

Knowledge Summary

Energy management in buildings December 2008

**Prepared by Catherine
Haynes, CIRIA**



Introduction

This knowledge summary outlines the issues and challenges that facility managers need to consider with regards to energy management in buildings. It also suggests how energy management policies may be approached and applied to both new and existing buildings. This summary highlights the different challenges faced by new build and refurbishment of existing stock. Most importantly it outlines the opportunities available to improve energy efficiency in buildings.

This report has been produced by CIRIA in conjunction with the Modern Built Environment Knowledge Transfer Network (MBE KTN).



Fig. 1 LED building in Korea. LEDs for exterior lighting are an energy efficient option. They have high durability and intelligent light control.

Energy and buildings overview

Modern society in the developed world is based on the assumption that energy is both freely available and relatively cheap. However, the global consumption of energy has economic and environmental impacts. High energy expenditure by our consumer society is of major concern. Buildings are responsible for around half of all energy consumed in the UK and nearly fifty per cent of all carbon dioxide emissions. Energy demand and supply is heavily influenced by the built environment. If the UK Government is committed to targets for reducing carbon emissions it is vital to make buildings energy efficient (see: <http://www.berr.gov.uk/whatwedo/sectors/construction/sustainability/page13691.html>).

Energy use in buildings

Why is energy wasted?

- poorly designed buildings and installations. Buildings that are poorly insulated result in high space heating costs. Undersized mechanical ventilation ducts leads to high fan consumption power
- inadequate controls for heating systems
- poor control settings or wrongly set heating systems so that the building is being heated when not in use
- inefficient plant operation, use of old or out of date technology. This is parallel to poor maintenance practises
- poor operating and working practices (photocopiers left on, heating at highest setting all day)
- building designers do not pay energy bills. The design process is closely allied to the construction process and usually designers select the low capital cost solutions. This results in high operating costs. There are different budgets for construction and running a facility
- energy consumption is taken for granted. Most building occupiers do not pay the energy bills. They are concerned with their own personal comfort and not the amount of energy being consumed
- most organisations do not have a culture of energy efficiency
- in many countries the cost of energy is low in comparison with labour costs

The Building Regulations introduced major changes in 2002 covering the conservation of fuel and power, for domestic buildings (part L1) and non domestic buildings (part L2)

It is important to recognise that there are cost effective energy efficient measures that go beyond the minimum standards required.

Managing energy use in buildings

Some organisations are being encouraged by stakeholders and customers to take action on the energy performance of their buildings.

Energy management policies or schemes will only succeed in delivering long term improvements if there is sustained

commitment and buy in from top level management.

The main activities for developing an energy management policy are;

- analysing stakeholders needs
- determining current energy consumption and costs
- mapping the ways in which energy is used
- identifying factors which affect energy use
- determining performance against benchmarks
- analysing energy use, so that realistic targets can be set
- recognise the environmental impacts of energy consumption

Before a framework for an energy management scheme can be applied or any energy saving measures undertaken it is first necessary to collect comprehensive energy data. The aim of an energy audit is to identify viable and cost effective energy measures, which will reduce operating costs.

The audit process usually involves collecting data from energy invoices, meters and undertaking surveys of equipment and the building. This should identify problem areas and help resolve occupant comfort issues.

Energy auditing can be expensive. Preliminary studies determine if a more detailed survey is needed by highlighting the areas to focus on.

The development and implementation of the energy management policy should engage the entire workforce. To be effective it must be agreed and improved by everyone and incorporate action plans based on actual budgets and realistic energy targets.

Heating

Heating needs vary greatly from building to building, however the same issues should be considered;

- centralised or decentralised – prices and availability of fuel, space available for the distribution of pipework, size of loads

- combined heat and power (CHP), simultaneous on-site generation of both electricity and heat. There is a heating source issue with CHP (see <http://www.chpa.co.uk/>)
- types of heating system – consider the system previously installed, heating requirements, level of insulation, building design and structure, building function and availability of fuels
- heating controls – time control, optimum start control, weather compensation, room thermostats, black bulb thermostats, zone controls, thermostatic radiator valves (TRVs) (see <http://www.bbc.co.uk/bloom/actions/radiatorvalves.shtml>) and Building Energy Management System (BEMS) (see <http://www.carbontrust.co.uk/Publications/publicationdetail.htm?productid=CTL019&metaNoCache=1>)
- boilers – these range from small domestic central heating systems to large industrial boilers. There are opportunities to replace old boilers with more efficient models. Boilers should only run when there is a heat demand and consider using heaters other than the main boiler when demand is low (eg during summer months). All parts of the boiler system should be properly insulated so heat is only supplied or used where and when is it needed.

Lighting

Lighting accounts for twenty per cent of the UK's electricity use. Modern energy efficient lights and controls can reduce energy consumption whilst also improving the quality and quantity of light delivered. This is referred to as energy effective lighting. There are opportunities to maximise the use of natural daylight and to design in cost effective controls for new buildings. Substantial savings can be made by retrofitting and improving existing systems. Benefits include saving energy and running costs, improved visual environment and increased end user control.

Ventilation and air conditioning

Natural ventilation is the most energy efficient. Mechanical ventilation provides filtered air that can be heated or cooled.

Fans and pumps consume considerable amounts of energy. Cooling systems should be controlled similar to heating systems.

In the design process natural ventilation should be considered for;

- reduced energy consumption
- lower capital costs
- reduced maintenance costs
- reduced plant noise
- more direct control for users

It is recommended to group energy intensive equipment into a few mechanically ventilated areas allowing the rest of the building to be naturally ventilated.

The “stack effect” refers to ventilation stacks used to draw air in at lower levels and as it rises warms the building. Most effective natural ventilation is achieved using a combination of low level windows and high level vents.

Building fabric

Most building fabric measures are cost effective when they form part of general maintenance or refurbishment. Typical measures include:

- insulation of loft spaces
- draught stripping around windows and doors
- fitting secondary glazing
- installing cavity wall insulation or internal/external wall insulation
- reducing excessive glazed areas by replacing glass with insulated wall panels

Solutions for existing buildings

In existing buildings the scope for improving energy efficiency is reduced although there are still options for refurbishment or replacements. For example:

- minimise cooling needs through the use of building fabric
- maximise the use of natural ventilation
- upgrade the lighting systems with more efficient lamps and controls
- hot water can often be provided in more efficient ways

- improved control systems
- using energy efficient office equipment

Opportunities in new buildings

Energy conscious design involves modifications to conventional design;

- optimise the location and orientation within a site
- make use of the lay-out, form and fabric to moderate energy needs
- reduce heat demand by using insulation and air tight construction
- meet remaining heat demand with efficient controls
- fitting automatic closures on outside door
- passive solar design uses free solar gains to offset energy demands

These are most effective when introduced with energy efficiency measures.

Energy Performance Certificates and Display Energy Certificates

Energy Performance Certificates (EPCs) give an energy efficiency rating and advice on improvements that can be made to buildings. Display Energy Certificates (DECs) show the actual energy consumption of a building. They are now a legal requirement for public buildings with over 1000m² floor space. All properties will have a certificate when they are constructed, sold or let by 2009. EPCs for non-domestic buildings focus on design and construction elements whilst DECs are concerned with the operational rating. Communities and Local Government have introduced EPCs and DECs as measures to improve the energy efficiency of our buildings. There are currently no legal requirements to act on a low rating however in an increasingly competitive and environmentally aware consumer market high ratings are attractive to potential tenants and buyers.

(For further information see references section).



Fig. 2 The twelve story headquarters for Public Utilities Commission in San Francisco is a leading building demonstrating energy and water efficiency and a reduced carbon footprint.

Summary – people and energy management

Energy wastage comes from poor strategic and operational management and a lack of energy saving culture amongst staff. Energy can be saved by instigating good work practices. For example simply switching off lights and equipment when not in use and by reporting defects as soon as possible.

It has been estimated that most energy bills can be reduced through establishing good energy management practices. It is therefore worth considering the human aspects of energy management schemes.

The sustainability of buildings is not just about energy efficiency. Other factors such as water efficiency and the movement of people and goods to and from buildings are also important. There is a pressing need for action and improving the energy efficiency of the built environment. The economic costs and risks are not an option.

References

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http://www.tcpa.org.uk/press_files/pressreleases_2008/20080331_CEG.pdf
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Useful websites

Building a greener future: Policy statement
<http://www.communities.gov.uk/publication/s/planningandbuilding/building-a-greener>
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Building Regulations Part 2L 2000
http://www.planningportal.gov.uk/uploads/br/BR_PDF_ADL2A_2006.pdf
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About the Modern Built Environment Knowledge Transfer Network (MBE KTN)

The MBE KTN is a single, national, overarching knowledge transfer network for the built environment. It aims to stimulate increased innovation and support its effective implementation in the modern built environment.

MBE KTN works with its members to identify industry challenges, showcase potential innovations, broker new collaborations, facilitate access to funding opportunities and help members connect

with each other. It is currently concentrating on five themes that have implications for all sectors of the built environment:

- Energy Efficiency
- Adaptability of Space
- Intelligent Buildings and Infrastructure
- Climate Change Impact
- Life Extension of Structures and Building Refurbishment

Web: www.mbektn.co.uk

Email: information@mbektn.co.uk

Tel: 01923 664473