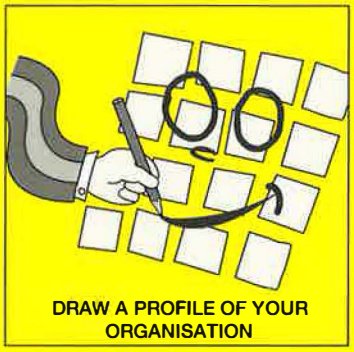
SOME BUILDINGS ONLY NEED FINE TUNING

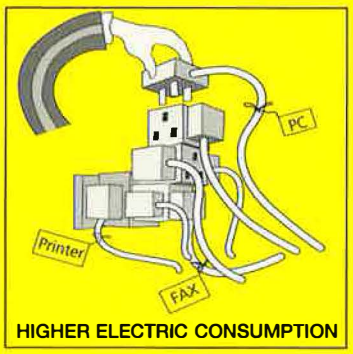


DRAW A PROFILE OF YOUR ORGANISATION

INCREASINGLY ASKED TO THINK GREEN

FIDDLING WITH THE CONTROLS

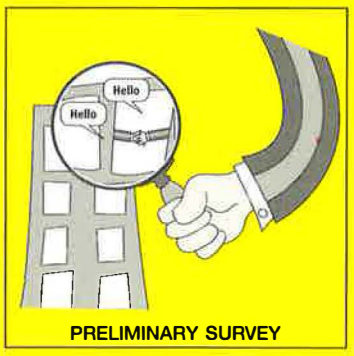
NOT JUST TECHNICAL ISSUES



HIGHER ELECTRIC CONSUMPTION

CHEAP BUILDINGS MAY NOT GIVE THE BEST VALUE

AMBITIOUS FIRST ACTION



PRELIMINARY SURVEY

THE FACILITIES MANAGER'S ENERGY PRIMER

BEST PRACTICE PROGRAMME

ENERGY EFFICIENCY

DEPARTMENT OF THE ENVIRONMENT

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THE FACILITIES MANAGER'S ENERGY PRIMER

THE ROYAL INSTITUTION OF CHARTERED SURVEYORS

British Institute of Facilities Management

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CONTENTS

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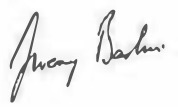
FOREWORD

We welcome the opportunity to introduce this publication which is the result of collaboration between the British Institute of Facilities Management, the Department of the Environment and the Royal Institution of Chartered Surveyors, and results from a project managed by the Building Research Energy Conservation Support Unit (BRECSU) as part of the DOE's Energy Efficiency Best Practice programme.The impact on the environment of human activity is significant. It is estimated that 15% of the UK's total energy expenditure comes from non-domestic buildings. With all organisations seeking ways in which they can improve their cost control and enhance their profitability, attention to the organisation's energy use will aid the balance sheet and contribute towards improving the environment.

Deciding where to start, an ad-hoc or systematic approach, what energy conservation may include and how to measure the benefits may be some of the questions which you are facing. This guide will assist managers from non-technical backgrounds, by providing a general overview or stimulate interest in energy efficiency from other key stakeholders helping the more experienced facilities manager. In easy stages you will learn how to reduce running costs, gain ideas for actions and where to find further sources of information.

Applications of the ideas and techniques in this guide should lead to benefits for business and the environment.

Jeremy Bayliss



President
The Royal Institution
of Chartered Surveyors

Derek Paxman

Chairman
The British Institute
of Facilities Management

HOW TO USE THIS BOOK

This guide to managing energy efficiently gives an overview rather than detailed guidance. It will be particularly relevant to someone from a non-technical background for whom energy management is only one aspect of the job.

Parts of the guide will also be of interest to more experienced facilities managers, for example those who have recently taken up a new post or see an opportunity to reactivate interest in energy efficiency in their existing organisation.

We have used the term 'facilities manager' to refer to anyone concerned with the interaction between buildings and their occupants. You may have a background in engineering or maintenance, or perhaps have experience in personnel management or accountancy. You may operate within an organisation's structure, or in a specialised facilities management consultancy.

The purpose of the guide is to help you think about how to integrate energy efficiency into all aspects of your role in the management of facilities. In this respect its main objectives are:

- to help you to reduce energy consumption and running costs of your building
- to improve your own understanding
- to give ideas for action
- to help you enhance your influence with other people in your organisation, especially with senior managers
- to give pointers to further sources of information.

The chapters can be read in any order – not necessarily in one sitting. Most of the detailed guidance is in Part 2 of the guide which can be dipped into at will. What we would suggest is that you get an overview of what the book contains so you can refer back to it when you want particular help.

PART 1 OPPORTUNITIES

MANAGING ENERGY EFFICIENTLY

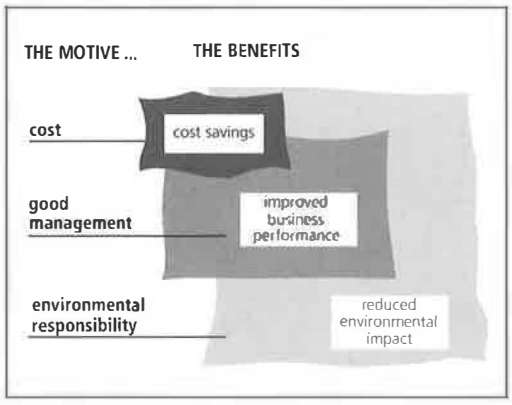
You have a hundred and one things on your plate. Energy management may only be your concern for a small proportion of your time – if it is formally a part of your job at all. So why should you bother about it?

The case for energy efficiency

Energy efficiency can save money. Saving energy could release funds for other activities within your organisation – improving patient care in a hospital, for example, or developing new business opportunities in the retail sector. Energy may be one of the largest controllable costs for your organisation, and thus a handy source of improvements to profitability.

Environmental issues have also come to the forefront, both as a motivator for individuals to cooperate in energy-saving initiatives and as an important aspect in client relations.

Energy efficiency means providing the required environmental conditions for building users at minimum cost – in other words, increasing value for money.



Staff costs immensely outweigh expenditure on the buildings that house them. This means that improving working conditions can bring savings in staff effectiveness that greatly multiply cash savings on fuel bills.

Energy efficiency is an indicator of all round management effectiveness. You can demonstrate the impact you are having in this area, improving your department's profile within your organisation and advertising your own talents. Even if your organisation as yet places no special emphasis on energy efficiency, your competitors may.

What impact can you have?

Your role as a facilities manager may involve making strategic decisions with wide-ranging implications for energy use.

Some of these have immediate energy use implications, for example fuel budgeting. However, many others have indirect energy implications; for example, decisions about space standards could influence how much heating is required. Selection of furniture systems can have an impact on how efficiently the heating and air-handling systems work. Even activities unrelated to energy – for example specification of a security system – could be linked with monitoring energy use, through an automated building management system (BMS).

The diversity of the facilities manager's activities can be broadly categorised as:

1 Providing accommodation and services which allow your organisation to meet its core objectives.

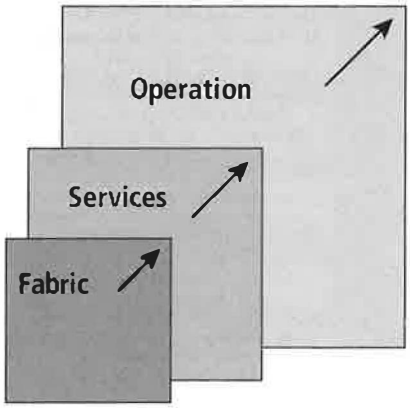
2 Providing a comfortable and satisfying working environment for people in your organisation.

3 Using resources efficiently and reducing costs in the provision of this accommodation.

Trying to improve the energy efficiency of the buildings you occupy needs to be set in the context of these overriding objectives. So energy management is but one aspect of good facilities management and efficient resource utilisation.

Interaction of the three factors

Fabric, services and use can account for a ten-fold variation in energy operation between similar buildings. Plan depth, orientation and façade design can account for a variation of about 2.5 times. Differences in building services extend the range to about 5 times and variation in building operation extends this to 10 times.



Buildings and energy use

The interaction between buildings and the people who use them is complex. Three factors contribute to the energy efficiency of your building:

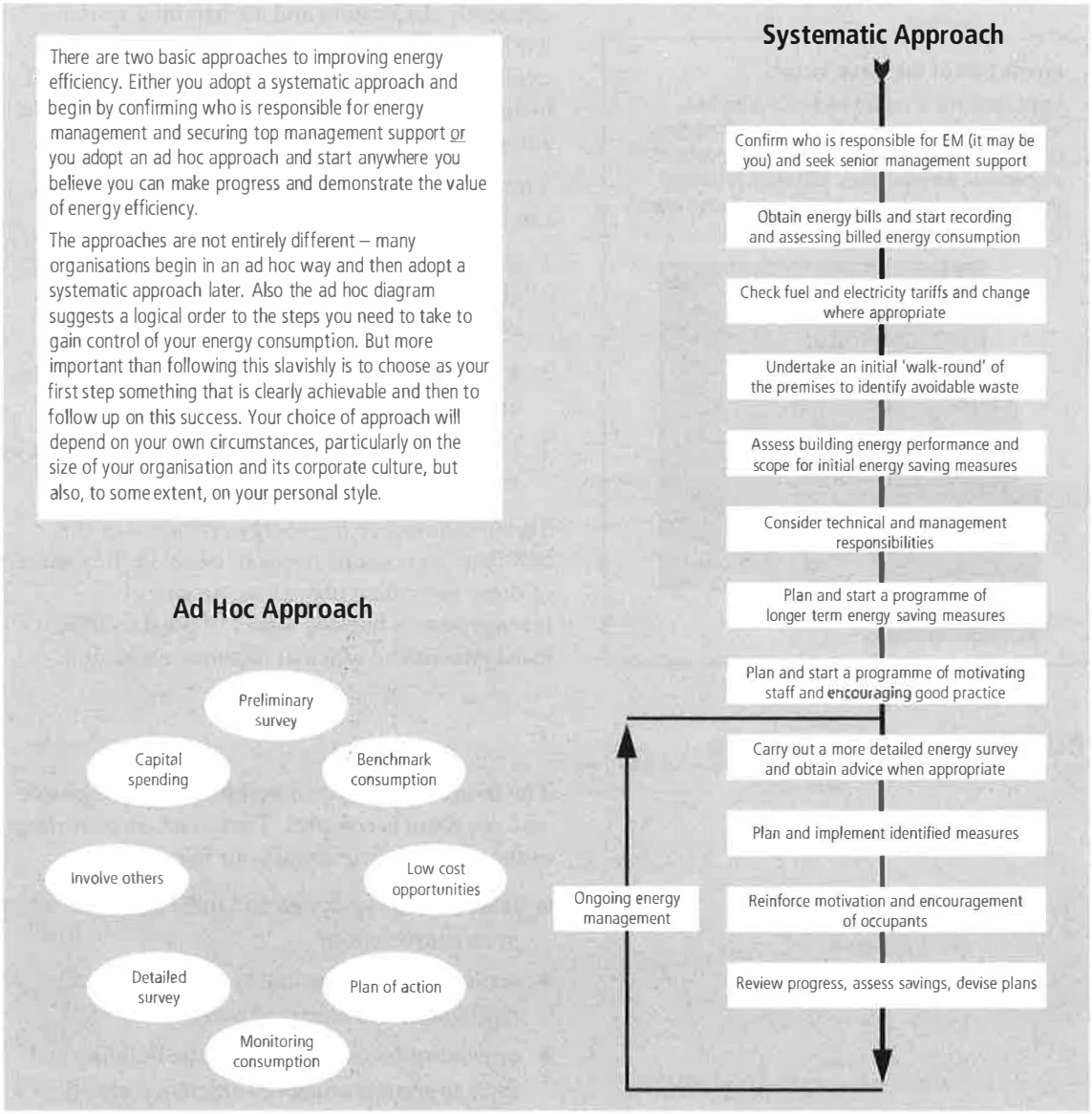
- **fabric** (building design and materials used in its construction)
- **services** (environmental systems, including mechanical and electrical plant)
- **operation** (occupants' use of the building and their awareness of energy efficiency issues).

Any of these three areas could offer scope for improvements in energy efficiency, and there is a multiplier effect if you make progress in more than one area. **The first imperative is to get a feel for how your building is performing** now, and how much potential there is for improvement. This benchmarking process is described on pages 35-36.

Systematic or ad hoc approach?

There are two basic approaches to improving energy efficiency. Either you adopt a systematic approach and begin by confirming who is responsible for energy management and securing top management support or you adopt an ad hoc approach and start anywhere you believe you can make progress and demonstrate the value of energy efficiency.

The approaches are not entirely different – many organisations begin in an ad hoc way and then adopt a systematic approach later. Also the ad hoc diagram suggests a logical order to the steps you need to take to gain control of your energy consumption. But more important than following this slavishly is to choose as your first step something that is clearly achievable and then to follow up on this success. Your choice of approach will depend on your own circumstances, particularly on the size of your organisation and its corporate culture, but also, to some extent, on your personal style.



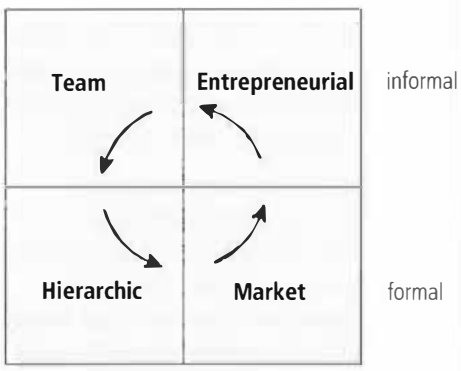
NEEDS AND OPPORTUNITIES

A facilities manager who can deal with the other parts of the job should have no difficulty with energy management. A key to success is understanding your organisation. Organisations are not static and processes of change create opportunities that can be exploited to gain energy efficiency improvements.

Organisational cultures

Corporate Culture

A simple model of corporate culture based on the formality of an organisation's management structure and the timescale over which it plans. Although one of these cultures may predominate, most organisations contain a mix of cultural types



Every organisation has a different set of priorities and operating conditions so that no two will ever go about the same task in exactly the same way, even if they are in the same business. How priorities are expressed to some extent defines the respective cultures, perhaps influenced by the dominant personality of a single charismatic individual or a particularly strong mission. Some organisations care for the environment and turn this into a unique aspect of the culture, helping to set the organisation and its products apart from competitors. Others believe in keeping costs down above all else; or in service to the customer.

Many facilities staff are experienced at 'reading' the culture and some can intuitively understand what will work and what will fail in a given situation. **In order to be effective, it is essential to work in sympathy with your organisation – but also to take opportunities which present themselves.**

Your starting point will depend on the existing skills, interests and objectives of your organisation's staff. A technologically-oriented company may naturally gravitate towards excellence in building services or information services, and naturally recruit more people with these skills. A company which has a strong personnel department may appoint its facilities staff from its ranks, and they may then naturally focus on health and safety,

housekeeping, personnel and other non-technological matters.

Needs and priorities

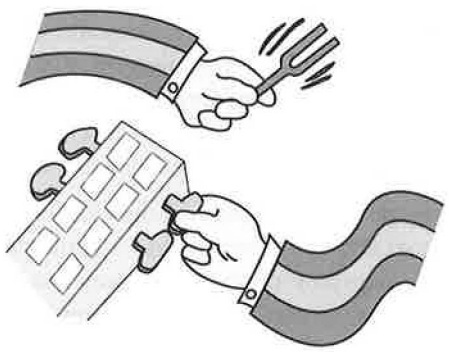
In most organisations core objectives come first. Unless there are very well argued reasons for introducing green initiatives like energy efficiency, they will not be given priority.

Energy efficiency is just another form of good management practice which happens to have individual, organisational and environmental as well as cost payoffs. There are several similar areas which can also fall within the responsibility area of the facilities manager – building maintenance, for instance, cleaning, personnel programmes or health and safety initiatives.

All of these share common management features which may include:

- Regular auditing or monitoring of performance, whether for space occupancy, energy, routine maintenance, risk (insurance) or health and safety reasons.
- Checking performance against pre-defined objectives, standards, indicators and industry norms.
- Dealing rapidly with problems when they occur, especially those which directly affect the work, comfort and health of staff, and being able to deal with situations which may be risky or dangerous.
- Clear communication of changes in procedures, design changes or changes in customary policies which affect staff and/or users, and the ability to deal with users' problems when they arise.

Because facilities tasks have a common basis, involving similar techniques and methods, excellence in any one of them can contribute to excellence in most or all of them. **The very activity of monitoring performance and acting on the findings helps to ensure that the total environment is being properly looked after.**



SOME BUILDINGS ONLY NEED FINE TUNING

People sometimes say that plants grow better if you talk to them every day. It may be true, but it certainly is not the talking, it is the constant 'performance monitoring' which is critical.

A virtuous circle?

One Bridewell Street

One Bridewell Street Bristol, pre-let by the developer MEPC to Arthur Young (now Ernst and Young), is far more energy efficient than most air-conditioned offices.

Because well-developed management and quality control procedures are in place and the building used simple and robust designs with good user control interfaces, efficient energy performance figures are achieved. The building is also extremely comfortable for its occupants.

Strategic planning

Forte plc (formerly Trust House Forte), the international hotel and restaurant group, has had an energy-efficiency policy since the mid 1970s, when the oil crisis first made clear the likely social consequences of finite environmental resources. The policy and its implementation has now become a part of the company's normal operation, so that energy matters always have a place in the group's strategic planning. In this way, environmental thinking has become internalised in the company culture, and is no longer perceived by staff as a costly extravagance. A clear link has been demonstrated between costs and benefits, and interest engaged at board level. Energy efficiency is now the norm for facilities managers.

Experience shows that organisations which excel at any one of these tasks – planned maintenance, for instance – will eventually find that they excel at the others. For example, research evidence shows that office buildings which have comfortable and healthy staff are also likely to be more energy efficient than the norm. There is no direct connection – energy efficiency does not cause comfort or satisfaction by itself but there is an indirect relationship via good management practice. As comfort is also linked to staff productivity, there is convincing evidence in support of what can be referred to as a 'virtuous circle' where health, comfort, satisfaction, cleanliness, staff productivity and energy efficiency are all linked together and tend to reinforce each other, underpinned by a common body of effective management procedures.

The offices at One Bridewell Street, Bristol illustrate that high performance standards can be achieved through good management practice throughout the briefing, design, fit-out and occupancy stages. High performance is the result of expertise and attention to detail rather than high-tech design solutions.

Office energy costs usually account for only 1-2% of total occupancy costs including salaries and it often seems a wasted effort to reduce these further. But if effort spent on energy efficiency also cascades through the organisation so that other invisible benefits are gained in health, comfort and productivity then this gearing effect will quickly pay for the extra cost.

Keeping complexity under control

All buildings impose some kind of management cost, as they all need cleaning and maintaining to some extent. However, as buildings become more complicated, especially as lighting, heating, cooling and control systems are introduced to service deeper plan forms – or to satisfy notions of corporate 'prestige' – so the management costs increase more rapidly. Facilities managers are often aware of the inefficiencies and costs of buildings whose complexity outruns the capability of management resources to cope.

Part of your job may involve coping with the consequences of unnecessary complexity, for instance occupant discomfort, tortuous services, incomprehensible controls and dangerous activities. There are two solutions: simple and robust solutions which help to reduce management and cost overheads, or seek more resources to help manage problems created by physical design. Either strategy may help, but the first is much more efficient than the second.

Responding to changes

Health, productivity, satisfaction, comfort and energy efficiency all tend to be found together because they all share common good practice management features. Rapid response to changes in these features is most important to maintain standards in the organisation. Generally speaking, if your organisation has clear goals which are well communicated, rapid decision-making and response, with a good understanding of costs and performance, it is also likely to be energy efficient.

Response time applies to many different aspects of the building – the speed with which the building adjusts to human comfort requirements; the ease with which furniture and partitioning layouts can be changed; how fast the cabling can be reconfigured; the speed with which complaints are dealt with; how fast graffiti is erased and the effectiveness of maintenance and repair regimes.

Changes that create opportunities

- Relocating, acquiring new premises or rationalising the existing estate
- Altering the organisation's areas of activity or revising product/services mix
- Refurbishing existing premises/plant/equipment
- Making major plant/equipment/materials purchases
- Renewal of contracts for maintenance to premises, plant and equipment

It is essential to match the physical characteristics of the building with those of its control system and the needs of its occupants. The more a building is tuned to user needs, and how these change over time, the better people will like it. This is why it is not sufficient to provide facilities 'just in case' they will be required, leaving them running when people are not present, because this is intrinsically wasteful and inefficient. It also shows again how energy efficiency is connected to good management elsewhere in the building. The more the physical and technological systems – fans, pumps, lights, heaters and chillers – switch off when not required, the more demand is being properly met. So sensitivity to demand and speed of response is critical to good performance.

Opportunities

If energy management is only a part of your job, you will need to focus your efforts to achieve success. Decide where you stand the most chance of achieving an improvement and build on that success.

At a series of energy management workshops organised by BRECSU in 1993, 470 facilities managers were asked what they thought was their best opportunity to make progress in energy management in their organisation. Their answers were categorised into the four main areas shown in the box *Opportunities for improvement*.

Opportunities for improvement

Incentives

- obtaining top management commitment
- implementing an energy policy
- offering incentives to individuals or departments

Promotion

- publicising cost savings
- promoting energy as a 'green issue'
- marketing inside and outside the organisation

Accounting

- local responsibility for energy use
- energy accounting
- investment appraisal

Expertise

- broadening personal experience/knowledge
- staff training in good housekeeping
- incorporating energy measures in new-build/refurb

Around 60% of respondents saw their best opportunity in the area of incentives or promotion. This emphasises the importance to many facilities managers of an organisational approach to improving energy performance, and may give you some ideas for applying to your own situation.

The best time to make a major improvement in your organisation's environmental performance is when a significant change is being considered. See box *Changes that create opportunities* for the kinds of things you need to look for.

These are your major opportunities for making significant improvements to your organisation's environmental impact. Notice they operate over different time scales. They happen infrequently. So, when such changes are proposed, you need to seize the opportunities they represent. If you miss them, they will lock your organisation into unnecessarily heavy environmental impacts for long periods, potentially ranging from a year to several decades. Use the set of questions in the box *Checklist for change* to help you prepare for what needs to be done.

Checklist for change

- In what order are opportunities likely to occur?
- Will any of them occur in the next six months?
- Are these the ones you should concentrate on first?
- Will others initiate them without consulting you?
- How can you influence their decision-making?
- Are there changes you should be initiating yourself?
- What do you need to do now to be prepared?
- With whom do you need to consult or negotiate?
- Who has the authority to sanction the decisions?
- Who holds the budgets that will need to be tapped?
- Should you act as a broker between these people?

It should be clear from this list of questions that you will not be able to bring about the changes you are seeking by yourself. Sometimes you will need to work with – even build alliances with – other people inside your organisation, some of whom you have never cooperated with before. Sometimes you will need to look for advice and support from outside.

Energy management matrix

To be successful organisations need to adopt a balanced approach to energy management. There is not much sense in having a highly sophisticated information system if the information is never used by managers.

To help facilities managers measure their organisation's approach to energy management, the Department of the Environment has published an Energy Management Matrix. This is described in detail in BRECSU/DOE General Information Reports 12 and 13.

You can use the matrix to draw a profile for your own organisation. The shape of this profile indicates where energy management is more or less advanced and where attention needs to be directed.

The Matrix

Locate your own organisation on the matrix by:

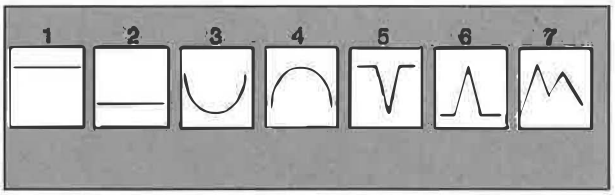
1 Considering each column, one at a time. Mark the place in each column which best describes where you think you are currently located. You can put your mark in the middle of the square, between squares or anywhere between 0 and 4 on the scale.

2 Joining up your marks across the columns to produce a graph line.

	Energy Policy	Organising	Motivation	Information systems	Marketing	Investment
4	Active commitment of top management	Fully integrated into general management	All staff accept responsibilty for saving energy	Comprehensive system with effective management reporting	Extensive marketing within and outside organisation	Positve discrimination in favour of 'green' schemes
3	Formal policy but no commitment from top	Clear delegation and accountability	Most major users motivated to save energy	Monthly monitoring and targeting for individual premises	Regular publicity campaigns	Same appraisal criteria used as for all other investment
2	Unadopted policy	Delegation but line management and authority unclear	Motivation patchy or sporadic	Monthly monitoring and targeting by fuel type	Some ad hoc staff awareness training	Investment with short term payback only
1	Unwritten set of guidelines	Informal part-time responsibility	Some staff awareness of importance of energy saving	Invoice checking	Informal contacts used to promote energy efficiency	Only low cost measures taken
0	No explicit policy	No delegation of energy management	No awareness of the need to save energy	No information system or accounting for consumption	No marketing or promotion	No investment in energy efficiency

The Profile

- provides a diagnostic tool for assessing energy management in your own organisation
- helps you focus on one area to attempt to make progress

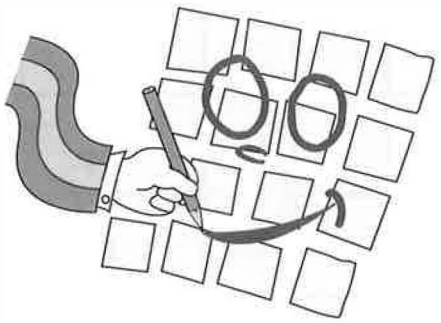


Different profile shapes imply different problems and suggest different courses of action:

1 A flat line at the top of the matrix means excellent performance. The problem is to maintain this high standard.

2 A flat line in the middle or low down means less advanced performance. Possibly you have only just started to think about energy management.

3 The U shape indicates that policy and investment are more advanced. This is a risky shape. Adopting a corporate policy and investing in energy efficiency means that senior management attention will be focused on you but the other areas of energy management are undeveloped and this puts your effort at risk.



YOU CAN USE THE MATRIX TO DRAW A PROFILE FOR YOUR ORGANISATION

4 The ∩ shape is the opposite condition. The structure is in place and motivation is high, but there is no corporate commitment and no money for investment so little is likely to be achieved and this effort will be wasted.

5 The trough reflects good performance on all fronts but one and this imbalance may hold back achievement on a broad front.

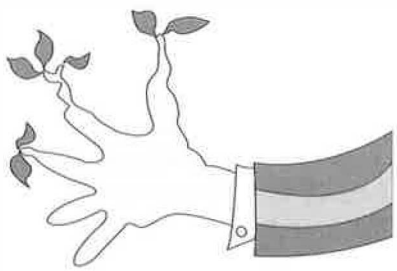
6 The peak shows that one area is more advanced than the rest and since there is no support for this advance this effort will also be wasted.

7 Imbalanced profiles show that again effort is likely to be wasted because some areas are more advanced than others. About a third of delegates to the workshops drew this kind of profile.

ENVIRONMENTAL IMPACT

There is little doubt that facilities managers are increasingly being asked to think 'green'. The principles of the green agenda have gained widespread acceptance – but how can good intentions be turned into action?

Thinking green



FACILITIES MANAGERS ARE INCREASINGLY BEING ASKED TO THINK GREEN

Organisations need to pay increasing attention to the environmental impact of their operations. However, the extent to which you are currently expected to take action on this front varies. You may work for an organisation that has already introduced an environmental policy. Perhaps your organisation has even decided to comply with the British Standard in this area, BS 7750, or the European EMAS (Eco-Management and Audit Scheme) and is setting about introducing an appropriate environmental management system. Maybe reducing your organisation's environmental impact, through improved management of its facilities, has already been written explicitly into your job description. If you are in any of these positions, then you need to be able to recognise and act upon the opportunities open to you to help you to deliver these responsibilities.

Or you may work in an organisation that hasn't got an environmental policy. If you do, the likelihood is that it will introduce one in the foreseeable future, even if only in response to growing UK government and European legislation and directives, if not because of pressure from shareholders, financial institutions or consumers. In this case, your organisation's ability to show that it is making progress on this front will become more important over time, as clients, customers, and staff become more aware of green issues

UK and EU legislation and codes of practice

It is important to draw a distinction between mandatory legislation and codes of practice which are voluntary.

Mandatory

Health and Safety at Work Act 1974

Environmental Protection Act 1990

COSHH Regulations 1989 and 1990

EEC Workplace Directive 1989

Health and Safety (Display Screen Equipment) Regulations 1992

Noise at Work Regulations 1989

Voluntary

BS 7750 Environmental Management System 1994 (revised version)

EC Eco-Management and Audit Scheme 1993

BRE Environmental Assessment Method 1990

BSRIA Environmental Code of Practice 1994

DOE Energy Efficiency Best Practice programme (Making a Corporate Commitment campaign)

through the publication of indicators showing which organisations are performing best.

It is important to draw a distinction between legislation which you have to comply with, like the Health and Safety at Work Act, and codes of practice which are voluntary, like the BS 7750. (See the box *UK and EU legislation*.) The British Standard assumes, for instance, that compliance with existing legislation is the bedrock minimum against which your organisation measures its environmental performance. The Standard deals with the kinds of management structures, action plans, and review processes you need to put in place to make successive improvements over time. Outside of the Building Regulations (which only apply to new buildings and extensions), action to reduce energy consumption remains voluntary in the UK at present. So this chapter concentrates on voluntary actions which, like the Department of the Environment's Energy Efficiency Best Practice programme, describe management practices and technological opportunities above minimum statutory requirements.

Although voluntary at present there will be increasing pressure to comply with these standards. If you attend to them now you will save money and hassle in the future.

Identifying environmental impacts

CO_2 emissions

	kg/kWh delivered	pence/kWh
Electricity	0.68	6.37
Coal	0.32	0.99
Petroleum	0.28	0.97
Gas	0.19	1.31

1993 Figures: Building Energy Efficiency Group, BRE.

Electricity produces four times as much CO_2 as gas and costs five times as much.

The mix of fuels that your organisation consumes gives rise to varying amounts of carbon dioxide emissions which contribute to the threat of global warming through the so-called Greenhouse Effect (see the *CO_2 emissions* box). If your buildings have air-conditioning systems that are operating inefficiently, then you may be releasing CFCs which deplete the ozone layer. Both of these impacts occur at the global level.

The electricity you consume may be supplied by power stations that are emitting sulphur dioxide, harming plant and animal life not only within the UK but far away amongst our Northern European neighbours.

FREQUENT ACTIONS WITH
SMALL ENVIRONMENTAL IMPACTS

INFREQUENT ACTIONS WITH A
LARGE ENVIRONMENTAL IMPACT

As facilities manager, there are strategic decisions your organisation makes over which you have no control. But you do need to be aware of their energy and environmental impact – not least because, overall, they may undermine improvements you make in how much energy is consumed inside your buildings.

If your organisation has chosen a location which means that most of your staff have to commute to work by car, then this will add to pollution at the local level, both in terms of traffic noise and congestion, as well as reducing air quality through harmful emissions. Transport is the fastest growing area of energy consumption in the UK.

Strategic decisions, like choosing a location for your new premises so that staff can use public transport, can be more important than day-to-day operational decisions about whether you use recycled paper or switch to low energy light bulbs. If you are responsible for reducing your organisation's environmental impact, you will have to operate at both these levels:

- strategic – infrequent actions with large environmental impacts
- operational – frequent actions with small environmental impacts.

How regularly and how well you clean your premises – both in terms of plant and equipment and furnishing and fittings – will also affect air quality inside and outside your buildings. Inadequate maintenance to cooling plant and equipment, for instance, can lead to the risk of occupants and even passers-by contracting legionnaires' disease. Inadequate internal cleaning can lead to allergic reactions, affecting occupants' health, increasing staff turnover and absenteeism, and so reducing your organisation's productivity.

Environmental impact

Internal Thermal comfort, glare, air quality, noise, allergy risk from toxic materials and processes, quality of cleaning

Local Air pollution (CO, CO_2, NO_2) and noise from commuting and from on-site operations; land contamination; water pollution; Legionnaires' disease from cooling systems

Regional SO_2 pollution from electricity generation and CO_2 pollution from transport energy consumption

Global CO_2 emissions contributing to global warming; CFC emissions contributing to depletion of ozone layer; depletion of finite resources, eg energy, hardwoods, top soil, bio-diversity

The box *Environmental impact* shows a wide range of impacts which your organisation may be having on the environment. Depending on where you are located in your organisation, and how your responsibilities are defined, you may be required to introduce policies and practices to manage any or even all of these.

Looking at this list may help you to assess where your own responsibilities currently lie and who else you need to collaborate with, inside your organisation, in order to deliver an effective and comprehensive environmental strategy.

Just how significant is energy?

Buildings consume about half the energy used in the UK and are responsible for a similar proportion of CO_2 emissions. **Although energy consumption isn't your organisation's only environmental impact, it is probably one of its most significant.** Facilities managers have estimated that it represents somewhere between 25-50% of the environmental impact that they are personally responsible for reducing. Energy consumption is certainly involved, in one way or another, in most environmental impact.

Properly managing your energy consumption may be the only area in which you can reduce your organisation's environmental impact without imposing additional costs. Indeed, making your organisation more energy efficient will often lead directly to cost savings. So gaining control over your energy consumption, and managing this resource more effectively, are good ways to start implementing an environmental strategy.

But success on the energy front alone is not enough. Successful environmental management requires a holistic, integrated approach. **You need to make progress across a broad range of fronts and avoid over concentrating on single issues.** Above all, you have to guard against making

improvements in one area that lead to higher environmental impact in another.

Identifying priorities

It isn't possible to be categorical about what you should do first. This will depend on a large number of factors, including:

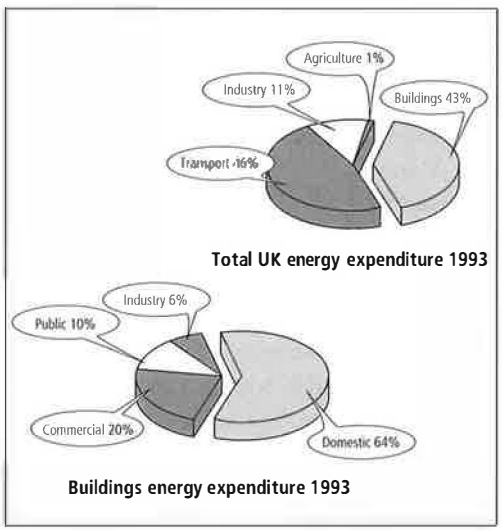
- the nature of the organisation you work for and its types of activities and operations
- your range of environmental impacts and their intensity
- whether you have a fully developed environmental strategy in place or are just starting out down the road to effective environmental management
- whether you are responsible for formulating policy or simply implementing one that has already been decided elsewhere
- the level of corporate commitment you can depend on and the extent to which this has been translated into access to resources, staff time or external expertise.

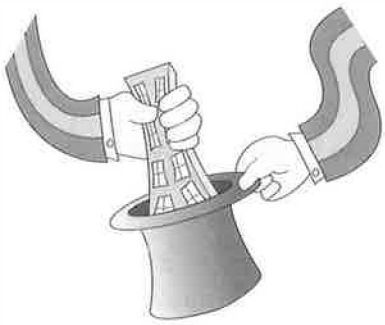
For all these reasons, facilities managers legitimately disagree about what should be given priority. What you need to do is identify what is most appropriate in your own particular case.

One of the most important factors affecting your chances of success is your personal style – how you like to get things done – and how well this meshes with the circumstances you find yourself in.

Some people prefer a systematic approach to energy management:

- defining a policy
- gaining corporate commitment for it
- getting the right management and auditing systems in place
- assembling a robust database about current performance
- drawing up a short-term action plan, and





AN IMPORTANT FACTOR AFFECTING SUCCESS IS YOUR PERSONAL STYLE

- developing a long-term programme of work.

Others like a more 'ad hoc' approach:

- narrowing in immediately on a substantive issue where rapid achievements are possible, and
- using these achievements to signal the benefits of 'going green'.

These two approaches, the 'systematic' and the 'ad hoc', have their strengths and weaknesses. You need to choose one that best suits you and the corporate culture of the organisation in which you work. In the medium-term, it is worth trying to mesh these two approaches together into a coherent whole, through a series of short-term goals underpinned by an adequately resourced, long-term strategy.

Setting goals and performance indicators

On the energy front alone, there is a wide spectrum of ways in which you can set yourself goals and targets. It is important here to be clear about what you are actually trying to achieve. Is your aim solely to save your organisation money? If so, you can probably do this through buying your fuels more cheaply or by installing equipment that will make you more productive or efficient. But, while both of these measures may reduce your bills (energy and/or staff costs), the first won't reduce the amount of energy you consume and the second may actually increase it (whilst delivering improved output). Even if your goal is to reduce the amount of energy you consume, is this to be measured in an absolute or relative way?

Senior management may be keen to reduce energy consumption, but they are unlikely to be willing for this to occur at the expense of core business objectives. Core objectives may involve growth diversification and possibly a more energy intensive mix of products. The aim, of course, is to achieve the required level of output for the minimum use of energy.

Targets

Define targets and performance indicators which are realistic and will work in your organisation.

Set reduction targets:

- per heated area (m^2) volume (m^3), or
- per member of staff, or
- per unit of production or service delivered

Report results by:

- reduced consumption, fuel by fuel, or
- reduced fuel bills, section by section, or
- reduced CO_2 emissions, section by section

BUILDING PROJECTS

Involvement in major building projects is the exception rather than the rule for facilities managers. But these projects – whether new build or refurbishment – provide a special opportunity for higher standards of energy efficiency. This chapter explains how to keep energy efficiency high on the agenda.

'Let's build!'

From time to time the facilities manager's routine is interrupted by a dramatic event – a new building or a major refurbishment project. Suddenly budgets are measured in millions of pounds instead of thousands and all the defects and difficulties you have learned to live with are up for grabs. It's an exciting opportunity – but a challenge. How do you make the best of it?

It is vital that your organisation's requirements and objectives dominate the project, and this includes your energy efficiency objectives.

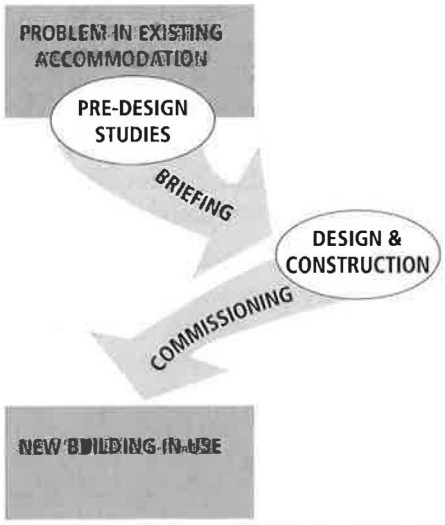
This chapter describes some factors that will affect the ultimate energy efficiency of the new building, and suggests some ways that you as facilities manager can contribute to, and influence, the project. This advice should be relevant for any project involving significant expenditure on building work other than routine maintenance expenditure, including new build, refurbishment and fit-outs or re-fits.

Briefing and commissioning are critical points in the dialogue between users and the construction industry.

In briefing the design team you describe the building you require, including its energy performance, and in commissioning you check whether you are getting what you ordered. See the box *The building process*.

The building process

The development of a new building begins with a problem or a need. Pre-design studies lead to the crystallisation of a brief. The facilities manager should be fully involved at this stage. The initiative then passes to the design and construction professionals who turn the brief into reality. Their work is monitored by the facilities manager who returns to centre stage on commissioning.

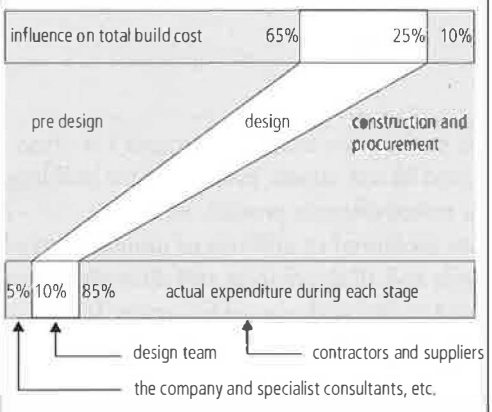


Pre-design – when to build, what to build, where to build

Diminishing effect of decisions

About 65% of the cost-critical decisions in a building project are made by the time the brief is written, about 25% are made during design, and only about 10% during construction. Yet only 15% of the expenditure goes on pre-design and design activities, and 85% is spent on construction itself.

A similar pattern applies to energy use – almost all of the energy-critical decisions are made before construction begins, and the pre-design phase is the most important of all.



Pre-design – key points

Location – An energy efficient building in a location reached only by private car might easily cause a net increase in energy consumption.

Incremental change to stock – Aim for the greatest incremental improvement in performance of your organisation's whole stock of buildings, don't focus narrowly on the new part. Can poorly-performing buildings be taken out of use?

Energy inflation – Be aware of the tendency for refurbishment projects to cause increased energy consumption, due to improved performance standards.

Activity analysis – There must be an accommodation problem or you wouldn't be thinking of a new building, but take the opportunity to think really carefully about what kind of building would be most appropriate.

Many of the facilities manager's most critical inputs are made before the design stage is reached. The project really begins with the emergence or perception of an accommodation problem or need, often caused by growth, by new activities, or by the obsolescence of existing buildings.

The most important single pre-design decision is that a new building is needed. No subsequent decision will ever have as much impact. Is a new building really needed? Consider, for example, whether rationalising the use of existing buildings could solve the accommodation problem.

Early decisions have the most impact while omissions are difficult and expensive to remedy later.

About 65% of the cost-critical decisions in a building project are made by the time the brief is written, about 25% are made during design, and only about 10% during construction. Yet only 15% of the expenditure goes on pre-design and design activities, and 85% is spent on construction itself. A similar pattern applies to energy use – almost all of the energy-critical decisions are made before construction begins, and the pre-design phase is the most important of all. See the box *Diminishing effect of decisions*.

Let's assume that a new building is the right solution. Some key issues that must be addressed in the pre-design stage are outlined in the box *Pre-design – key points*. Some of them may not appear to be energy-related issues, but in fact basic factors like the size of building and its location have a dramatic effect on energy consumption.

The role of the facilities manager in these vital pre-design studies will vary from organisation to organisation and project to project. Certainly the facilities manager will not work single handed; often professional advisors are brought in even at this pre-design stage.

Organising the project

Finding an energy efficient designer

Who you appoint as your design team is critical to achieving an energy efficient design. But finding an energy efficient designer is not easy.

Networking:

Use your contacts in the facilities management world.

Free advisory service:

Energy Design Advice Scheme – with regional offices, supported by DTI. EDAS holds a register of consultants.

Case studies:

DOE publishes a series of case studies of energy efficient buildings – available free of charge.

Periodicals:

Architects' Journal, Building (both weekly)

Books:

Visit and browse at the RIBA Bookshop (66 Portland Place, London, and in Belfast, Birmingham, Cambridge, Leeds, Manchester and Nottingham); the Building Centre Bookshop (Store Street, London); or the RICS Bookshop (Great George Street, London).

Professional bodies:

BIFM (British Institute of Facilities Management)

RIBA (Royal Institute of British Architects) – contact the Clients Advisory Service

RICS (Royal Institution of Chartered Surveyors)

CIBSE (Chartered Institute of Building Services Engineers)

Nearly all building projects will involve designers and builders from outside your organisation.

You should ensure that your building is designed by people who know about energy in design.

The best way of assessing whether prospective members of the design team are well qualified for an energy efficient project is to study their previous work – have they been involved in projects where energy efficiency was an important priority, and did they come up with convincing ideas? – as well as their general background and approach. To identify practices with a track record of energy efficient design, there is a central advisory body as well as professional institutions. Or you could also look through architectural and construction journals and books – see the box *Finding an energy efficient designer*.

When energy efficiency is an important design objective you should consider adding an energy consultant to the design team – put forward this idea if the team do not do so themselves. The advantage of such an appointment is that an energy consultant can focus specifically on energy, whereas it is only one of many issues which are competing for the attention of the team members. Also, a non-specialist may not be familiar with the latest developments in energy efficient design. Additional consultants will increase the bill for professional fees, but successful advice pays for itself many times over in the lifetime of the building.

Briefing for energy efficiency

Before the brief is written, you should make sure that the objective of energy efficiency is agreed and accepted within your organisation – that yours is not a lone voice. You will need allies. The more senior their positions in the organisation the better – ideally you want the top person to be decisively on the side of energy efficiency.

Briefing for energy efficiency

- Brief may (should?) evolve during design.
- Don't try and create a fictional, 'perfect' brief.
- It is easy to write an impossible brief – always check for feasibility.
- Get the project team to accept the brief formally.
- If you state your brief as a set of performance requirements the project team have maximum flexibility to consider design alternatives.

Your organisation's basic commitment to energy efficiency must be communicated to the project team from the outset – it should be raised when you are interviewing prospective project team members. It must be stated in the written brief and re-stated throughout the briefing dialogue.

All projects try to satisfy multiple criteria, but generally a few high profile issues 'lead' the project – they are the ones which mould the basic design concept and the ones which are least compromised if there are conflicts between competing criteria. Energy efficiency should be in the position of a 'leading' objective.

Your objectives for the building project must be communicated effectively to the design team via the project brief. If they are not properly briefed there is a danger that they will make decisions based on their preferences – or their last client's preferences – and not on yours. There is no single, foolproof formula for briefing. It is almost always a process involving interaction between the client and project team, but a central feature is usually a written document – the brief.

The task of writing the brief can be handled in different ways: as an internal exercise by the client organisation, by specialist consultants appointed before the main project team, or as the project team's first task. Here we are concerned with what the brief says about energy – see the box *Briefing for energy efficiency*. Energy performance is only one part of the brief, and it will not be the largest part. **If you want an energy efficient building you must say so in the brief.**

Simply stating and re-stating your commitment establishes energy efficiency as a project objective. That may be all you say about energy efficiency in the brief, relying on the project team to ask the right questions and make the right design decisions. But such a non-specific brief does not actually help the project team very much – they are left to interpret your priorities on your behalf; nor does it help you to know for sure whether the end product meets your expectations.

If you can state your energy efficiency targets more specifically, everybody will be in a better position to reach a successful outcome.

A thorough energy brief contains information of three types, describing:

1 your performance requirements, without specifying how the project team should achieve them;

2 any design features that you want the project team to include in the building;

3 background data that the project team needs to know in order to make the right energy design decisions.

Performance requirements Briefing through performance requirements is extremely powerful, pinning down the project team's targets but giving them scope for imaginative solutions. There are many sources of information to help you select appropriate energy performance targets. Or you may decide to use specialist consultants to set performance requirements in the brief. The performance indicators you use should be measurable in the finished building – otherwise you will never know whether they have been met or not. (An example of an unmeasurable performance indicator would be, 'energy consumption to be lower than the average of all new buildings completed in the same year'.)

Design features As well as specifying performance requirements, you can use the brief to tell the project team what specific design features you want in your building. This applies to energy and environmental design just as much as to materials, spatial features, etc. You may want condensing boilers, natural ventilation, high efficiency lighting, and so on. But remember that the brief describes a problem, not a solution. If the brief encroaches too far into design matters you may find the designers have to keep coming back to ask if they can make changes to the brief; or, what is worse, they may fail to explore fruitful design options.

Background data The brief also tells the project team about aspects of your organisation that affect energy efficient design. How many people will there be in the building? doing what? how many machines? of what type? what are the hours of operation? are the activity patterns stable or variable? – and so on.

Important issues relate to capital investment policies: some energy efficient design options increase building cost in exchange for reduced running costs. Does your organisation have a long-term or short-term time horizon? is there a maximum payback period? or a minimum rate of return on investment? (see also 'Capital spending', p.54).

Having got all this information, or as much of it as possible, into a written brief you must still expect a dialogue with the project team. They may ask you questions which do not appear to have any relevance to energy efficiency, but which may be critical to the choice between design options. For example, if a handful of people sometimes work late, you may need a completely different method of controlling the lighting.

Do not set targets that are incompatible – like, for example, asking for both natural ventilation and constant, cool interior temperatures which could only be achieved with air-conditioning. Your brief should set challenging but achievable targets.

Design and construction

Once you have briefed the project team you have to judge their proposals in terms of all the criteria set out in the brief, including energy efficiency.

Be a demanding client. Insist that the project team explain the energy strategy and preferably present quantified predictions of energy performance. If you have set performance standards in the brief, ask for performance data for the design proposals. Where alternative options are under consideration, ask for comparative data to justify selections.

Embodied energy

Even though the quantity of energy consumed in a building during its lifetime will be many times the energy consumed in its production, there are a number of reasons why reducing embodied energy is important for environmental improvement:

- The manufacture of many building materials is inherently energy intensive, but there are significant differences in the energy consumption of alternative processes.
- Manufacturing processes often have the opportunity for using low grade energy in place of high grade energy, i.e. minimising the use of electricity.
- There are wide differences in the embodied energy content of alternative materials, so savings could be made without having to make design changes.
- Savings in the embodied energy in a building are made at once, whereas savings in the energy used in a building accumulate over many years.

An issue that is likely to come up in the appraisal of design proposals is lifetime energy use, including energy used in construction, during the life of the building, and even in demolition and re-use of materials. The energy used in the manufacture and transportation of the materials in a building and in the construction process itself is known as a building's *embodied energy* – see the box *Embodied energy*. The numbers are significant; for example, the embodied energy in a typical new office building is approximately equal to the energy used to run it for five years. If materials have to be replaced several times in the life of a building, the embodied energy of each replacement should be considered in the lifetime energy use. These ideas are still in their infancy and it is too early to expect most design professionals to present calculations for lifetime energy, but this will definitely change as research data becomes established and these ideas are more widely accepted.

Do not give approval to the design until you are really satisfied that it meets your objectives – it may be difficult to make changes at a late stage of design but it is even more difficult once construction has started, let alone when the building is finished.

Projects under construction have to be carefully monitored, but it is unlikely that new issues will arise that have a major impact on energy efficiency. The main mechanism for monitoring construction is usually a monthly report which tends to focus on progress and cost. Regular site inspections may identify unforeseen issues – it is often difficult to anticipate fully what a building will be like from drawings. It is problematic to make late changes – but if changes are necessary, the sooner the better.

Commissioning and use

Along with briefing, commissioning is a critical stage in the users' dialogue with the project team. In the brief you tell the project team what you want, and in commissioning, the project team hand over what they have provided.

Commissioning new buildings

Commissioning procedures should be set out in the brief. For electrical and mechanical plant the commissioning procedures can be lengthy and detailed – they are set out in industry-standard manuals. The basic principles, which apply to all aspects of the building, are:

- Inspections for completeness and quality.
- Testing, demonstration and instructions on all electrical or mechanical systems.
- Training in the use of the building and equipment.
- Full documentation including 'as built' drawings and specifications, suppliers' names, maintenance schedules, service contracts.
- Testing and approvals certificates from all statutory and other bodies.
- Health and safety data about cleaning and maintenance of the building.
- Meter reading for all services and utilities.

In the worst case, it is only when the building is finished that the facilities manager actually gets involved. If this happens to you, try to ensure that you are at least involved in commissioning and that the design concept and all the systems in the building are fully explained to you, so that you understand how the building is expected to work.

The procedures for commissioning should be fully specified in the original brief – see the box *Commissioning new buildings*. Only after all aspects have been carried out satisfactorily is the project finished. Commissioning includes inspection and approval of all parts of the completed building and working demonstrations of all components, including energy-consuming plant and environmental control systems. Particular attention should be paid to control systems, especially where innovative or complex controls are incorporated. Malfunctioning control systems are an extremely common cause of sub-optimal energy performance and the facilities manager's role is absolutely vital in preventing this.

Every new building should be handed over with a 'user handbook', prepared by the project team. It should include full information about the building, how to use it and how to maintain it, including health and safety aspects of maintenance. After gaining experience of using the building, the facilities manager may be able to augment and improve the manual for the benefit of future facilities managers during the life of the building. Facilities managers should also keep it up to date.

The new project is now a building in use and the advice on monitoring and management set out in the chapter *Buildings in use* applies. With a new building you have an added incentive to monitor performance to make sure that the exciting ideas of energy efficiency you dreamed about at the inception of the project turn into reality.

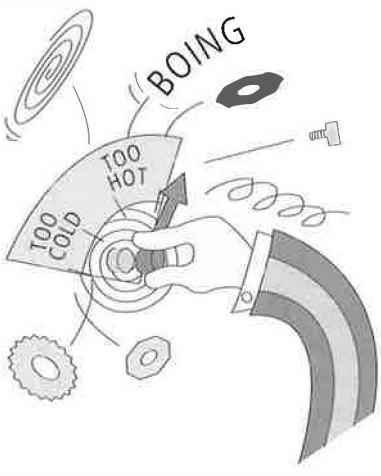
BUILDINGS IN USE

The purpose of this chapter is to provide an overview of the management aspects of gaining control of energy in existing buildings. Part 2 provides more detailed advice on technical and financial aspects of energy management.

'What's the problem?'

Managing buildings ought to be fairly straightforward; after all we have been creating shelter for large complex activities for thousands of years. Of course buildings have become more sophisticated, but not to the same extent as, say, transportation. So what is the problem?

Ask facilities managers and, with a wry smile, nine out of ten will tell you it's the people. If only the staff would behave sensibly and not fiddle with the heating on a Monday morning or if only people would turn the lights off when they weren't necessary. Facilities managers will also say they face particular problems in their organisation – the lighting in a television studio creates overheating problems, or the widely differing age and types of buildings on a hospital campus pose complex control problems.



IF ONLY STAFF WOULD BE SENSIBLE AND NOT FIDDLE WITH THE CONTROLS

Facilities managers have a point. The job is made more difficult because most of the occupants want to be able to get on with their job without having to think about the building. What if the building responded spontaneously, like our skin or our heart, to the changing needs of its individual occupants? Systems are available that allow us to control all aspects of the internal environment and make it responsive to changes in the weather and occupancy. Isn't the answer to automate?

We know that well thought-out buildings that have been designed to avoid obvious problems are much

easier to manage and more pleasant to work in than badly designed buildings that overheat or have little daylight. But we also know that time and again highly automated buildings fail. As in most things there is a happy medium, and it is up to you as the facilities manager to find it. But you are not alone. There are tried and tested ways of doing things and solutions to the problems you come up against. **You can tap into this communal wisdom by joining a local energy management forum or by employing an outside consultant to advise you.**

Different types of buildings in different industries pose very different management problems, which makes it difficult to give a simple description of how you should go about managing your premises. Nevertheless there is a common thread that can be adapted and applied to most situations and this thread provides the eight steps to gaining control of energy consumption that are introduced later in Part 2. First though we will look at some of the key factors which create differences.

Some of these have been discussed in the chapter on *Needs and opportunities*. What goes on in your buildings; the corporate culture in which you have to operate; the attitudes of staff and building occupants to energy efficiency and top management interest and support will all influence your approach to energy management and the style you adopt. Two aspects of the building stock itself will also have a big influence: tenure and building type.

Tenure

Attitudes to energy conservation action vary with tenure. If you are an owner occupier there will be strong incentives for both reducing running costs by good management and for upgrading your stock by investing in energy efficiency. If, on the other hand, you are a tenant there will be less incentive to invest in capital projects. Although most landlords do not have to pay for energy used in their buildings there will be circumstances, for

Building tenure

Tenancy	Control consumption	Low cost measures	Capital investment
Owner occupier	yes	yes	yes
Full repairing	yes	yes	yes
Service contract	indirect interest	no	no
Landlord	no financial interest	maybe	maybe

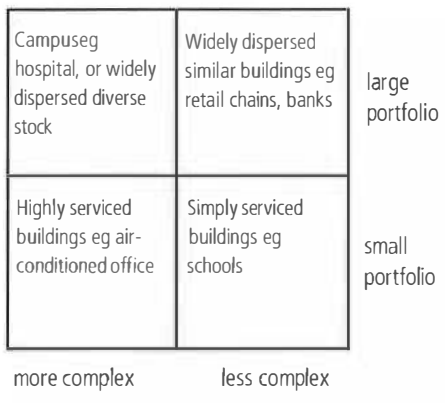
example when tenants are exerting pressure for a rent reduction, where it is important to increase energy efficiency in order to reduce service charges and thus maintain the headline rent.

Whether you occupy the whole of the building or only a part will also affect your energy management. There is little incentive to be energy efficient for tenants occupying part of a building on a service contract where the energy costs are apportioned by floor area. **It is important therefore to ensure that service charges are based on metered consumption for the part of the building you actually occupy.**

The same reasoning would also apply on a campus site such as a university or hospital where you wanted to introduce cost-centre accounting to make individual departments responsible for their energy consumption. Apportioning charges on any basis other than actual consumption is unlikely to have the desired effect. So unless you can discretely identify consumption by local metering do not opt for departmental budgeting.

Building type

Building type



The type of buildings you occupy will determine how you need to go about energy management. Some types of buildings are much more difficult to manage than others. For example campus sites such as acute hospitals are more complex than smaller, simply serviced buildings such as schools. The more complex the problem the greater the need to employ full-time energy management staff or contract out your energy management.

The size of your building portfolio will also determine your approach. Managing 3000 branches is obviously of a different order to managing a single shop or office building and will need standardised procedures and computerisation. Some buildings consume much more energy than others so the potential savings are much higher and consequently the return on effort is much greater.

Possible pitfalls

Sometimes our best intentioned efforts to improve energy efficiency and reduce waste can fail. Introducing new technology to improve efficiency can turn out to be ineffective or even counterproductive. Ill thought-out management measures to reduce costs or motivate staff can turn out to have the opposite effect. So you must try to avoid doing more harm than good.

Technological pitfalls

- The technical measure is not used as envisaged because it is too complex for people to understand, so it gets disabled.
- Dramatic malfunctions occur as a result of factors that the designers failed to anticipate, often because they did not understand how the technology would be used.
- The fix imposes limitations or rigidity on behaviour that people don't like so they subvert its use.

Management pitfalls

- Inconsistent top management support which produces uncertainty and lack of direction.
- Re-organisation which creates chaos at the sharp end of building management and maintenance with a loss of continuity and control.
- Bureaucracy that spawns paperwork and administrative ritual rather than any real improvement.
- Incentive schemes based on dubious apportioning of costs which lose credibility and become a disincentive.

Reducing waste is important, it makes the organisation more cost effective, it reduces the impact on the environment and it has spin-off effects on all other aspects of good management and healthy organisations. But facilities management can itself become a waste. If you get

lost in the technology or get sidetracked by the data then you will be wasting your own time and effort and your organisation will be the loser.

So beware. Often you are on your own with little guidance from above. Regularly ask: am I using my time effectively? Is there a simpler way of doing this that would get there quicker and more easily?

The answer is to keep it simple, involve others in the process and remember what you are trying to achieve.

This chapter has provided an overview of buildings in use. Part 2 gives detailed tactical guidance about managing energy in buildings.

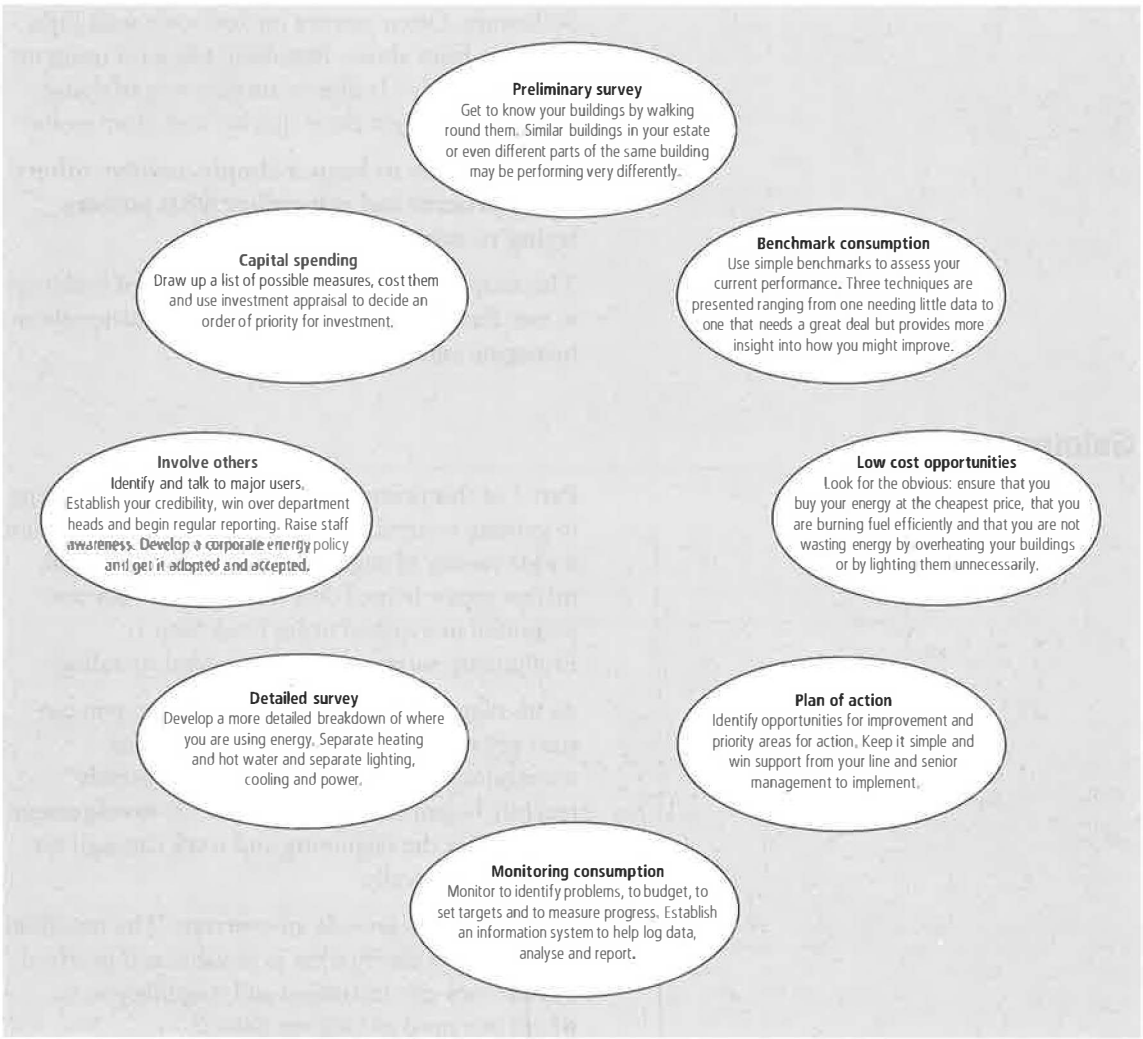
Gaining control

Part 2 of this primer provides eight Practical Steps to gaining control. Twenty facilities managers from a wide variety of organisations in the public and private sector helped devise the steps. They are presented in a logical order from Step 1: Preliminary survey to Step 8: Capital spending.

As we suggested in the opening chapter, you can start anywhere. If you are new to facilities management or if your organisation has only recently begun to think about energy management then start at the beginning and work through the steps systematically.

The eight steps provide an overview. The intention is to help you clarify what is possible and practical in your own circumstances and to guide you to where you need to look for help.

Practical steps



PART 2 PRACTICAL STEPS

PRELIMINARY SURVEY

Take a quick look round your buildings to see how they operate and to introduce yourself to people. The aim is to identify which parts of the building and what plant is causing energy waste.

Walk round the site and buildings at different times of the day and different days of the week. Don't focus on energy but look at how the whole building operates. Which parts get too hot or remain too cold?

Look at the **fabric**. Where is heat lost through inadequate insulation, ill-fitting windows or open doors? Is the heat loss due to inadequate specification or to poor workmanship? Make a note of how this heat loss might be reduced and use this information in your *Plan of Action.*

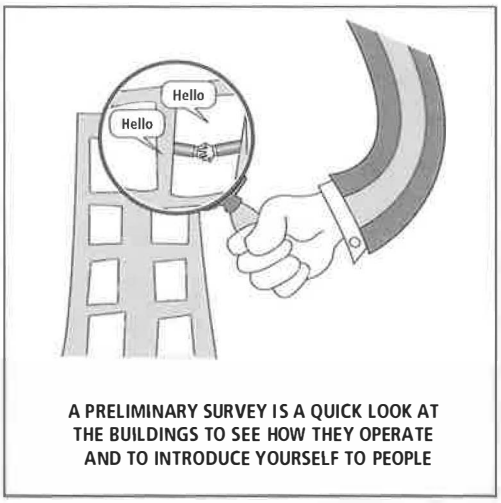
Check the **lighting**. Choose mid-morning on an overcast day. Which lights are left on when they are no longer needed? What kind of lamp fittings are being used? Are they kept clean? Find the switches. Could these be relocated to make the lighting more efficient?

Check **temperature and time controls** and relate these to how the building is supposed to operate.

Talk to the **maintenance** staff and check maintenance records. Telephone the previous facilities manager. Where are the problems?

Talk to the **occupants** as you walk round. What do they think of the building? Try not to raise expectations but don't pretend staff and their attitudes to the building don't exist. Check sickness records. Are staff in some parts of the building going sick more often than others?

A Practical Guide to Energy Auditing in Buildings, (BRECSU/EEO, 1994), provides matrices to help you assess and record the performance of hot water, space heating, lighting and building fabric.



A PRELIMINARY SURVEY IS A QUICK LOOK AT THE BUILDINGS TO SEE HOW THEY OPERATE AND TO INTRODUCE YOURSELF TO PEOPLE

BENCHMARKING CONSUMPTION

The first step to gaining control is knowing how much energy you are consuming and whether this is much more than you could be using with better management.

To assess your energy consumption you compare your performance against national averages for organisations in the same sector as yourself. Two techniques are presented: one needing little data; and one that needs a great deal but provides more insight into how you might improve.

Benchmarking energy cost

Energy costs

	Annual Cost £
Gas	
Oil	
Electric	
TOTAL	X 100/Annual Turnover

Building Sector	Average Performances Considerable room for improvement	Problem Building Need to act immediately
Retail	0.5–1%	>1%
Banks and agencies	0.8–1%	>1%
Nat. vent. offices	1–2%	>2%
Hospitals	1.5–3%	>3%
Higher education	3–4%	>4%
Transport termini	3–5%	>5%
Local authorities	2–3%	>3%

Source: Data collected at EEO Energy Management Workshops in 1993 and 1994 attended by nearly 2000 UK energy managers.

This is a quick and simple technique designed to give you a rough idea of how efficiently you are currently using energy in relation to other similar organisations in your sector and secondly to indicate what the total savings are likely to be from good energy management.

The technique is based on the strong relationship between size of operation and energy consumption.

To use this benchmark you will only need figures for your total energy spend last year in £ and your total turnover or revenue. **Calculate what percentage energy is of total revenue** and then compare your figure with the table in the box *Energy costs.*

If your buildings are in the 'Problem Building' column then you need to act immediately and devote effort and resources to investigating and tackling the problem.

To report energy savings to motivate staff as part of an awareness raising campaign it may help to translate energy costs into other units such as number of teacher days in a school or number of patient attendances at a clinic.

Benchmarking energy consumption

To give you a sharper indication of your energy performance you can compare your energy consumption with norms for your building sector. As well as allowing you to benchmark your performance against other organisations this technique also allows comparisons between similar buildings in your estate.

Part 3 provides a table of *Performance indicators* for different building types which summarises the information in the *Introduction to Energy Efficiency in Buildings* series published by the DOE.

To use this benchmark you will need figures for your total energy consumption of each of the fuels you used last year and accurate estimates of your floor area. The figures for consumption you will get from your invoices. Using Table 1 *Converting consumption* in Part 3, translate these units of energy into kilowatt hours.

Get photocopies of all your energy bills for the last two or three years. It might also be appropriate to begin your systematic collation of energy data by establishing a steady stream of copies of future invoices to be sent to you. This data will be necessary for monitoring your consumption.

The figures for floor area may be more difficult to obtain and depending on the size of your portfolio this exercise will demand time and effort. The *Performance indicators* table indicates whether you need treated or gross area.

You may have figures for gross area from cleaning contracts or lettable floor area from estate agents and if you are confident that these figures are reliable then use them. If figures are not available in your property records then you will need to measure from plans of your buildings and you will need to check that they are up-to-date.

This technique gives a fairly crude indication of the scope for improved performance. This means that you should not use this benchmarking approach if you cannot get reliable floor area data accurate to 10-20% of the true figure.

LOW COST OPPORTUNITIES

Before you have to spend any real money to get savings there are many low cost measures you can take. This is the low hanging fruit you need to pick to get the support and funding for bigger projects.

Even if you have been engaged in energy management for a good while, a fresh eye can produce new ideas or a change can open up new opportunities.

Look for the obvious: ensure that you buy your energy at the cheapest price, that you are burning fuel efficiently and that you are not wasting energy by overheating your buildings or by lighting them unnecessarily.

Energy procurement

The market for energy has been opened up to even the smallest consumers and ensuring that you are **buying your energy at the cheapest price could save your organisation about 15% of your energy bill.**

BUYING YOUR ENERGY AT THE CHEAPEST PRICE WILL CURRENTLY SAVE YOUR ORGANISATION ABOUT 15% OF YOUR ENERGY BILL

Gas

In future, the gas supply industry will be fully deregulated. At present there are more than 30 companies eligible to supply gas to sites throughout the UK.

The larger the supply the larger the discount on prices is likely to be. Different supply meters within the area of a site can be collected into adjacent supplies.

You should go out to tender for your gas supply. To negotiate the best price, when presenting your sites for tender, aggregate the individual supplies into the largest units possible. Greater savings are possible when individual organisations form a consortium and negotiate together.

Electricity

In April 1994 the electricity supply industry was further deregulated to allow sites with maximum demands of 100 kW to become eligible to receive supply from companies other than their regional electricity company (REC).

If your maximum demand in any three months is more than 100 kW or your total annual consumption is more than 200 000 kWh per year you should go out to tender for your electricity supply. To negotiate the best price when presenting your site for tender, you must have an accurate profile of your demand throughout the year. As with gas, greater savings can be made when individual organisations form a consortium and negotiate together.

The main ingredients of successful negotiation are: detailed and accurate information about consumption over the past two to three years, a professional invitation to tender sent out to all eligible suppliers, intensive negotiation with the short list of tendering companies and a spreadsheet to analyse and compare the ten to fifteen bids you receive.

There is also plenty of proprietary software available and, for those of you who would like help, consultants can help you with this process.

Controlling heating and hot water

Parts of the same building lose heat to the outside at very different rates. Some parts of a building may be used for much longer hours than the rest. For these two reasons all but the smallest buildings need to have the heating system zoned. Heating the whole building outside normal hours because one small part is in use, or over-heating the whole building to bring the coldest part up to the required comfort level, leads to large wastage and poor temperature regulation.

Efficient zoning and the sensible siting of thermostats is thus the key to efficient heating control.

Controls

Look for the obvious. Check time controls – rooms should only be heated when that heat is needed by the occupants. Check thermostats – is the building heated to the right temperature? Upgrade control systems where you can out of revenue savings.

Controlling the use of electricity

In most buildings your consumption of electricity may be only a quarter of that of gas or oil, but the cost of that electricity will typically be 50-60% of your total energy bill. This is because electricity costs per kWh, on average, are five times that of gas. In addition burning fossil fuels in power stations produces three to four times the CO_2 and sulphur dioxide per kWh of delivered energy as does burning gas or oil in your boiler. So managing your electrical energy is as important if not more important than space heating and hot water.

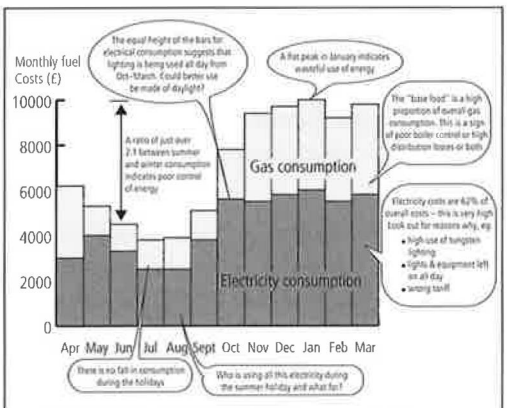
There are two key ways to reduce consumption:

1 **install correctly sized energy efficient equipment**

2 **switch it off when you don't need it**

You may buy your electricity on a maximum demand tariff. This means that in addition to the unit charge for the total number of units used and the standing charge based on the supply capacity in your contract, you will also be charged for the maximum demand in any half-hour period in the month.

Demand management thus becomes a key aspect of your energy management role. Keeping your electricity costs down becomes a question of trying to smooth out your demand and avoid short periods of very high consumption. This smoothing benefits the electricity industry and the nation as a whole because increased demand can be met by existing power stations rather than building new ones.



A school with higher than average energy costs

Usage is charged by kVA rather than kWh. This is because some equipment, for example older fluorescent tubes and electric motors, imposes an inductive rather than a resistive load. This inductive load needs a magnetising load in addition to the load current, so although it does not contribute to the power used it does result in an increase in current and consequently kVA drawn from the supply.

The ratio of power to current is known as the power factor. Since the supply company imposes a cost penalty you need to aim for unity, or in practice a power factor of 0.96. This is achieved by installing capacitors near the supply company's board. Suppliers of power factor correction equipment will be able to survey and advise you.

Note that power factor equipment can go wrong and when it does it dies catastrophically and without telling you. Your power factor may drop from 0.96 to 0.7 and you may then not notice this for three, six or even twelve months or more. This can cost you a lot of money since it will mean you are paying 30% more than you need for your electricity. **So check your power factor monthly**.

Lighting

Lighting will be a substantial part of your energy bill, probably in the region of 20-40% of the total cost of energy. **Reducing lighting consumption is an important part of energy management.**

You can reduce consumption by either reducing the load, by delamping or by installing more efficient lamps, or by reducing operating hours, by switching off the light manually or by installing time switches or occupant and/or daylight sensitive controls.

Compact fluorescent lamps are four to six times more efficient than tungsten bulbs and last about eight times as long so they save both in terms of energy and maintenance costs. Slimmer 26 mm fluorescent tubes with high frequency ballasts are 30% more efficient than the older switch start

38 mm fittings. These high frequency lamps produce no noticeable flicker so cause less eye strain and headaches when working on computer monitors. The efficiencies and colour rendering of higher output lamps, in particular high pressure sodium lamps, has also improved dramatically.

There is sufficient daylight in most buildings to meet lighting requirements for a major part of the time the building is occupied. Yet lights get switched on in the morning and then left on long after they are no longer needed. Lights should always be switched off when a room is unoccupied or when there is sufficient daylight. It is a myth that it is cheaper to leave lights on no matter what type of lighting is used.

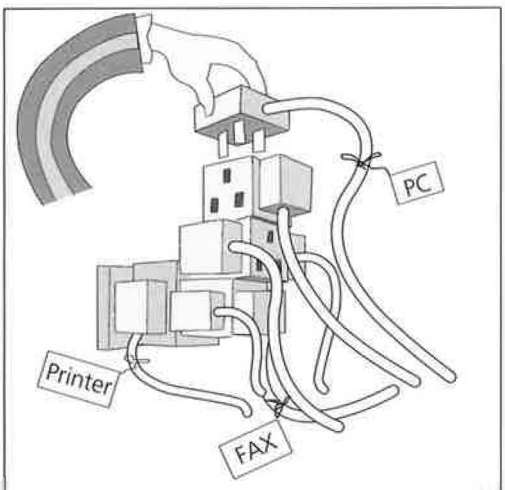
Maintenance of light fittings is also important. The gradual accumulation of dust and dirt on reflectors and diffusers can reduce light output by more than 30%. In all but the smallest installation, therefore, it is good practice to maintain fittings on a planned basis.

Small power

It is wrong to assume either that the use of small power is bound to continue increasing into the future, or that nothing can be done to curtail current usage without reducing your organisation's effectiveness. A survey has predicted that power demand per person is likely to halve over the next decade *(BRECSU Energy Consumption Guide 35)*, due largely to increases in machine efficiency.

Here are some guidelines for reducing wasteful provision or use of small power:

- Don't make over-generous assumptions of electrical demand, especially for future use.
- Select equipment with low power demand, especially during idle periods for intermittently used items like photocopiers. In the case of personal computers, pay attention to VDU power consumption and look out for innovative features such as flat screens and automatic switching to idle mode.



A MUCH HIGHER LEVEL OF ELECTRICITY CONSUMPTION FOR OFFICE EQUIPMENT?

- Make sure equipment is turned off at the end of the working day, or when unused for long periods. If there are perceived problems with rebooting PCs or other equipment, it is likely to be due to a technical fault: service or replace the equipment.
- Avoid unnecessary over-specification of supplies.

The following DOE publications will be of help: Econ 35 *Energy Efficiency in Offices: Small Power Loads*; FEB 9B *Economic Use of Electricity in Buildings*; GIL 06 *Energy Efficiency in Office Lighting*; GPG 158 *Energy Efficient Lighting in Industrial Buildings*; FEB 12 *Energy Management and Good Lighting Practices*; all of the *Introduction to Energy Efficiency in Buildings* series.

PLAN OF ACTION

Identify opportunities for improvement and priority areas for action. Keep it simple and win support from your line and senior management.

YOUR FIRST ACTION DOESN'T HAVE TO BE TOO AMBITIOUS OR LONG-TERM

To avoid losing sight of what you are trying to achieve you need to focus your efforts and devise a plan of action. The timescale for this plan will vary in different circumstances. But a useful period might be over the next two years.

Your first action is crucial. You need to be able to demonstrate success in order to gain the top management support you need to invest in energy efficiency measures.

Careful analysis of your profile on the Energy Management Matrix (pages 10-12) will help you to decide which key area to focus on first. This first action does not have to be too ambitious or long-term. It might be something quite modest. The two most important things are that it is successful and that it fits into your plan and will lead on to other action and improvement.

Make a list of all the opportunities you have spotted to improve energy management and reduce consumption. Define what action will take advantage of these opportunities and make a rough estimate of how much the action is likely to cost and how long it is likely to take. Then try to order the opportunities in terms of priority, taking into account that it makes sense to implement the cheaper quicker actions first.

This first draft may then need to be discussed and refined with your line manager before formalising and getting senior management approval.

MONITORING CONSUMPTION

Monitor to identify problems, to budget, to set targets and to measure progress. Establish an information system to help log data, analyse and report.

There are **five important reasons for monitoring** your energy consumption:

1 to identify if something is going wrong and consumption is rising when it shouldn't be

2 to be able to budget for next year

3 to measure and quantify savings from measures you have taken

4 to set and measure progress towards a target reduction in consumption

5 to have results to report to finance managers and hence gain further resources.

Before you start, and before you get bogged down in the data, it is worth remembering that it is not collecting the information that brings the benefit but its intelligent analysis and interpretation.

There are **three basic approaches to monitoring** energy consumption:

1 monthly invoices

2 manual meter readings

3 automatic data systems

The right approach for your organisation will depend on the size of your energy spend and the type of buildings you occupy, see the box *Approaches to monitoring*.

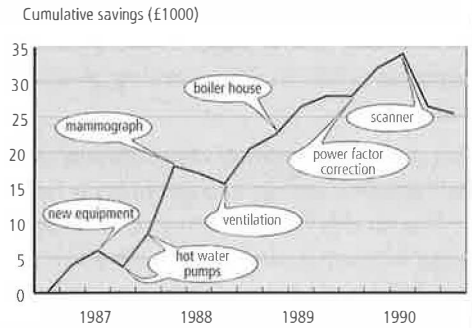
Approaches to monitoring

Building type	Example	Current approach	Future approach
Campus	hospital	invoice	automatic
Dispersed	bank	invoice	automatic
HQ	office	invoice	automatic
Mixed	LA	manual	varied
Small	school	invoice	automatic

Approach 1: Monthly invoices

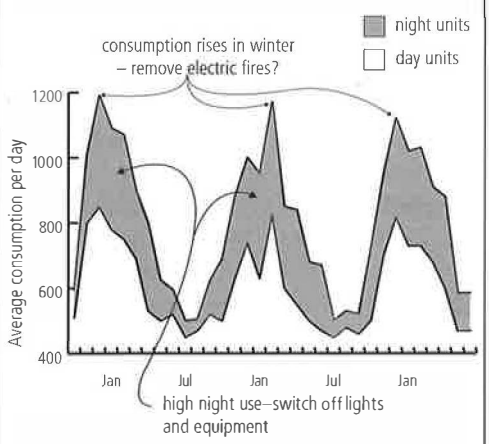
To monitor effectively you will need monthly invoices for each fuel for each of your buildings. Then you need to validate that these invoices correspond to each building or part of a building you intend to monitor.

CUSUM



CUSUM graph for a hospital showing cumulative savings of £35 000 over 3 years. Changes in the shape of the line pinpoint actions that have affected consumption. The difference between the area under the new curve and a projection of the old pattern shows the reduction in consumption. Future plans to continue savings include lighting controls, CHP and good housekeeping.

Monitoring electricity



Moving average graph for an office showing how electricity consumption rises in winter, in part due to increased lighting during the day. But on site investigation revealed unauthorised use of electric fires and lights and computer equipment left on at night.

Invoices for larger customers should be based on monthly metered readings. But customers with small buildings may find that their bills are likely to be quarterly.

Having collected valid and reliable data you will need to analyse it in order to define a stable pattern, the baseline, and to monitor changes.

Analysing heating invoices

Most buildings are required to be heated to a temperature of 18-22°C during the hours they are occupied and about 10°C at other times. The amount of energy needed to maintain these temperatures will depend on how cold it is outside.

For the purpose of monitoring buildings this is measured in 'degree days'. Degree days indicate how much you had to heat your building each month against which you can compare the actual energy you consumed. One way to do this, because it exaggerates changes in the pattern of energy use over time, is the CUSUM method. This is a simple technique which plots the sum of the cumulated differences between actual and predicted energy use.

There are a number of proprietary energy management systems which will calculate CUSUM, but it can also be done quite easily on a spreadsheet which has a built-in charting facility. Cheriton Technology's *Energy Monitoring and Target Setting using CUSUM* describes the use of this statistical technique.

Analysing electricity invoices

Having verified which meters are supplying electricity to which buildings, on a computer spreadsheet set up a table with columns for the date and the day and night meter readings. Calculate the units consumed and then divide this total monthly consumption by the number of days in the month. Then create a chart of the day and night consumption per day for each month.

Consumption rises substantially in winter, as lighting is used for longer periods. However, part of the increased consumption may be due to the

Approach 1: Monthly invoices

Pros:

- Simple approach that uses available data
- Reveals monthly patterns which can be analysed with powerful statistical techniques

Cons:

- Tends to result in a slow response to fault detection
- Estimated readings create problems
- Impossible to monitor different parts of the same building

Approach 2: Manual meter reading

Pros:

- Low initial cost
- Fast, local response in those buildings where someone takes an active interest

Cons:

- Requires a high degree of commitment and consistency from the local energy monitors

Approach 3: Automatic data collection

Pros:

- Easy, reliable data entry
- Allows hourly, daily and weekly patterns of use to be analysed as well as monthly pattern
- Much easier to gain control of electrical consumption

Cons:

- High initial cost of data logging equipment and energy management system
- More appropriate for large energy users with in-house expertise

greater use of portable electric heaters. If your space heating is working properly these should not be necessary and should be outlawed. Night use in the summer holiday period suggests computer and other equipment is left on after working hours throughout the year.

Within this seasonal pattern of consumption one can also tell whether energy consumption is rising or falling. You do this by calculating the moving daily average for each month and plotting this on a chart. Look for consumption dropping in response to energy saving initiatives or rising as more electronic equipment is installed.

The main advantage of this approach is simplicity of data input. The main disadvantages are: the unreliability of this data, its coarseness which precludes analysis of daily and weekly patterns and the inherent time delay in identifying faults.

Approach 2: Manual meter readings

If reliable monthly invoice data is unavailable, it may be better to take meter readings manually. If you have many buildings in your estate it may be best to restrict this exercise to those that consume the most energy or those that you believe might be particularly poor performers.

Oil is invoiced by tanker load and you will need to take a dip-stick reading at the beginning of each month and before and after each delivery. If you use coal for heating, consumption can be estimated visually from sight lines in vertical hoppers. It is also worth mentioning that this same approach to analysing invoices and monitoring consumption can and should also be applied to water.

You begin by using your invoices from the previous year. These are used to construct a target and consumption sheet using a standard computer spreadsheet. The consumption shown on the invoices is used to construct your best estimates of the weekly target consumption. In the first year these will be fairly crude estimates.

Each week at the same time, preferably early on a Monday morning, read the gas, electric and water meters and enter the readings. (Many facilities managers have reported that weekly monitoring fits in with their routine walkround.)

The main advantages of this approach are that the system is extremely simple and that faults are much more likely to be identified sooner. On average faults might take only half the time to rectify with this approach compared to a centralised system using monthly invoices.

The main disadvantage of this approach is that manual reading becomes unfeasible in organisations with many buildings.

Approach 3: Automatic data systems

Recent changes in the energy supply industry and in data logging technology have made automatic data reading a feasible option for larger organisations.

Both gas and electricity suppliers are installing electronic meters which download meter readings automatically by modem telephone links. This will mean that in the future accurate monthly meter readings will appear on all customer invoices. It is possible to get this information electronically from the meter operator or supply company, although this will have to be negotiated with the terms of your supply contract.

If you have an automatic Building Management System (BMS) it should also be possible to collect half-hourly consumption data.

You will need computer software to help you analyse and report this information and various proprietary systems are available.

The main advantages of this approach are ease of data input, detail to allow daily, weekly and monthly patterns to be analysed and alarms to signal faults. The main disadvantages are higher capital cost and greater expertise needed on the part of the user.

DETAILED SURVEY

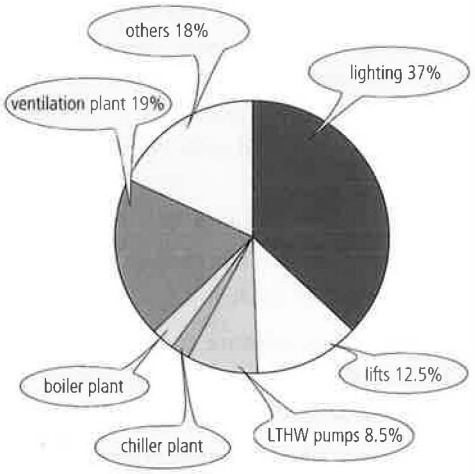
Develop a more detailed breakdown of where you are using energy. Separate heating and hot water; and separate lighting, cooling and power.

The object of this step is to identify particular buildings or parts of buildings that are using energy wastefully. This will allow you to focus on areas which promise the biggest potential savings and to decide priorities for future action.

If you identify particular problems of excess consumption or inadequate comfort levels then you will need to do a more detailed survey.

This may involve sub-metering for a period to get detailed information. It will also entail monitoring building use to reconcile consumption to occupancy. By taking your own readings and by inspecting the building carefully you will gain a much clearer understanding of its energy performance and the actions you need to take to gain control of energy consumption.

Hospital electrical audit



Although lighting was the largest item, the good condition of the existing lighting systems and the relatively high capital cost of changing them, meant that initial efforts were directed to the other items.

If the problem concerns heating you will also need to measure temperature and to separate energy used for hot water and catering. Most avoidable waste occurs when the heating system is only partly loaded in spring and autumn. Because of inadequate control, internal temperatures are higher than necessary to provide comfort. Windows are opened to dissipate excess heat and energy is wasted.

Providing hot water from a central boiler plant can be extremely wasteful and you should investigate providing point-of-use water heaters for toilets and catering facilities.

If the problem concerns electricity consumption you will need to differentiate lighting from cooling, ventilation and small power use.

Most waste occurs on overcast mornings when lights are switched on early and then left on after light levels improve. Recent research has

demonstrated how important light is to staff morale and productivity. But you need to ensure that lights are turned off, preferably automatically, as soon as outside light levels increase.

Draw up a planned programme for upgrading your light fittings and controls. Lighting technology has dramatically improved in the last few years. Fluorescent lamps now give good light, and daylight and occupancy sensors are much more sensitive and user friendly. Costs have also fallen dramatically and when increased reliability and savings on planned maintenance are taken into account, investment in energy efficient lighting is very cost effective.There may also be opportunities to increase natural daylighting by installing windows or roof lights or by removing internal partitions.

Similar opportunities exist to reduce the energy consumption of electric motors and drive systems. These might include drive fans in mechanical ventilation plant, lift motors, compressors in refrigeration plant, motors in conveyor systems and many other electrical applications. Depending on the amount of electricity you consume it may be worth employing a consultant to conduct this detailed survey and a list of recommendations. The DOE's *Good Practice Guide 2: Reducing Energy Consumption Costs of Electric Motor and Drive Systems* provides advice in this area.

To have any impact on improving energy efficiency you need to analyse the results of this detailed survey and translate the findings into a set of recommended actions that need to be taken. These will then need to be reported effectively if people are to act on your recommendations.

The DOE publishes *Is your Energy Use under Control?: A Practical Guide to Assessment and Action* which provides a set of diagnostic tools to help guide your inspection of fabric and services. There is also a booklet in the Fuel Efficiency Series: *Energy Audits for Buildings* which will be useful to you.

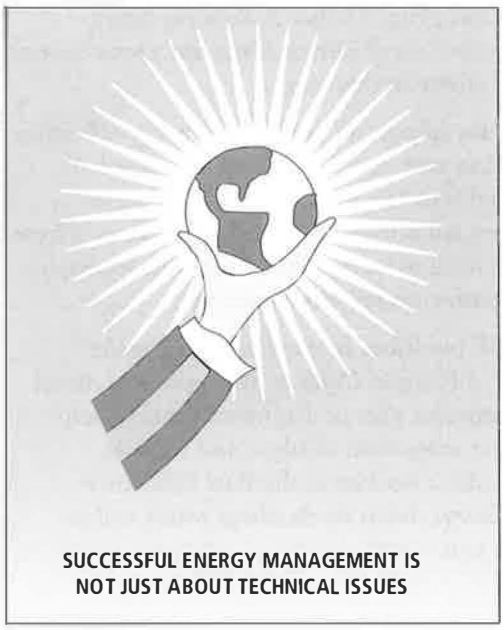
INVOLVING OTHERS

In the process of getting to know your building stock you will have talked to many of the occupants. Now you need to be more systematic about involving others in energy efficiency.

Management is a process of achieving your aims through other people and you will have to try to affect people's behaviour by example and persuasion rather than by telling them what to do. Successful energy management is not just about the technical issues, it is also about raising awareness and motivating people to behave differently.

Your problem is that for most people, energy efficiency is a low priority. People have other much more pressing concerns and only take any notice of their environment when they feel too hot or too cold or if it is too bright or too dim.

You may want to reduce energy consumption to save your organisation money but this is not necessarily what will motivate the occupants of your building to be more energy conscious. **You have to translate this organisational goal into things people want to do for themselves.**



SUCCESSFUL ENERGY MANAGEMENT IS NOT JUST ABOUT TECHNICAL ISSUES

Staff need to be made more aware of:

- why and how energy is consumed in your organisation
- why energy saving is important
- how their everyday behaviour affects energy consumption
- what effect saving energy will have.

You need to think first about who in the organisation is a log-jam to progress and how you can win them over or circumvent them; and secondly you need to decide who is likely to be your strongest ally and support your plans.

Identify and then talk to major users. Win over department heads, building managers and maintenance staff because they can all have a major

impact on performance. Choose a single simple action that will help establish your credibility with senior management and the finance department as someone who can deliver.

Motivating people is not simple and straightforward and you need to avoid doing more harm than good. This is one of the key areas where you are likely to need professional help, either from someone in your own personnel or training division or from an outside consultant.

Some of the key aspects to motivation are:

- Do not assume that money incentives are the best or only way to motivate.
- Recognition and responsibility may provide much greater incentives, and financial rewards can be seen as a recognition for work well done.
- Give people personal responsibility and discretion to act rather than restricting or controlling their behaviour.
- Unless people want to change and are motivated to learn, training is ineffective.

Two DOE Good Practice Guides: Guide 84 *Managing and Motivating Staff to save Energy* and Guide 85 *Energy Management Training* provide guidance in this area.

Reporting

Reporting energy consumption and progress towards reaching a target is another important aspect of involving others. Begin regular reporting. Decide who to report to: the Board, finance, estates, maintenance, department heads, occupants. How often and in what form should you report?

If the reports are to aid decision making what happens to these reports? What actions or decisions do they affect?

There are three levels to decision making in organisations which demand different types of information:

- operational control
- managerial control
- strategic planning.

If the information is meant to influence behaviour and encourage greater awareness then present the information in a way that staff can relate to. Define usage by meaningful criteria: fuel/meal, heating/patient, power/work station, etc. Don't get bogged down in the data.

Energy/environmental policy

Adopting a corporate energy or environmental policy is another way of involving others and raising the profile of energy management, especially with senior managers. The DOE's 'Making a Corporate Commitment' campaign is aimed at top management and two publications in this series, The *Chairman's Checklist* and *Executive Action Plan*, will help you.

It is quite possible to operate energy management without a formal policy. Having a written policy which is ignored in practice is obviously worse than nothing. But there are also very good reasons for having a policy and more importantly getting it adopted and accepted throughout the organisation.

Without a written policy energy management will be vulnerable to:

- changes in personnel
- changes in organisational structure
- changes in priorities.

As long as your commitment to energy efficiency is informal and ad hoc it can be derailed or undermined by the loss of a champion or a change in structure. And unless commitment is formally endorsed there is a danger that more pressing

priorities will crowd out attention to energy management.

The policy has two main purposes and these can be written as two separate parts:

- a public expression of your commitment to energy conservation and environmental protection
- a working document to guide practice and provide continuity.

Promotion

One aspect of your role you may not have given much attention to is concerned with promoting energy management as an activity in your organisation and publicising your achievements. This involves marketing. Maybe you didn't realise your job has anything to do with selling. Yet to be effective you will need to sell yourself and energy management.

Apart from raising awareness mentioned earlier, promotion has the following key objectives:

- proving value for money since it will increase top management support
- publicising your achievements both inside and outside the organisation since this will increase support from staff and customers.

The amount of time and effort you need to spend on marketing will vary, but **as a rough guide you need to spend perhaps not less than a tenth of your time and 5% of your budget on promotional activities.** Once you start to achieve energy savings you will want to keep up the momentum. The point is to keep energy management in the public eye and not let yourself get sidetracked into a technical backwater. By raising the profile of energy management you will help ensure that it has a long-term future.

Demonstrating achievement

Demonstrating that you have achieved real energy (as opposed to cost) savings – especially from no cost measures, like good housekeeping, or from low cost measures (with short paybacks) – can serve several objectives:

- indicate to staff and senior managers that there are tangible benefits to be gained from implementing an environmental strategy
- show that you are capable of achieving positive results which can often result in you being allocated further resources, and
- promote, both inside and outside your organisation, the message that you take your environmental responsibilities seriously.

CAPITAL SPENDING

Draw up a list of possible measures, cost them and use investment appraisal to decide an order of priority for investment.

You should not have much difficulty in getting agreement for proposals with little or no cost especially those that involve little reorganisation. However, any measures that involve capital spending or a change in management practice will need much more negotiation and will have to take their chance with all the other issues demanding money and management attention. This will usually mean making a financial case for the investment and that will involve you in financial appraisal.

The function of investment appraisal is to determine the merits of different proposals so that they may be compared.

Investment in energy efficiency is quite amenable to standard financial appraisal techniques and the fact that energy measures fail to get approval may be due to poor preparation and presentation rather than lack of financial viability.

The kinds of things you need to guard against are that:

- options are inadequately explored and the optimum solution is never found
- benefits are underestimated and the proposal appears less attractive than it really is
- costs are underestimated which creates prejudice against future proposals
- simple payback filters out proposals which would have continued to produce increasing benefits long after the payback period.

The brief to the design team and the contract with the builder are the keys to ensuring energy efficiency is incorporated in any capital spending.

The DOE's Good Practice Guide 165 *Financial Aspects of Energy Management in Buildings* gives

useful guidance on how to choose which projects to invest in. It also provides a detailed comparison of the various methods: payback, undiscounted cash flow, discounting and net present value.

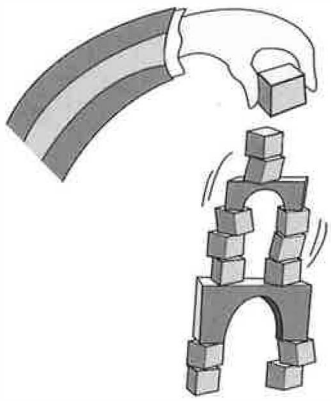
Life-cycle costing

The cheapest building may not give best value. Decisions frequently have to be made about whether to specify lower-cost materials that give poor performance and need to be replaced quickly, or higher cost materials that give better performance and last longer. Life-cycle costing aims to take account of both initial cost and running costs.

There are alternative techniques of life cycle costing, from very simple ones to others that are complex to apply and interpret. One reason for using complex techniques is that costs or savings that arise now or in the near future are worth more than costs or savings that occur some time further into the future. This principle is applied by discounting future costs or savings, using a percentage discount rate. The higher the discount rate, the less importance is attached to future costs or savings.

For example, consider an expensive window which reduces heat losses and therefore fuel costs compared to a cheaper window; if you costed fuel savings over a very long period of, say, 100 years, then the more expensive window would apparently cost far less overall than the cheaper window. But is this reasonable? We do not know what will happen in 100 years and it is foolish to construct expensive buildings now in the hope of making savings in the distant future.

By applying a suitable discount rate to future costs, balanced decisions can be made that are most economical in life cycle terms. These calculations can be very sensitive to the discount rate, but this figure is usually determined by corporate policy within an organisation. For a given discount rate, you can test design options and identify those with the lowest life cycle costs.



THE CHEAPEST BUILDING MAY NOT GIVE THE BEST VALUE

PART 3 FURTHER INFORMATION

PERFORMANCE INDICATORS

The following table gives energy consumption norms for different building types. They are to be used according to the method described in Part 2 to judge the energy performance of your own building stock.

Building Type	Average kWh/m² per year	Poor > kWh/m² per year
Health Care (treated floor area)		
Large acute hospitals (>25000m²)	510	600
Small acute hospitals	450	600
Long-stay hospitals	455	530
Nursing homes	450	570
Dentists' surgeries	230	350
GP surgeries	190	280
Health centres	270	350
Schools (treated floor area)		
Primary/middle	157	216
Secondary, no pool	173	235
Secondary, with pool	198	254
Higher Education (treated floor area)		
University – residential	325	390
University – academic	260	305
Colleges of Further Education	180	265
Sports Centres (gross floor area)		
Swimming pool	1220	1390
Sports centre with pool	570	840
Sports centre	270	340
Sports club	270	340
Hotels		
Luxury hotels	390	610
Business or holiday hotels	340	540
Small hotels	320	480
Catering (gross floor area)		
Restaurant	1750	1980
Fast food	1300	1560
Pub	340	470
Public Services (gross floor area)		
Library	240	280
Museum/art gallery	265	310

Building Type	Average kWh/m² per year	Poor > kWh/m² per year
Entertainment (ground floor area)		
Cinema	650	780
Theatre	600	900
Social club	200	360
Bingo halls	57	70
Retail (sales area)		
DIY	280	355
Non food shop	280	390
Department store	390	510
Small food shop	480	600
Supermarket	830	1210
High Street (gross floor area)		
Bank/building society	140	200
Post office	185	280
Travel/estate agents	205	305
Offices (treated floor area)		
Traditional cellular	130	330
Open plan naturally ventilated	160	420
Standard air-conditioned	240	600
Prestige headquarters	400	800
Manufacturing Buildings		
General	250	410
Paper	280	390
Electronics	260	360
Textiles	260	340
Light manufacturing	200	325
Engineering	250	300
Emergency Services (treated floor area)		
Prison	550	690
Police station	340	470
Fire station	440	620
Ambulance station	400	530
Court	220	300

The figures are from *Energy Consumption Guides* and the *Energy Efficiency in Buildings* series published by the Department of the Environment.

USEFUL TABLES

The following tables provide information you need to be able to monitor your energy consumption.

Table 1: Converting consumption to kWh

Table 1

Fuel Type	Billed Units	for kWh multiply by
Natural gas	Therms	29.31
	Cubic feet	0.303
Gas oil (35 sec)	Litres	10.6
Light fuel oil (290 sec)	Litres	11.2
Medium fuel oil (950 sec)	Litres	11.3
Heavy fuel oil (3500 sec)	Litres	11.4
Coal	Tonnes	7600
Anthracite	Tonnes	9200
Liquid petroleum gas	Litres	7

We suggest that you convert all different energy you use into kilowatt hours. This is because your electricity consumption, which is probably your biggest energy cost and the consumption you most need to control, is measured in kWh and for most customers gas consumption, which used to be measured in Therms, is now also billed in kWh.

A kilowatt-hour is relatively easy to visualise – a one bar electric fire burning for one hour uses 1kWh.

Table 2: Converting other energy units

Table 2

Energy units	for kWh divide by
Btu (100,000 Btu = 1 Therm)	3412
KiloJoule (KJ)	3600
MegaJoule (MJ)	3.6
GigaJoule (GJ)	0.0036

Energy is also measured in British thermal units (Btus) and Joules. Table 2 provides you with the conversion factors to kWh.

Table 3: Converting floor areas

Table 3 Floor Area	to get m^2 multiply by
Square feet	0.0929
Square yards	0.836

Table 3 provides conversion factors from imperial to metric measures of floor area.

Table 4: Allowing for site exposure

Table 4 Exposure	Factor
Sheltered	0.9
Normal	1.0
Exposed	1.1

Most buildings (90%) occupy normally exposed sites. Table 4 provides factors to multiply your consumption by for abnormally sheltered or exposed sites. If in doubt assume your building occupies a normally exposed site.

Table 5: Allowing for location

Table 5 Location	Factor
Scotland	1.2
Midlands	1.1
South	1.0
South West	0.9

Other things being equal, the farther north a building is located the more energy it will consume. Multiply your heating consumption by the factors in Table 5 to allow for this difference.

Table 6: Allowing for occupancy

Table 6 Occupancy	Factor
10 hour occupancy 5 day week	1.0
10 hour occupancy 7 day week	1.2
15 hour occupancy 5 day week	1.3
15 hour occupancy 7 day week	1.4

The more hours a building is occupied the more energy it will consume. Multiply your consumption by the factors in Table 6 to allow for this difference. (Do not apply to hospitals, hotels, prisons or residential schools.)

ENVIRONMENTAL STANDARDS

The following represent current voluntary environmental standards.

BS 7750 Environmental Management System 1994 (revised version)

This sets out a voluntary standard for an environmental management system. Systems are certified by the National Accreditation Council for Certification Bodies and progress towards meeting stated environmental objectives are audited. Certification started in December 1994.

EC Eco-Management and Audit Scheme (EMAS)1993

Sets out a similar voluntary, but pan-European, approach to environmental auditing to BS 7750. Its major difference is that it requires organisations to provide information on their environmental performance which is verified, again by the NACCB. Registration began in April 1995.

BRE Environmental Assessment Method (BREEAM)

Developed by the BRE to provide guidance on ways of minimising the adverse effects of buildings on the global and local environments. Assessments are undertaken by external, qualified BREEAM assessors.

BSRIA Environmental Code of Practice 1994

Aimed at reducing environmental impact of buildings, it adopts a 'cradle to grave' approach to the procurement and management of premises.

WHERE TO TURN FOR HELP

In addition to the many detailed technical guides available for the various building sectors and particular energy efficiency measures, the following more general publications are worth having on your bookshelf.

BRECSU/DOE, General Information Report 12, Aspects of Energy Management, 1993

Provides a strategic overview of how to manage energy, a method of profiling your current management performance and practical advice about how to improve in the six key aspects of energy management.

BRECSU/DOE, Good Practice Guide 167, Organisational Aspects of Energy Management: a self-assessment manual for managers, 1995

A self-assessment tool that allows you to analyse the current state of energy management and guides you in deciding how best to improve. It helps identify the key factors, including corporate culture and personal style that influence your ability to introduce change successfully.

BRECSU/DOE, Good Practice Guide 85, Energy Management Training, 1995

Contains practical advice on how to raise awareness and motivate staff to save energy. Also details how to develop a training programme.

Grigg and Jordan, Are You Managing Facilities? Allied Dunbar, 1993

Provides a useful simple overview of facilities management,and includes a chapter on energy management.

The following organisations are able to provide help on energy management.

BRECSU, Building Research Energy Conservation Support Unit

BRECSU is part of the Building Research Establishment and provides guidance on energy efficiency in all building sectors by delivering the most appropriate information to facilitate more effective decisions and actions by users.

Tel. 01923 664258 Fax. 01923 664787

ETSU, Energy Technology Support Unit

ETSU is based in Harwell and promotes energy technology in industry. It also manages the Environmental Technology Best Practice programme.

Tel. 01235 436747 Fax. 01235 433066

BSI, British Standards Institute

The BSI is the independent national body for the preparation of British Standards.

Tel. 01908 226888 for general inquiries.

BSRIA, Building Services Research and Information Association

BSRIA is an independent, non-profit distributing, member-based research organisation whose objectives are to assist the building services industry to improve the quality of its products and services, the efficiency of their provision and the effectiveness of their operation.

Tel. 01344 426511

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Key

BRE	Building Research Establishment
BRECSU	Building Research Energy Conservation Support Unit
BSI	British Standards Institution
BSRIA	Building Services Research and Information Assoc.
CIBSE	Chartered Institution of Building Services Engineers
DOE	Department of the Environment
ETSU	Energy Technology Support Unit
RICS	Royal Institution of Chartered Surveyors

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