which overhang, keep in mind that some trees are the subject of Tree Preservation Orders - for advice on tree-felling consult the Local Authority's Forestry Officer.

Specific impact at the estate level

Biodiversity can be effectively handled at the estate level as a guiding force by which individual project delivery, new or refurbishment, contributes. As such, some overarching procedures apply:

- avoid disturbing protected plants and animals and time construction work to avoid adversely affecting species on site. It is illegal to either knowingly or unknowingly destroy the breeding sites or resting places of European Protected Species;
- protect trees while working by avoiding physical damage to branches, trunk or roots. Ensure that the soil characteristics around the roots are not altered by oil spillage, changing water tables or raised soil levels. Keep vehicles away from trees - even one piece of machinery going over the roots can cause damage;
- before starting work, fence off sensitive habitats and ensure that any subcontractors understand which areas need to be protected. To ensure compliance, write this requirement into contracts;
- consider the impact of off-site associated infrastructure - such as access tracks, sewage and drainage arrangements that may impact indirectly on valuable habitats;
- when landscaping, avoid invasive foreign plant species that may damage neighbouring habitats;
- support a variety of species by establishing habitats appropriate to the area;
- if there are semi-natural habitats bordering the site, see whether it is possible to enlarge them when landscaping the site or designing sustainable drainage systems; and
- create wildlife corridors where possible.

5.2 Building layout and flexible building design

The layout and construction strategy of a building will greatly influence the performance of the building in use and particularly the ability to adapt and reuse existing buildings in the future.

There is a need to undertake a site appraisal as part of developing the initial design approach to the project. This appraisal will inform the designers about both potential opportunities and restrictions which must be considered in context of the building type.

For example, a site may have a clear aspect to the south which could allow solar gains to be maximised, or solar panels incorporated. Whilst these options should be considered, it may be that the building type is such that cooling is the higher energy requirement which could be served more efficiently by heat recovery from chiller plant.

During the design process, particularly for more complex buildings, the design team should use thermal modelling techniques to analyse the heating strategy for the buildings. These techniques should be used to refine the design and not, as is commonly the case, to identify the problem which is then fixed by adding in more services.

It is also important to remember that within any institution that is undertaking a campus development program, the user groups, the needs of the user groups and teaching methods may change over time. What may be a perfectly usable building in one set of circumstances may well become redundant with the introduction of new technology or pedagogy.

When designing buildings for specialised needs, such as laboratories, thought should be given to alternative uses which they could accommodate in 25-30 years.

By planning for not one but two buildings over time, an institution can refresh its most specialised facilities regularly without impacting on the teaching programme, as well as freeing up an existing asset for redeployment.

Specific impact on existing buildings

An institution must understand their existing built asset in order to be able to plan for future campus renewal.

It is not uncommon for an institution to have inherited a diverse collection of buildings built in different eras and using different construction techniques, many of which may already have had a number of uses and have been altered or extended in the past. These buildings may also be of architectural or historical importance and are protected by statute.

An appraisal should be made of a building's condition, performance and suitability for current and alternative uses. Equally, careful thought should be given to ways in which it might be additionally altered, extended or partially altered to meet new needs.

In some circumstances it may make sense to sell the building and use the capital receipt for a new building or refurbishment of the existing estate.

Specific impact at the estate level

Existing and new buildings should be seen in a campus-wide context, particularly in the ways that existing and new buildings relate to each other. For example, it may seem that some older buildings will always have poor energy performance, however if a new building, which will have a high cooling load, is being built it might be possible to export the surplus heat from one to the other.

Where a number of individual buildings have older boiler plants, a new building could become an energy centre for that part of the campus. Equally, linking buildings or designing in gap sites can not only make better use of space, but partially clothe a poorly insulated building in a new skin.

5.3 *Building materials*

As resources are finite, energy and materials must be used efficiently. Projects should be designed to make efficient use of materials produced with minimal adverse environmental and social impact. The Scottish Government has set targets for the level of recycled material specified in public sector procurement projects. At least 90% (by value) of construction projects should have minimum levels of recycled content in the tender specifications and contracts for goods, works and services. In construction applications, at least 10% of the total value of materials used on projects over £1 million should derive from recycled or reused content. Sustainable materials are:

O □ △

- unprocessed or use a minimum amount of energy in their production;
- non-polluting in manufacture, use and disposal;
- non-toxic in production, disposal and destruction, particularly if burned;
- extracted and/or produced with minimum ecological damage and no worker exploitation;
- sourced near to the point of use, to cut down on transport costs and negative environmental impact and to support the local economy; and
- materials that can be reused and recycled.

Examples of materials that are sustainable are:

- robust, natural and locally sourced;
- demolition materials;
- recycled aggregate / in situ concrete containing pulverised fuel ash;
- lime based mortars (Portland cement production generates 8% of world CO_2 emissions); and
- independently certified timber supplies.

Sustainable products and supplies use materials and finishes that have no, or low, toxicity either in use or in situ. These types of products do not contain or emit Volatile Organic Compounds (VOC) and ensure minimal environmental impacts.

It is important that materials are specified safe for construction workers to use.

The production and transport of building materials consumes large amounts of oil, gas, coal and electricity. This ‘embedded’ or ‘embodied’ energy has its own environmental impacts, such as emissions of carbon dioxide as well as air and water pollutants.

As such, an agreed percentage of materials should be sourced from within a set distance from the construction site so as to reduce the embodied energy / transport related impacts of the building.

These are only some of the factors that should be considered. More detailed information is available from organisations such as the Waste & Resources Action Programme (WRAP) or the Association for Environment Conscious Building (AECB).

Specific impact on existing buildings

When undertaking maintenance work the following should be considered:

- identify the recycled and reused materials to be used;
- identify maintenance work that minimises the use of highly processed materials;
- identify finishes to be used and minimise the use of toxic materials;
- identify how the use of composite materials and non-maintainable components will be minimised;
- avoid applied finishes and finishes that require harsh cleaning regimes;
- ask manufacturers for information the environmental impact of a material and consult independent sources of information where available;
- specify materials that can be maintained and repaired - aiming to minimise the energy consumption and environmental impact;
- avoid composite materials such as steel-reinforced PVC windows or steel cladding with integral insulation, as it is difficult to separate components for recycling;
- where possible, avoid 'no maintenance' products, such as PVC components that cannot be repaired;
- avoid the use of complex assemblies with components from different manufacturers, as obtaining replacements may be difficult; and
- select components that can be safely and efficiently disassembled and reused or recycled if the building is demolished or refurbished. For example, design the building so that components are fixed by bolts, screws, or clips rather than sealants.

Specific impact at the estate level

There is growing awareness of the problem of poor indoor air quality, which is likely to become an increasingly important issue over the next few years. Taking care at the outset to choose paints, carpets and other fittings that do not emit VOCs will reward occupiers with better health, businesses with higher productivity, and developers with a reduced exposure to litigation.

Institutions should set a recycled materials content target informed by the latest research from the Waste Resources Action Programme (WRAP) and use WRAP tools to monitor progress. Committed institutions should be able to achieve 25% or higher at little or no additional cost.

5.4 Water management

Reduce use and demand for water

Adopting water saving measures will reduce the pressure on water resources:

O □ △

- install a meter to monitor the amount of water used so that leaks can be detected and fixed;
- reducing costs of metered water in and sewage water out of sites saving on running costs;
- specify low-flush, dual flush or composting toilets and urinal designs that do not require a constant flow of water;
- fit taps that spread out the water flow so that less is needed for washing;
- select appliances that use water efficiently - refer to EU Energy Labels on dishwashers, washing machines, washer-driers, etc.; and
- avoid using plants in landscaping that require regular watering at times of low rainfall.

Consider re-using greywater and collecting rainwater

A greywater system collects water from sinks, washing machines, etc. which is then screened and treated against contamination before being re-used for flushing toilets and watering gardens. This reduces the need for water supplied through the mains.

Rainwater collected from a roof is relatively clean - as long as the air is clean - so it only requires minimal treatment for non-drinking water uses. When harvesting rainwater:

O □ △

- collect rainwater in water butts for external uses. Keep water containers covered to prevent algae and insects from breeding; and
- capture rainwater through standard guttering with fitted filters and collect it in an underground storage tank.

Consider installing suitable drainage systems

Sustainable Urban Drainage Systems (SUDS) are designed to reduce flood risks and tackle pollution by treating and attenuating water and returning it to the natural drainage system as soon as possible.

O □ △

- design the drainage system from the start as part of an integrated design that includes all aspects of drainage and sustainability issues for both the building and the site.

Specific impact on existing buildings

Consider reusing greywater and collecting rainwater. Mains water is treated to be suitable for drinking but water of such high quality is not needed for other building uses.

Consider installing sustainable drainage systems. Traditional drainage techniques move rainwater quickly from where it has fallen. This can result in flooding, contamination of surface water run-off by oil from roads, etc. and can also deplete water levels.

Specific impact at the estate level

The need to save energy and costs is increasing pressure to conserve water. Mains water treatment and distribution demands significant amounts of electricity so reducing consumption will save energy and reduce running costs where water is metered.

Collecting and using rainwater will reduce the amount of water entering streams and surface drainage systems, which in turn will help to reduce problems with flooding. In areas where rainfall is plentiful, using rainwater is likely to be more cost effective than installing a greywater system.

Consider multiple-use of SUDS areas. This may enhance not only visual amenity but also natural heritage, which in turn may connect fragmented habitats and provide green space and local amenity.

5.5 Pollution and toxicity

According to the World Health Organisation:

> Physical factors in the workplace such as noise, vibration, ionising and non-ionising radiation and microclimatic conditions can also affect the health of building users adversely if not controlled. Occupational chemical exposures are another area of increasing concern. About 100,000 different chemical products are in use in modern work environments and the number is growing.

The health of our natural and built environments is coming under increasing scrutiny as a result.

It is important that materials are safe for construction workers and building users to handle and will not cause problems once they are in place. Using materials that do not damage air quality can reward the users with better health, businesses with higher productivity and developers with reduced exposure to litigation.

Buildings and their construction have profound impacts on:

- the global environment through their direct and indirect generation of gases which promote climate change (most specifically, CO_2); and
- diverse local environments, through the use of natural resources extracted at great environmental cost from all corners of the globe.

However, buildings also have important impacts on the environmental, social and economic areas of their immediate surroundings.

To reduce toxicity and ensure better indoor air quality, the following should be considered:

O □ △

- choose materials that cause minimal harm to the environment in manufacture, construction and use;
- review material choices to ascertain which are toxic in their makeup - refer to the manufacturer's safety data sheets and Control of Substances Hazardous to Health (COSHH) sheets; and
- specify processes for construction, operation and maintenance that have positive social and environmental impacts.

Specific impact on existing buildings

When undertaking maintenance work the following should be considered:

- consider the possible presence of lead paint or asbestos in older buildings and take appropriate precautions;
- when using or specifying imported products or materials, try to ensure that they are not produced in ways that exploit local populations or cause environmental damage - obtain assurance from suppliers and manufacturers;
- specify locally-produced materials to minimise the cost and pollution of transport - however, there is a balance to be struck between sourcing materials locally and bringing in specialised products specific to older buildings;
- as far as possible, avoid the use of toxic timber preservative treatment;
- exercise caution in the use of PVC products and components, and select an alternative material such as timber. There is a significant debate about the safety of PVC in construction, both in terms of the health of building users and its eventual disposal through landfill or incineration - PVC has been banned by several European countries.;
- vitrified clay pipes, which are durable and resistant to chemicals, can be used in place of PVC pipes for underground services;
- use cast iron, galvanised steel or other metals for soil and vent pipes and rainwater drainage; and
- polyethylene and rubber coated power cables give off less toxic fumes in a fire - they are used by many underground railway companies for this reason.

Specific impact at the estate level

Estate wide pollution avoidance strategies should integrate:

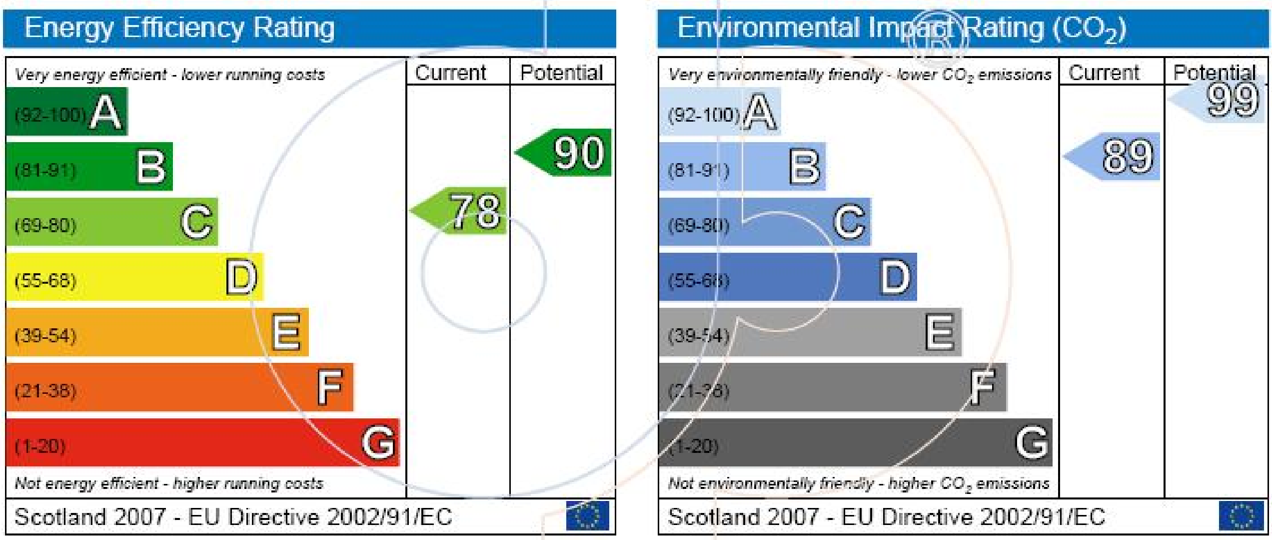
- energy generation;
- waste;
- recycling;
- water treatment;
- material specification;
- maintenance and cleaning regimes; and
- any on site research or experimentation involving chemicals or other hazardous substances.

A duty of care, beyond legal requirements, should be taken to protect all stakeholders against exposure to contaminants and/or volatile organic compounds (VOCs).

Gardening and fertilising routines and water course run-off should also be considered, thereby protecting people, flora and fauna from exposure.

5.6 *Energy performance certificates*

Figure 1: example section of energy performance certificate



The EU Directive on the Energy Performance of Buildings (EPBD) came into force in January 2003. The Directive requires member states to implement the requirement to analyse the energy performances of a range of building types on a systematic and comparative basis, the aim being to provide basic information to building owners, buyers and tenants about the performance of buildings.

The deadline by which Energy Performance Certificates (EPC) must be in place under the Directive is January 2009. However, they are being phased in via different methods in England and Wales, Northern Ireland and Scotland based on specific trigger points. In Scotland, the opportunity has been taken to widen the requirement in order to provide an EPC for the completion of any new building for which a building warrant has been applied for from 01 May 2007.

In addition, the EPBD includes a requirement for all existing public buildings to have a Display Energy Certificate (DEC). Public buildings are defined as "having a useful floor area of 1,000 m^2 or more occupied by public authorities or providing public services". This requirement comes into force in April 2008 and will require renewal on an annual basis.

As the illustration shows, the actual EPC has a design and layout which is similar to the requirements for the energy performance of consumer goods. In the case of a public building, the EPC itself must be displayed in a place clearly visible to the public. These displayed EPCs must be renewed every year.

Every EPC must be prepared by a skilled and independent expert. The Scottish Building Standards Agency is entering into protocols with a number of organisations and professional bodies whose members have the qualifications and experience to produce EPCs, including RICS and BRE.

5.7 Minimising energy consumption

Fossil fuels are a non-renewable resource and will become depleted at some point. However, their current continued production and combustion is a major factor in the climate change impacts that are being experienced across the world. In the UK, as in most developed countries, around 50% of our energy consumption and related emissions are accounted for by buildings and construction.

Historically, the main energy load has been used for heating but a warmer climate and expectations of further temperature rises are resulting in increased demand for comfort and equipment cooling. This has important resource and cost implications for energy loss, for example converting fossil fuels into electricity and converting electricity into 'coolth' by way of mechanical air conditioning. It will also bear heavily on operations costs given that on average it costs three times as much to cool an enclosed space by 1°C than to heat it by 1°C.

The UK and Scottish Governments have ambitious targets to reduce CO_2 emissions which may require further tightening of building codes beyond the changes of the current *Building Regulations, Section 6 of the Building Standards (Scotland).*

Reduction in energy use and incurred maintenance costs can be achieved more readily when simple, established and passive technologies are favoured over more active ones which rely on mechanical equipment and electronic controls to operate effectively.

The following are the four areas that institutions should focus upon for 'easy wins' in regard to passive technologies.

O □ △ ***Insulation***

- Insulation can be integrated into walls, roofs and floors. It is cheap to obtain and has the single largest influence over how much energy a building needs to be heated. Insulation materials should be carefully selected and care taken to ensure that they are all environmentally friendly, biodegradable and come from renewable sources; and
- High embodied energy insulants such as mineral/rock wool should be avoided as they make large CO_2 impacts during manufacture.

O □ △ ***Natural ventilation***

- Natural ventilation uses the passive stack effect and pressure differentials to bring in fresh air from the outside whilst extracting stale air from within the building. This process is undertaken without the use of mechanical systems to cool the building and improves the internal conditions. Energy demand for air-conditioning should be reduced or even eliminated. Natural ventilation can also easily be provided by having windows that open to the outside.

O □ △ ***Natural daylight***

- Day-lighting is the controlled entry of natural light into a building through windows, skylights and other glazed apertures. A properly designed system should only allow as much light as is necessary, avoiding glare. Daylight offers building users connection to the outdoors that can promote well-being and morale.

O □ △ ***Passive solar technologies***

- Passive solar technologies convert sunlight into usable heat, cause air-movement for ventilation or cooling, or store heat for future use, without the assistance of other energy sources;
- Passive solar technologies include direct gain and indirect gain for space heating, solar water heating systems, use of thermal mass and phase-change materials for dampening indoor air temperature swings, solar cookers, the solar chimney for enhancing natural ventilation and earth sheltering; and
- 'Low-grade' energy needs, such as space and water heating, have proven over time to be better applications for passive solar energy utilization.

Energy consumption can be greatly reduced through automated control of heating, ventilating and air conditioning (HVAC) and lighting systems. However, achieving this requires controls which:

- are easily understood and can be adjusted by users;
- are installed, commissioned and operated correctly;
- use proven adaptable technologies such as lighting systems with daylight sensors and movement detection controls;
- should be kept simple with a standard configuration adopted;
- should be capable of manual override for short periods of time or within a range of set points; and
- in all cases, control systems should be intuitive to use and not complicated.

Bodies such as the Energy Savings Trust and the Carbon Trust provide can provide further information and detailed guidance on sustainable energy use.

Energy management and monitoring strategy

The identification of an individual building's energy consumption is required in order to evaluate and assess where energy reductions can be made to minimise use. Evaluations must be done on an individual building basis as building use and user activity will differ throughout a campus. This can be done by monitoring information gained through sub-meters and billing and by energy surveys of the building fabric and of the end-use equipment.

Consumption may also be reduced through supply side intervention. Supply side intervention should be investigated and evaluated in full in order that the best on-site low or zero carbon technology can be selected to ensure its suitability to the site.

Specific impact on existing buildings

When assessing an existing building's current energy consumption, the 'easy wins' in energy savings are often the everyday activities and actions of the building users. A survey of a building's energy consumption should include questions such as:

Has all available natural light been well utilised?	✓
Have energy saving light bulbs been installed throughout the building?	✓
Have all tungsten lamps been eliminated from use in the office?	✓
Are all luminaries of consistent design throughout the building?	✓
Are lighting controls localised to the corresponding work spaces?	✓
Are heating temperatures adjustable in each room/zone of the building?	✓
Have all piping, ducting and vessels been appropriately insulated?	✓
Has a gas condensing boiler been installed?	✓
Has a woodchip boiler been installed?	✓
Have steel panelled radiators fitted with thermostatic radiator valves and low temperature range settings been installed?	✓

Common problems with existing buildings that have impact on energy consumption:

- heating and cooling systems on at the same time;
- blockages in natural ventilation ducts;
- controls which are very difficult to understand or reach, therefore are not used;
- excessive use of artificial lighting in daytime - may be due to blinds or curtains being drawn to reduce glare and reflection; and
- badly functioning building management systems - may be due to programming malfunctioning or the misuse of temporary overrides.

Specific impact at the estate level

Institutions can minimise their CO_2 emissions in part by reducing the energy needed to provide heating, cooling and other services to occupants during the use phase.

5.8 Renewable energy sources

The choice of renewable energy resources will reduce our present dependence on the non-renewable energy sources. Renewable energy sources can be incorporated into new developments and in many instances, reduce the running costs by offsetting the need to import energy. The availability of renewable energy sources will vary from site to site so a careful assessment of the resource over different seasons must be undertaken. Specialised expert advice should always be sought.

O □ △ ***Wind Power***

- Wind power is clean, abundant and renewable and reduces CO_2 emissions if used to replace fossil-fuel-derived electricity. It can be used in large scale wind farms (national electrical grids) as well as small individual turbines to provide electricity for individual buildings. To compensate for the varying power output, grid-connected wind turbines may utilise some sort of grid energy storage.

O □ △ ***Combined Heat and Power (CHP)***

- CHP is an efficient, clean and reliable approach to generating power and thermal energy from a single fuel source. CHP is not a specific technology but an application of technologies to meet energy users' needs. CHP is able to achieve typical effective efficiencies of 50-70%, helping reduce air pollutants and CO_2 emissions. This is a substantial improvement over the average efficiency of separate heat and power.

O □ △ ***Ground Source Heat Pumps (GSHPs)***

- GSHPs are located a couple of metres below the ground where the temperature is a constant 10-20°C. Water is circulated and warmed before passing through a heat pump. The heat pump requires either a borehole or a trench to accommodate the ground loop which transfers the heat from below the ground to the building above. A suitable space free of obstructions is required for a trench, whilst boreholes require less space but may be more costly. GSHPs can be as efficient as a condensed gas boiler and at their most effective when they form part of an under-floor heating system.

O □ △ ***Air Source Heat Pumps (ASHPs)***

- These systems extract thermal energy from the air and upgrade it to a higher, more useful temperature. The system comprises a compressor, an evaporator coil and a heat exchanger. A refrigerant liquid circulates within the system and evaporates when absorbing heat from the outside air. The resulting gas is compressed adding more heat energy. This heat is passed via the heat exchanger into water and used to provide heating through conventional heating systems. ASHPs are most effective in smaller, energy efficient buildings as the technology to date has been developed with the housing market in mind.

O ☐ △ ***Photovoltaics (PVs)***

- PVs technology converts light into energy. PVs generate electricity in any weather condition during daylight hours. PVs need only daylight, not direct sunlight, to operate. PVs systems:
  - can be connected to the National Grid System and feed/sell their surplus daytime energy to a local utility provider who may then supply electricity outside of daylight hours back into the system;
  - can be used on almost any type of roof, however, the optimal roof angle for Scotland is 30^{o} to 40^{o}; and
  - on a north facing roof, generate 60% of the amount of electricity generated on a south facing roof.

O ☐ △ ***Solar Water Heating***

- Solar water systems work by allowing the sun to heat a fluid in a solar roof panel which then circulates through the system and heats the water tank. This preheats the water, reducing the amount of energy needed from elsewhere to heat the water. These systems can supply as much as 50% of hot water use. This system is most effective when employed within large building complexes where large quantities of hot water may be required.

O ☐ △ ***Biomass***

- Biomass involves the growing of crops such as willow that is then dried and fed into a boiler. The collected gas is then used to produce electricity. Forestry and wood waste can also be used. The carbon dioxide produced by the incineration is more than offset by the carbon absorbed by the biomass crop in its lifetime.

Specific impact on existing buildings

When extending, converting or refurbishing an existing property, consider incorporating renewable technologies. Care should be taken to choose an appropriate local supplier as the main cost for many of these systems occurs when the equipment is installed. If installing small scale fixed wind turbines to existing properties, particular attention and advice should be sought as to how the turbine might be fixed to the building. The Local Authority should be consulted. If considering installing a biomass boiler, particular attention should be paid to the supply and sourcing of materials/biofuel to avoid problems in the consistency and quality of materials, especially within an urban setting.

Specific impact at the estate level

Buildings should be constructed and designed to utilise renewable sources of energy. This can be cost effective if incorporated at the earliest possible stage of a development. If it is not possible to do so, then buildings must be designed in such a way as to allow the building to be adapted to use renewable technologies in the future.

5.9 Waste management and recycling

Construction waste results in increasingly large costs to institutions. Disposal charges rise as landfill tax increases and as more and more limited landfill space becomes more expensive.

Much valuable energy is used in producing new products for consumption and prompt disposal, contributing to climate change.

Institutions that are committed to continuous improvement of waste management practices and a reduction in the proportion of waste sent to landfill adhere to the following hierarchy of options:

- reduce at source;
- reuse and repair;
- recycle; and
- responsibly dispose.

Recycling and disposal

Waste Management and Recycling Reports can outline the progress made by a college or university against its waste minimisation and recycling targets during the year. These reports can be included in record keeping or other auditing systems. As a minimum, they should contain details on costs, weights and waste streams.

For construction, institutions should specify reused or recycled construction materials. Some of these recycled aggregates can actually have better performance than new products.

Institutions should adopt separate campus-wide segregation schemes for paper, cardboard, IT equipment and residual general waste. If possible, waste should be sent off-site for further segregation.

The designated Code of Practice should be referred to and extreme care should be taken for the safe collection and disposal of clinical and hazardous waste.

Specific impact on existing buildings

Recycle

Provide written information regarding recycling and the responsible disposable of waste to both staff and students. Provide waste bins that are clearly labelled and have prominently placed pictorial representation. Clear instruction should be given to how best dispose and segregate the waste into the recyclable items:

- glass;
- paper and cardboard;
- some plastics;
- drinks and food cans;
- scrap metal;
- wood and green waste (compost);
- hazardous and clinical waste; and
- Waste Electrical and Electronic Equipment (WEEE).

Reduce

- if you have to print, use both sides of the paper and use toner-saving options;
- buy goods made from recycled content avoiding disposable products;
- do not buy over packaged goods;
- buy things in returnable containers - and return the containers once empty;
- buy in bulk - significantly reducing the amount of packaging going to waste;
- for some products refill packs can be bought, therefore using less packaging.

Reuse or repair

- rechargeable batteries and electrical appliances will save on normal batteries.

Producer responsibility legislation is in place in relation to packaging and end-of-life vehicles and will also extend shortly to Waste Electrical and Electronic Equipment (WEEE).

Specific impact at the estate level

All institutions should be committed to continual improvement of waste management practices and the reduction of waste going to landfill. A Waste Reduction Policy including codes of practice should include, amongst other guidelines:

- a reuse and recycling of computers and other electronic equipment policy; and
- a hazardous waste code of practice.

5.10 Site waste and site management plans

Scotland produces around 19 million tonnes of waste annually, 7 million tonnes of which is from the construction and demolition sector, making up 36% of Scotland's waste. Landfill has been the main and cheapest waste management option but this has changed due to measures such as Landfill Tax. Construction firms are now being urged to take early action on waste before the planned enforcement of Site Waste Management Plans (SWMPs). The plans focus on onsite operations and primarily identify:

- an individual responsible for resource management;
- the types of waste that will be generated;
- resource management options for these wastes;
- the use of appropriate and licensed waste management contractors; and
- a plan for monitoring and reporting on resource use and the quantity of waste.

The key benefits of a SWMP are:

- provides a structured approach to management and recycling on site;
- reduces cost of waste management and increases profit margins;
- better control of regulatory risks relating to materials and wastes onsite;
- compliance of contractual needs of public and private sector needs; and
- helps to deal with any queries from environmental regulatory bodies.

Once a project moves into the construction phase, good housekeeping onsite can help reduce the waste generated and ensure that it is dealt with in an appropriate manner. Practical measures that may be undertaken include:

O □ △

- safe and secure storage of materials to ensure that the materials are less likely to get weather-damaged, broken or stolen; and
- regular removal of debris helps to reduce trip hazards, which account for a significant proportion of construction site injuries.

Segregate all site waste into:

O □ △

- reusable materials such as unused tiles or materials for which salvage markets exist, such as doors, fireplace surrounds or sanitary fittings;
- recyclable materials, such as paper and cans or rubble that can be recycled into secondary aggregate; and
- biodegradable materials.

Ensure that the main contractor has prepared a SWMP that identifies:

O □ △

- types and quantities of waste likely to arise;

- how waste produced onsite will be segregated for reuse or recycling;
- who is responsible for managing waste;
- that rubble or other building materials are not burnt; and
- that all skips are clearly signed.

Include in subcontractors' contracts an obligation to properly use waste segregation facilities. Make sure that site induction for new workers includes instruction on the site's waste management arrangements. Further instruction should be given during weekly toolkit talks. Organisations such as Envirowise can provide further information and details on site waste management plans.

Try to find local uses for reusable materials or send waste materials such as excess topsoil or broken aggregates to be used on another site with current planning permission in force. Any waste transferred in this way must be properly transported and handled at the receiving end to comply with the *Duty of Care under the Environmental Protection Act 1990*. There may be restrictions on the type of waste and where it can be re-used; seek advice from the Scottish Environmental Protection Agency (SEPA).

Specific impact on existing buildings

SWMPs are important for the continued day-to-day operation of any building on campus during a construction phase and can limit the impact of any building works on an estate level. Good housekeeping onsite helps to avoid breakages and results in a site that is safer for workers, staff and the public. Simple measures that can be implemented are:

- the regular removal of waste on a daily basis from work areas; and
- arranging for waste packaging to be returned to suppliers for reuse.

Specific impact at the estate level

The public sector should lead by example in terms of dealing with its waste. The Scottish Government has requested that all public bodies specify the use of recycled materials in all construction and paper procurement.

More sustainable ways of treating waste are being sought as Scotland moves away from landfill. Measures such as recycling and composting are becoming common place and are growing in importance. The perceived image of waste is changing. Waste should no longer be seen as useless. Waste is a resource that has not been used and has a financial value especially when transportation and disposal costs are taken into consideration.

Programmes such as Remade Scotland, the National Industrial Symbiosis Programme (NISP) and the Waste Recycling Advisory Programme (WRAP) are helping to develop markets for recycled products.

5.11 Transportation and travel plan development

To make appropriate provision for sustainable transport options, institutions are encouraged to:

O □ △

- carry out a Transport Assessment, predicting how many people will travel to and from the site and by what means; and
- prepare a Travel Plan based on this assessment.

Details on preparing Transport Assessments and Travel Plans are given in the Scottish Government's *Guide to Transport Assessment in Scotland* (2003). The aim of the Travel Plan should be to:

O □ △

- create high quality pedestrian and cycle routes that will connect the places people want to access;
- provide facilities for cyclists to use roads safely and park bicycles securely;
- link into public transport networks to ensure that sites are accessible; and
- reduce the impact of road traffic by designing road layouts and car parks so that vehicle traffic does not inconvenience users of other forms of transport.

Local Authority Transport Officers are available to offer advice about likely traffic impacts, the level of detail to use in a Transport Assessment and what methodologies to apply. Traffic-flow statistics may be available at a charge.

Encouraging sustainable transport choices does not necessarily mean excluding cars. It does seek to minimise the number of car journeys that are made. The choice of location and layout for developments has a major influence on travel patterns. Large developments should be located so as not to depend exclusively on car access.

Once a Travel Plan is in place, monitor the results and adjust measures accordingly.

When designing for road traffic it is recommended that the following points are considered:

O □ △

- do not allow road layouts to dictate the positions of buildings or pedestrian routes;
- vehicle parking and use should not dominate an area or inconvenience users of other forms of transport;
- minimise the need for parking by choosing the site carefully and promoting alternative forms of transport and car sharing;
- integrate car parking areas into the landscape design;

- design large areas of hard standing to enable rainwater to infiltrate the soil so that it does not contribute to flooding; and

O △

- avoid positioning roads where they might form a barrier to interaction between parts of a community.

Pedestrians and cyclists should have safe and convenient access to facilities and ideally links to public transport services. For more information about providing facilities for cyclists, see the Scottish Government's *Cycling by Design*. Pedestrian and cycle routes should:

O □ △

- be designed to connect people to the places that they would like to go;
- be convenient and direct, with crossings that are easy to use;
- be welcoming, well lit, overlooked and safe;
- be wide enough to allow for expected pedestrian traffic; and
- be easy to locate and follow.

Specific impact on existing buildings

Particular issues that concern cyclists:

- well covered and well sign-posted cycle parking facilities;
- appropriate security in a well-lit area to reduce any fear of crime;
- designed for easy parking and release of cycles;
- easily accessible and close to the entrance of the building; and
- access to showers and locker space to store clothing, equipment, etc.

Particular issues that concern road traffic:

- car parks are secure and well lit; and
- designated parking bays for drivers with disabilities.

Specific impact at the estate level

An institution should seek to work, as part of its commitment to social, economic and environmental sustainability, in partnership with others to reduce its impact caused by travel. Partners may include the Local Authority, transport operators and the Scottish Government.

Institutions should adopt an Integrated Travel Policy and are advised to consult and involve public transport operators from the outset when planning to develop schemes that could generate large numbers of journeys

6.0 Refurbishment and new build

Introduction

Whereas section 5.0 addressed the issues relating to routine operational management, this section addresses the key sustainability issues that should be considered at the various project planning stages for major refurbishment work or new build construction. For further information and general guidance on project development and management please refer to the Scottish Funding Council's *Estate Strategy Guidance* and *Business Planning Guidance*.

6.1 Timelines

Achieving sustainable buildings and refurbishments often requires a slightly different timeline to standard patterns. This does not mean that the end result will take longer to achieve. In fact, sustainable projects often complete ahead of schedule because more time is spent early in the design process addressing subjects such as:

- better team coordination;
- likely construction difficulties;
- early specification and sourcing of key materials; and
- development site waste management plans.

Spending extra time at the beginning of the process reduces the likelihood of problems on site which lead to delay.

6.2 Inception

At project inception, there is a risk that sustainability is not identified as being of sufficient strategic importance to be considered at this stage. However, project inception draws together all the thoughts which instigate the project, such as a spatial or functionality demand, a funding opportunity or a critical maintenance issue. Therefore it is vital that sustainability is seen as an integral part of the design process from the very start. It is the client's responsibility to send unambiguous messages to both internal decision makers and to design teams about the requirement for high performance buildings.

6.3 Appraisal

The appraisal establishes the need for the project, determines whether the existing estate can meet that need and assesses the options for acquisition and refurbishment as well as for new build. Once a project brief has been developed, it should be continually challenged to ensure optimum sustainable performance. For example, project briefs will assume 100% occupancy even on the hottest days, optimising the internal heat gain from people and equipment and determining a higher level of cooling than may actually be required. In this case, it would be necessary to question how likely maximum occupancy would be, particularly given the academic calendar. If possible, provide actual occupancy rates or informed estimates for the design team who will be using analytical techniques such as Computational Fluid Dynamics (CFD) and daylight analysis to ensure that passive heating, cooling and lighting is maximised, therefore designing out services and service running costs.

6.4 Developing a strategic brief

A good brief should send both a general message of intent and set specific non-negotiable sustainability requirements. It should cover issues from the institution's strategic position (Sustainability Policy) through to the finer details of specification and performance. It should also include requirements for thorough commissioning and post occupancy assessments of the building.

It is essential to set clear and measurable sustainability standards as part of the project brief based on current best practice and the institute's own experience and knowledge. Resources should be allocated for the sustainability components and both the design and procurement teams must be under no doubt as to what the performance targets are and the penalties for failing to meet them.

6.5 Design

Key to the successful design of any building or refurbishment is a thorough understanding on the part of the design team of the needs of the client as stated in the project brief. Therefore it is vital that sustainability is on the agenda from the inception stage. It must be made clear to the project team that sustainability is integral to every stage, including the design process.

6.6 The design team

Regardless of scale, when undertaking design and construction projects the assembly of a multi-disciplinary team that works together from goal setting to building operation is essential to the success of a project. In selecting a team the following key players must be considered for inclusion:

- building owner;
- proposed tenants;
- operations and maintenance staff;
- sustainability advisor and champion;
- architects;
- project manager;
- quantity surveyors;
- energy consultants;
- mechanical and electrical engineers;
- construction contractors; and

- material suppliers.

Every team should have someone who has a clear responsibility for promoting the environmental and sustainability issues and is centrally involved in all discussions. This individual should have sufficient authority and knowledge to ensure the sustainability requirements are incorporated into the design.

When appointing team members, consideration should be given to whether the proposed consultants have experience of delivering sustainable development projects, both as individuals and as part of an integrated team. The experience, reliability and project management skills of the contractors and main sub-contractors must also be given careful consideration.

6.7 Procurement

Sustainable procurement is the application of sustainable development principles to procurement. There are a wide range of approaches to sustainable procurement. Institutions should adopt an intelligent procurement policy that makes positive environmental, social and economic impacts.

The *Procura Sustainable Procurement Campaign* defines sustainable procurement in its *Guide to Cost-Effective Sustainable Public Procurement Manual* as follows:

> Sustainable procurement is smart procurement - it means improving the efficiency of public procurement and at the same time using public market power to bring about major environmental and social benefits locally and globally.

For further procurement information please refer to the *Construction Works Procurement Guidance* (Scottish Government, 2005) and the *Review of Public Procurement in Scotland, Report and Recommendations* (John F McClelland, 2006).

6.8 Tendering

Regardless of the chosen procurement route, all tender processes should indicate clear sustainability objectives and should be highlighted at every stage of the process. This may be done by incorporating sustainability criteria within the tendering documents alongside more traditional criteria, such as quality, delivery and costs.

6.9 Communication

As the design process progresses, communication will become more complex, even on relatively simple projects, as more designers, contractors, suppliers and other parties become involved. It is the client's responsibility to challenge the project management team about the principles of the design and to ensure sustainability requirements are incorporated into the project. Therefore, it is vital that there is an effective process for recording and disseminating the outcomes of communication so that these issues are not overlooked.

6.10 Environmental assessment methods of buildings

There are several environmental assessment methods that can be used for assessing the environmental quality of a building or group of buildings. The methods consider the many design issues that impact upon the local and global environments and also the health and well being of building occupants.

The most commonly applied method is the Building Research Establishment Environmental Assessment Method (BREEAM). BREEAM is primarily a design stage assessment. It is therefore important to implement details into the design at the earliest opportunity.

Using this method, buildings are assessed against set criteria and depending on results are either given a rating of; PASS, GOOD, VERY GOOD or EXCELLENT.

Another system is the Leadership in Energy and Environmental Design (LEED) Green Building Rating System™ which was developed by the U.S. Green Building Council (USGBC).

The LEED Green Building Rating System™ promotes a whole-building approach to sustainability by recognising performance in five key areas of human and environmental health: sustainable site development, water savings, energy efficiency, materials selection, and indoor environmental quality. The rating system addresses six major areas:

- sustainable sites;
- water efficiency;
- energy and atmosphere;
- materials and resources;
- indoor environmental quality; and
- innovation and design process.

Using this method, buildings are assessed against set criteria and depending on results are either given a rating of; CERTIFIED, SILVER, GOLD and PLATINUM.

6.11 Construction

The primary concern of contractors is to complete works on time and within budget. Unless the contract is absolutely watertight, the contractor may choose the quickest and/or cheapest solution rather than the highest performance option. Therefore, it should be made clear to contractors and suppliers that the sustainability performance standards are a requirement of the contract and not something to be investigated or considered. When appointing contractors and sub-contractors, the project manager should consider their experience of delivering sustainable development projects.

6.12 Environmental management systems (EMS)

An EMS is an effective tool for managing the impacts of an institution's activities on the environment, including compliance with relevant legislation and showing that they are responsibly managing environmental risks and liabilities. It provides a structured approach to planning and implementing environmental protection measures. An EMS can integrate an institution's daily operations, long term planning and other quality management systems. There are several independent recognised systems. The most common is the international standard ISO14001. ISO14001 specifies all the requirements necessary for a robust EMS. Copies of the ISO14001 can be obtained from the British Standards Institution.

7.0 Post occupancy evaluation

7.1 Handover and monitoring

Commissioning and handover are the formal processes of demonstrating all aspects of the completed building to estate staff prior to the formal completion certificate being issued. It is essential that the proper amount of time is allocated for this activity well before occupancy.

Commissioning prior to handover should be carried out by an independent commissioning specialist. It is a quality assurance process performed after all the major systems have been installed and the building envelope is completed and fully sealed. It checks and fine tunes installed equipment such as building energy management systems, centralised lighting controls, etc. and validates that they conform to the design intent, specifications and the environmental performance criteria.

Although commissioning is relevant to all stages of a building, most activity is in the period before handover. The main environment-related activities which need to be undertaken at this stage are:

- thorough testing of system and equipment performance, using techniques such as air pressure testing and thermal imaging as well as rectification of any problems which emerge; and
- submission of high quality, user-friendly and increasingly, electronically searchable documentation of what has been built and how equipment and systems operate.

Environmental benefits rely on correct installation and operation of integrated systems and optimisation of controls which reflect actual rather than assumed occupancy. For these reasons, the US Leadership in Energy and Environmental Design (LEED) environmental assessment scheme credits independent commissioning and the Building Establishment Environmental Assessment Method (BREEAM) gives credit for seasonal commissioning, i.e. re-commissioning systems every three months during the first year of occupation.

Unless institutions measure the effect of what they achieve and make that information widely available, it is difficult to judge success. Monitoring may be conducted through human observation, mechanical or automated systems. What is important is that it is predictable, consistent, robust and respected. Internal reporting of these measurements can add value to strategic planning, budgeting and operations when they are provided on a quarterly basis or in other ways coordinated with other information inputs to senior management. It is also beneficial to share information with internal and external colleagues who may be addressing similar situations so that they may benefit from and improve on lessons learned from a project.

7.2 Post occupancy evaluation

Post occupancy evaluation (POE) is used as an umbrella term that includes a review of the process of delivering the project as well as a review of the technical and functional performance of the building during occupation. POE is a way of providing feedback throughout a building's lifecycle from conception through to occupation. The information from feedback can be used for informing future projects, whether it is on the process of delivery or on technical performance of the building.

When any programme or project is completed it should undergo a comprehensive POE. Evaluation and feedback are both an intrinsic part of good briefing and design of buildings. POE is highlighted in the Scottish Government's *Construction Works Procurement Guidance* and is part of the Gateway approval process. The principal benefits include:

- fine tuning and evaluating existing buildings;
- assessing building functional sustainability and fitness for purpose;
- improving the design of future buildings;
- improving future procurement processes;
- demonstrating best value; and
- involving stakeholders.

For further information please refer to the Scottish Funding Council's *Post Occupancy Evaluation Guidance*.

8.0 Conclusion

Sustainable development should not be seen as an additional requirement for capital investment but rather as an overarching principle that governs estate management and project development.

The SFC has embedded the principles of sustainability within its capital investment programme by making it a requirement for all SFC supported capital projects to have sustainability inherent in their design, procurement, construction and use.

Revision of the *Sustainable Development Guidance* is intended to help estate professionals and senior decision makers integrate these principles into all aspects of estate and facilities management, estate development and estate strategies.

This Guidance should be used to develop and implement estate strategies and capital projects which will reflect best practice in sustainable development.

Colleges and universities will benefit from a greater awareness and understanding of sustainability. Institutions that promote the environmental well-being of their staff, students and wider communities through the delivery of sustainable estates will not only improve the general quality of life but also provide a vital contribution to the Government's objective of improving Scotland's natural and built environment.

9.0 Case Studies

Case study 1 - new build: Lauder College EcoSpace Facility

The EcoSpace facility at Lauder College was officially opened in February 2007 at a project cost of £4.6 million. The 1,000m^2 building is used to provide students with high quality construction trades training.

The facility was designed and constructed to demonstrate value for money over the life cycle of the building using sustainable and environmental measures. Best practice in waste reduction, reuse of materials, procurement of renewable resources, energy use and other environmentally sustainable work practices is integrated into the curriculum. It is the College's intention that the EcoSpace facility be the cornerstone of the College's sustainability strategy.

Key sustainable features include:

- **Use of a Brownfield Site:** 75% of the excavation material from the site was retained and used on site (4,000m^3), reducing the volume of traffic on the surrounding infrastructure;
- **Porous Paving:** The external access road is formed using porous paving to reduce surface water run-off, lessening the pressure on existing drainage systems;
- **Timber Frame:** Made from Forestry Stewardship Council certified Douglas Fir from managed forests;
- **Auro Paints/Breathing Wall Technology:** Breathable paints, based on natural ingredients and plant and mineral pigments;

- **Rainwater Harvesting System:** Collects water from the existing roof and the new flat roof over the courtyard. Incorporates a greywater, low-flush toilet system and an irrigation system for the *Sedum Roof System*;
- **Solar Panel Energy:** Reduces energy consumption from conventional sources. With a total collector area of $50m^2$ the panels supply 45% of the annual energy required for the domestic hot water system load. It is also estimated that the annual CO_2 emissions savings will be 5.7 tonnes;
- **Sedum (green) Roof System**: Creating habitat for native flora and fauna reducing the amount of rainwater run-off; and
- **Transportation:** The College has a Cycle-2-Work scheme in place and have provided cycle racks to encourage the use of sustainable transport.

For further information please contact Janet McCauslin, Assistant Principal (jmccauslin@lauder.ac.uk) or visit www.lauder.ac.uk/sustainability.

Case study 2 - existing build: University of Aberdeen CHP installation

The University's previous heating system at the Old Aberdeen Campus at King's College was constructed in 1963 and had a life expectancy of some 30-40 years. The boiler plant and ancillary infrastructure had been well maintained over that period and as a result, the life expectancy was extended to 2005/2006. However, an assessment of the condition of the plant was undertaken and it was established that a modern system would be required.

The University decided that the incorporation of a Combined Heat and Power (CHP) plant would significantly improve the efficiency of the system, resulting in reduced expenditure as well as significant reductions in carbon emissions.

The £8.4million project involved the proposed installation of a combined heat and power plant and distribution network which would serve two halls of residence, housing almost 400 students, and 28 academic buildings with approximately 2,000 staff. It was funded by the University and by a Community Energy Programme Grant from the Energy Savings Trust.

CHP installation details:

The system is a Jenbacher 612, a 12 cylinder engine that is fired on natural gas. This engine is capable of producing a maximum of 1,630 kW of electricity and 1,700 kW of heat. The engine can generate electricity in the range of 800 - 1,630 kW. At the Old Aberdeen Campus the site base load is approximately 1,000 kW. This means that there is sufficient electrical demand at the site to allow for the engine to operate for the maximum number of hours of operation without exporting electricity.

The peak electrical loads occur during the working day with the maximum demand being 3,300 kW. During these periods the engine can operate at its maximum output.

Key sustainable features include:

- **Increased efficiency:** By making use of the heat, the overall efficiency of the engine is 83% which compares very favourably with power stations that typically operate at 40% efficiency;
- **Reduction in CO_2 emissions:** The result of this overall improvement of power generation efficiency is a substantial reduction in emissions at the Old Aberdeen Campus arising from use of electricity. The reduction in carbon dioxide emissions is projected to be 4,920 tonnes per annum and additionally it is projected to reduce oxide of nitrogen levels by 45%; and
- **Reduced costs:** Over a year the engine is projected to produce over 60% of the campus site electricity requirements;

For further information please contact John Kingsland, Utilities Manager (j.e.kingsland@abdn.ac.uk).

Case study 3 - sustainable development strategy: St Andrews University

In January 2006, the University Court of the University of St Andrews drafted and approved a Sustainable Development Strategy. The Strategy details how the University will meet a range of environmental and sustainability commitments. Central to this is the objective of integrating sustainability aspects into the day to day operations of the University. This includes research, teaching and estates related issues. The Sustainable Development Strategy recognises the difficulty in achieving a cultural shift amongst a wide number of stakeholders and other challenges such as rising energy and water bills, waste management, travel and transport, sustainable procurement and stricter environmental legislation. By ensuring that research, teaching and estates planning aspects are integrated, the University considers that this is the best way to embed sustainability within the institution.

In implementing the University's sustainability commitments, a positive response from staff, students and support by senior management lies at the heart of this endeavour. This support has provided the impetus, leadership and direction to ensure appropriate management and resource is in place to effectively deliver sustainability improvements.

An example of the integration process is the creation and issue by the Estates Department of a Design Guide for designers, architects and other consultants in order to place an emphasis on sustainable design. The Design Guide and supporting processes are being used to ensure refurbishment of existing buildings, as well as new developments, include sustainability aspects in their design and build.

The University recognised that it is fundamental to engage with the Project Team for new buildings and refurbishments at an early stage in order to explain University objectives and to understand how best to achieve good design that meets the University's needs. These needs also include consideration of:

- effective commissioning post-construction;
- robust maintenance of buildings, including new build;
- optimum space utilisation and maximisation of occupancy within the building; and
- monitoring of energy performance of the new building to determine if the building meets its design targets.

These considerations now form the core elements of how the University thinks about its procurement and management of new buildings refurbishments of existing building stock.

For further information please contact Roddy Yarr, Environment and Energy Manager (try@st-andrews.ac.uk).

10.0 Legislation

Colleges and universities should be familiar with the terms of the following environmental regulations and ensure compliance with the relevant legislation:

Air

Pollution Prevention and Control (Scotland) Regulations 2000
http://www.scotland.gov.uk/Resource/Doc/158532/0042982.pdf

The Greenhouse Gas Emissions Trading Scheme Regulations 2005
http://www.defra.gov.uk/environment/climatechange/trading/eu/pdf/etsregs05.pdf

(as amended)
http://www.defra.gov.uk/environment/climatechange/trading/uk/pdf/ggets-amend2007.pdf

Defra's *Carbon Reduction Commitment*
http://www.defra.gov.uk/environment/climatechange/uk/business/crc/index.htm

Energy

European Union Energy Performance of Buildings Directive
http://www.cibse.org/index.cfm?go=page.view&item=556

Hazard / Safety

Special Waste Regulations 1996
http://www.wasteworks.org.uk/legislation/legislation_detail5.asp

(as amended) http://www.sepa.org.uk/guidance/waste/amendment_faq.htm

Information

Freedom of Information (Scotland) Act 2002
http://www.scotland.gov.uk/about/foi

Environmental Information (Scotland) Regulations 2004
http://www.scottishexecutive.gov.uk/Publications/2004/11/20280/47014

Land

Town and Country Planning (Scotland) Act 1997 (Section 75)
http://www.scottishexecutive.gov.uk/Publications/2005/09/0893247/32533

Radioactive Substances

Radioactive Substances Act 1993
http://www.environment-agency.gov.uk/business/444304/945840/1064273/?lang=_e

The HASS (Scotland) Directions 2005
http://www.scotland.gov.uk/Publications/2005/09/-18

Waste

Environmental Protection (Duty of Care) Regulations 1991 (as amended)
http://www.defra.gov.uk/environment/waste/legislation/pdf/waste_man_duty_code.pdf
http://www.gw-consulting.co.uk/consultancy/dutyofcare.html

Waste Management Licensing Regulations 1994 (as amended)
http://www.sepa.org.uk/groundwater/legislation/waste_management_licensing.htm

End of Life Vehicles (Storage and Treatment) (Scotland) Regulations 2003
http://www.scotland.gov.uk/Resource/Doc/47210/0014608.pdf

Waste Incineration (Scotland) Regulations 2003
http://www.scotland.gov.uk/Publications/2005/04/19140354/03551

Waste Electrical and Electronic Equipment Regulations 2006
http://www.dti.gov.uk/innovation/sustainability/weee/page30269.html

Producer Responsibility Obligations (Packaging Waste) Regulations 2007
http://www.defra.gov.uk/environment/waste/topics/packaging/index.htm

Recycled Content in Construction Projects
http://www.wrap.org.uk/construction/construction_procurement/scottish_public_sector/construction.html

Water

The Water Environment and Water Services (Scotland) Act 2003
http://www.sepa.org.uk/groundwater/legislation/water_environment_services.htm

(Consequential Provisions and Modifications) Order 2006
http://www.opsi.gov.uk/SI/em2006/uksiem_20061054_en.pdf

Water Environment (Oil Storage) (Scotland) Regulations 2006
http://www.sepa.org.uk/regulation/oilstorage2006/index.htm

11.0 Sources of further information

Bibliography

Addis, B (2006) *Building with Reclaimed Components and Materials, A Design Handbook for Re-use and Recycling*

AUDE (2006), *Guide to Post Occupancy Evaluation* University of Westminster

Berge, B. (2000) *The ecology of building materials* Architectural Press London

BioRegional (2006) *Toolkit for Carbon Neutral Developments Part 1: The BedZED Construction Materials Report* http://www.bioregional.com/publications

BRE
(1995) Report 288 *Designing buildings for daylight*
(1995) Report 209 *Site layout planning for daylight and sunlight: a guide to good practice*
(2002) IP9/02/1 *Refurbishment or redevelopment of office buildings? Sustainability comparisons*
(2002) IP9/02/2 *Refurbishment or redevelopment of office buildings? Sustainability case histories*
(2005) *Standard Assessment Procedure (SAP 2005)*

CIBSE (2005) *Climate change and the indoor environment: impacts and adaptation*

CIRIA
(1997) SP133 *Waste minimisation in construction - site guide*
(2002) C578 *Brownfields - managing the development of previously developed land: a client's guide*
(2004) C607 *Design for Deconstruction: principles of design to facilitate re-use and recycling*
(2000) C521 *Sustainable urban drainage systems - design manual for Northern Ireland and Scotland*

Constructing Excellence (2004) Whole Life Costing
http://www.constructingexcellence.org.uk/pdf/factsheet/wholelife.pdf

Commission for Architecture and the Built Environment (2005) *The Value of Good Building Design in Higher Education*

Envirowise (2005) *Saving money and raw materials by reducing waste in construction: case studies from Scotland* http://www.envirowies.gov.uk

EST
(2004) CE65 *Community heating – Aberdeen City Council case study*
(2006) *Energy Efficiency: The Guide, Scotland Version*
(2006) *EU Directive on the Energy Performance of Buildings – implementation in Scotland*

Gill, B and Manchanda, S. (2006), *Z-squared; construction systems from waste - increasing recycled materials in the Thames Gateway volume 1: Background and analysis of materials, BioRegional*
http://www.bioregional.com/programme_projects/opl_prog/squared/zsquaredreports.htm

Gill, B and Manchanda, S. (2006), *Z-squared; construction systems from waste – increasing recycled materials in the Thames Gateway volume 2: Details of product and material alternatives, BioRegional*
http://www.bioregional.com/programme_projects/opl_prog/squared/zsquaredreports.htm

Hacker, J., Belcher, S. & Connell. R, (2005) *Beating the heat: keeping UK buildings cool in a warming climate*

HEFCE, *Risk Management - A guide to good practice for higher education institutions, Bristol, 2001* www.hefce.ac.uk/pubs/hefce/2001/01_28.htm.

HMSO (1997) *The climate of Scotland; some facts and figures.* http://www.metoffice.gov.uk/climate/uk/averages/19712000/index.html

H M Treasury (1997) *Appraisal and Evaluation in Central Government (the Green Book) HMSO* http://www.hm-treasury.gov.uk./media/D5E/29/96.pdf

Historic Scotland (1998) *Memorandum of guidance on listed buildings and conservation areas* http://historic-scotland.gov.uk/memorandumof guidance_1998.pdf

Institute of Civil engineers *ICE Demolition Protocol*
http://www.icextra.ice.org.uk/tlml/demolition

ISO
14040:2006, *Environmental management – Life cycle assessment – Principles and framework*
http://iso.org
14044:2006, *Environmental management – Requirements and guidelines*
http://www.iso.org

Katz, G. (2003) *The Costs and Financial Benefits of Green Buildings, A Report to California's Sustainable Building Task Force*

Local Governments for Sustainability, European Secretariat, *The Procura Manual, A guide to Cost-Effective Sustainable Public Procurement, 2nd Edition*

Leaman, A. (November 2000) *The Productive Workplace: themes and variations* Building Services Journal

Littlefair, P. (2001) *Solar energy in urban areas* BRE

McClelland, J.F. (2006) *Review of Public Procurement in Scotland. Report and recommendations*

Morgan, C. and Stevenson. F. (2005) *SEDA design guide No.1 Design and Detailing for Deconstruction*
www.seda2.org

Office of Government Commerce (2001) *Achieving Excellence - Procurement Guide.*

Royal Academy of Engineering (1998) *The Long Term Costs of Owning and Using Buildings*

Royal Institute of Chartered Surveyors (2005) *Green Value - Green Buildings, Growing Assets*

Scottish Government
(2004) *One future - different paths: the UK's shared framework for sustainable development*
(2005) *Choosing our future: Scotland's Sustainable Development Strategy*
(2003) *Guide to Transport Assessment in Scotland*
(2006a) *Changing our ways: Scotland's climate change programme*
(2006a) *People and place: regeneration policy statement*
(2006) *Renewable energy* Draft Scottish Planning Policy SPP 6
(2001) *Planning and urban sustainable drainage systems* PAN 61
(2002) *Renewable energy technologies* PAN 45
(2003) *Design statements* PAN 68
(2006) *Planning for micro renewables* PAN 45 Annex
(2004) *Best Value and Biodiversity in Scotland - A Handbook of Good Practice for Public Bodies*
(2005) *Construction Works Procurement Guidance*
(2007) *Scottish Public Finance Manual*
All can be found at: http://www.scotland.gov.uk

SEPA
(2005) *Drainage assessment - a guide for Scotland*
http://www.sepa.org.uk/publications/leaflets/sud/index.htm
(2003) *National Waste Plan*
www.sepa.org.uk
(2006) *State of the environment*
www.sepa.org.uk

Stern, N. (2006) *The Stern Review on the economics of climate change*

Thirdwave (2006) *Designing for Sustainability in the Highlands, Development Plan Policy Guidance*

Thirdwave, SUST: The Lighthouse on Sustainability and the Higher Education Environmental Performance Improvement (HEEPI) (2007), *High Performance Buildings for Universities and Colleges*

Town and Country Planning Association (2006) *Sustainable Energy by Design*

US Green Building Council (2002) Building Momentum: National Trends and Prospects For High-Performance Green Buildings
www.usgbc.org/Docs/Resources/043003_hpgb_whitepaper.pdf

Useful Organisations

Environmental Association for Universities and Colleges
http://www.eauc.org.uk/home

Sustainable Development Unit, DEFRA
http://www.sustainable-development.gov.uk

Sustainable Development and Biodiversity Division, Scottish Government
www.sustainable.scotland.gov.uk/

Communities Scotland
http://www.communitiesscotland.gov.uk/

Sustainable Development Commission, Scotland
http://www.sd-commission.org.uk/scotland.php

Scottish Natural Heritage (SNH)
http://www.snh.org.uk

Scottish Environmental Protection Agency (SEPA)
http://www.sepa.org.uk

SBSA
http://www.sbsa.gov.uk/

Association for Environment Conscious Building (AECB)
www.aecb.net/

Building Research Establishment (BRE)
www.bre.co.uk/

Carbon Trust
www.thecarbontrust.co.uk/

Envirowise
www.envirowise.gov.uk/

Energy Saving Trust
www.est.org.uk/

Institute of Environmental Management and Assessment
www.iema.net/

Leadership in Energy and Environmental Design (LEED)
www.usgbc.org/LEED/

National Industrial Symbiosis Programme (NISP)
www.nisp.org.uk

Natural Building Technologies (NBT)
www.natural-building.co.uk/

Netregs
www.environmentagency.gov.uk/netregs/

Remade Scotland
www.remade.org.uk/

Scottish Water
www.scottishwater.co.uk

Scottish Waste Awareness Group
www.wasteawarescotland.org.uk

Sustainable Design in Architecture (SUST)
www.sust.org/

Waste and Resources Action Programme (WRAP)
www.wrap.org.uk/