

## **Energy efficient lighting in the retail sector**



- Briefing design consultants, and selecting appropriate systems
- Raising awareness of energy saving
- Assessing the potential for savings through energy efficient lighting design
- Understanding commonly used technical lighting terms



**ENERGY EFFICIENCY**

**BEST PRACTICE  
PROGRAMME**

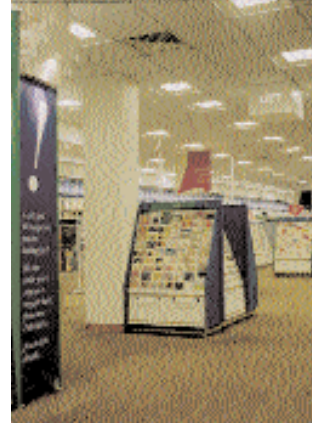
## 1 INTRODUCTION

In today's highly competitive market-place, the appearance of a retail outlet is a key component of its success.

Effective lighting is crucial if you wish to achieve 'the right look' for a retail store or chain of stores. Modern lighting techniques present opportunities for a substantial reduction in the use of energy, while achieving a greatly enhanced level of illumination and improved visual appeal.

This Guide is written for managers in multiple retailers. It provides information on how energy efficient lighting can be included in the brief for a lighting consultant or contractor.

In the pocket at the back of this Guide are several inserts designed to assess potential savings, and give more detailed guidance. Icons are used throughout the Guide to help link appropriate technical measures with the guidance text.



*Energy costs are one of the most easily controlled overheads, and a reduction in overheads is one of the most significant contributors to the profit margin*

### USING THE GUIDE

This Guide is in two sections.

- The main booklet briefly describes the retailing activities which consume energy, together with the benefits of including energy efficient lighting measures in retail schemes.
- The inserts are aimed at the technical specialists in your lighting design and management team, such as architects, surveyors, engineers, lighting and interior designers, shopfitters, maintenance managers, and project managers.

For example, your project manager should be interested in the lighting design aide-memoire to ensure that all relevant issues are considered by the design team. Your services engineer should be interested in all the technical inserts; your architect, interior designer or lighting designer and shopfitters will be interested in the comparison of lamp characteristics; your quantity surveyor will be able to assess the cost-effectiveness of the team's proposals using the economic appraisal insert; your maintenance manager should be interested in the maintenance and survey checklist; and finally, the glossary will help you with any unfamiliar technical jargon.

### LIST OF INSERTS



A guide for senior executives – on the benefits of adopting an energy efficiency policy



Economic appraisal of lighting – how to assess the economic viability of a lighting scheme, together with worked examples of the potential benefits available



Lighting survey checklist – what to look for when conducting an energy efficiency survey of your existing lighting scheme



Lighting design aide-memoire – a guide to energy efficient lighting design specification



Comparison of lamp types – a useful 'ready-reckoner' of the comparative merits of the most commonly used lighting types in the modern retail environment



Maintenance of lighting systems – a guide to the importance and implications of effective lighting maintenance



Glossary – an explanation of the technical expressions commonly encountered in energy efficiency and lighting

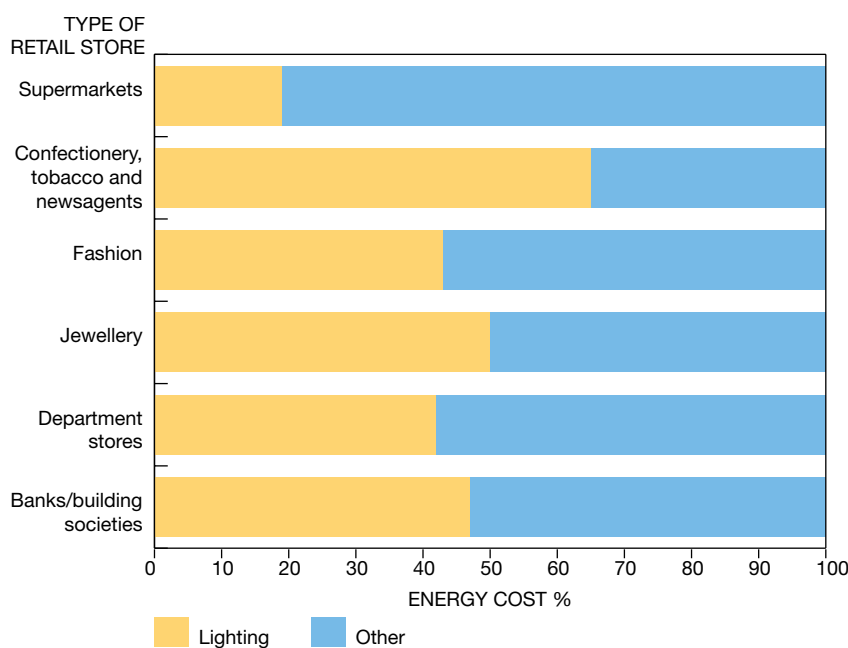
INTRODUCTION

**Efficient lighting can:**

- minimise energy costs
- reduce maintenance costs
- improve lighting distribution and control
- increase customer and staff satisfaction
- reduce heat gain, leading to a reduction in air-conditioning demand
- help you comply with legislation
- give your company 'green' appeal.

- The Guide and inserts will help you to:
- assess the potential for energy savings in your current store lighting scheme and indicate areas for improvement
  - brief your store design consultants to produce attractive, energy efficient designs
  - select the most appropriate lighting for your needs
  - appraise the economics of energy efficient lighting schemes
  - raise awareness of energy conservation among your staff and motivate them to reduce energy waste
  - become familiar with technical terms commonly used in energy efficiency and retail lighting.

Figure 1 Energy costs for different types of store



**Costs and profitability**

In retail businesses, reducing energy costs can directly increase profitability without the need to increase sales. It is estimated that a 20% saving in retail energy costs is achievable nationally, totalling some £340 million per year across the sector. Energy costs may be only a small percentage of turnover, but they represent a much larger proportion of profit. Lighting accounts for anything from 15% to 70% of your energy costs, depending on the type of store (see figure 1). Realistic savings can be easily achieved which increase the profits of your organisation.

**Environmental issues**

Fossil fuels are burnt directly to produce heat for homes, businesses and industry, and also for the generation of electricity for lighting, heating, cooling, ventilation and other uses.

- The fossil fuels we consume globally every year took 1 million years to be formed – they will not last forever.
- When fossil fuels are burnt, carbon dioxide (CO<sub>2</sub>) and other gases are released into the atmosphere, contributing to global warming and acid rain.
- Environmental pollution can be linked to gases produced when fossil fuels are burnt.



It is estimated that the total annual energy consumption of the retail sector is about 26 million tonnes of coal equivalent. This amount of energy, including what is burnt in power stations to generate the electricity, results in about 30 million tonnes of CO<sub>2</sub> being emitted to the atmosphere each year. The annual cost of this energy is in the region of £1700 million.

Cost-effective energy savings could reduce these figures by about a quarter.

## INTRODUCTION



WHSmith, Cambridge

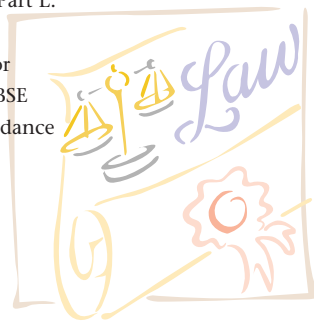
**Legislation**

New Building Regulations set out standards of energy efficiency which must be followed in the design of new buildings and major refurbishment projects, particularly with regard to selection of lamp types and provision of switching and automatic controls. An average lamp efficacy over the lit area of not less than 50 lumens per circuit watt is specified. For further information see the 1995 Edition of the Building Regulations, Part L.

You should also consult the CIBSE Code for Interior Lighting, and the forthcoming CIBSE Retail Lighting Guide for more specific guidance on how to achieve these standards.

Various EC Workplace Directives will apply where computer screens and VDUs are in regular use (particularly applicable in the office areas associated with the store).

Not only does energy efficiency make sound economic sense, you must also comply with the requirements of the law!



## 2 LIGHTING RETAIL STORES

### Attractive and efficient lighting

Customers expect a retail outlet to be attractively lit. With modern lighting technology, the most attractive schemes can also be the most efficient.

In addition to providing basic illumination and display functions, a well designed lighting scheme:

- draws attention to the shop and its displays
- sets the atmosphere of the store so that customers will want to enter
- helps to enhance the image of the store
- directs the customers' attention to the merchandise and stimulates impulse buying
- improves the use of space
- improves sales and the profitability of the shop.

From the point of view of the owners and staff of a retail outlet, a lighting scheme should:

- provide good working conditions, so that, at the end of the working day, eye fatigue and general tiredness are minimised
- provide adequate light to enable transactions to be completed efficiently, leading to fewer mistakes
- provide an effective deterrent against crime
- convey a suitable atmosphere within the store
- help to create the brand image of an individual shop or chain of shops.

It is essential that the lighting associated with the retail outlet is provided in the most efficient and cost-effective manner possible. Fortunately, energy efficient lighting does not mean a dull, underlit environment with poor colour rendering which could put off potential customers.

The vast range of lighting sources, luminaire designs and lighting controls now available means that an attractive, efficient lighting scheme can be readily achieved at minimum cost.



*WHSmith, Cambridge – audio/visual department*

In the case of banks, building societies and high street agencies which sell services rather than goods, the need for effective lighting for marketing purposes is even stronger. With no merchandise to display there is even greater emphasis on the need for an attractive interior to draw potential customers inside.

### Merchandising needs

Retail environments vary according to the type of merchandise or services on sale, the location of the outlet and the target customer group. There are many types of shop, and an effective lighting scheme has to be designed to meet the needs of the store in the most appropriate fashion.

The three main components are:

- illumination levels
- decorative or colour effects
- contrast and highlighting.



## LIGHTING RETAIL STORES

### RETAIL LIGHTING TECHNIQUES

Most shops fall within one of two well defined lighting categories.

- The functional, eg supermarkets or DIY warehouses requiring an overall level of illumination.
- The theatrical, eg fashion shops, jewellers and many high street shops, where lighting is used to draw the shopper's attention to the merchandise on display.

In the more functionally lit store it is usual to have a constant level of light throughout the sales floor with little differentiation between areas.

In a shop requiring an element of presentation, such as a fashion clothing shop or a jewellers, it would be more usual to employ a relatively low level of background lighting, plus a range of techniques to enhance the space.

- Spotlighting is chosen to display the merchandise to best effect, adding 'sparkle' and interest to displays. An added benefit is that spotlighting gives a degree of flexibility for subsequent adjustment and repositioning of displays and merchandise.



*Tesco, Brent Cross – meat and fish counter*

- Circulation paths require a lower level of light than display areas, and may be lit by a series of small lights regularly placed at floor or ceiling level to trace out the path of the walkway.
- Focal points of display lighting can be used to attract customers and draw them onwards through the shop.
- Perimeter lighting may be used to help to create the image of space, which can be crucial to a customer's impression of the shop.
- 'Wall-washing' techniques can be used to add interest to the space, enhancing textured wall surfaces and wall displays. It may also be used as a means of indirect lighting.

### Colour and contrast

Lighting can be used to provide contrast, and to attract the attention of the customer. The lighting of the merchandise may be different from that of the surrounding retail space, which presents the opportunity to use lower levels of background lighting.

The use of lighting with good colour rendering is essential in helping to generate sales, particularly in fashion retail, where the customer must be able to see the actual colour of the goods on sale. Good colour rendering is also critical in food retailing, where the goods must look appealing. The lighting designer should take care in selecting lamps to give the most appropriate colour rendering for the application.

- Lighting of a cooler appearance installed over chilled displays can enhance the fresh appearance of the goods.
- Special lamps can be used over red meat displays to bring out the fresh appearance of the meat.
- 'White goods' are best displayed under bright, clear, cool lighting.
- 'Brown goods' are better displayed under subdued lighting.
- Gold is best displayed under warm lighting, since under cool lighting its differentiation from silver is less pronounced.

Remember that, while it is always important to display merchandise to best effect, it is an offence to mislead customers about the quality of the goods on sale.

## LIGHTING RETAIL STORES

### Novel lighting technologies

There are several technologies which, although not new, are now finding increased popularity in retail applications. For example, in display areas where lamp accessibility may be poor or where heat gain is a problem, fibre optic cables may be used to transmit the light from a remotely positioned light source.

Induction lamps have an extremely long life (around 60 000 hours) and thus present significant financial advantages in lighting areas not readily accessible for routine maintenance or lamp changing.

New lighting technologies should be considered – for example, fluorescent lamps fitted with high frequency control gear, compact fluorescent,

metal halides, mercury discharge and high pressure sodium lamps all present opportunities for enhanced appearance but with significant energy savings.

When lamps are being selected consider these three main characteristics:

- efficiency and light output
- colour rendering and appearance
- servicing and replacement periods.

### Lighting controls

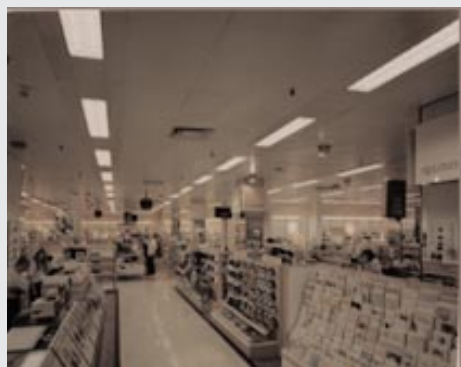
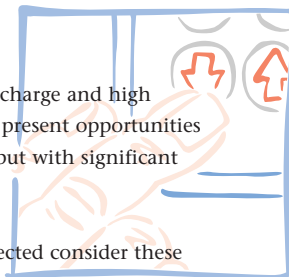
Substantial savings can be achieved by the use of lighting control equipment to minimise the wasteful use of light and to maximise the use of natural light.

Investment in lighting controls can be recouped quickly by the savings available, but the advantages are not purely financial. For example:

- lighting levels can be tailored to employee and customer needs
- lighting patterns may be quickly and easily changed to fit in with new shop layouts and displays.

Various control options are available, and the method selected will dictate the hardware requirements. Common techniques include the following.

- **Localised switching** – allows greater flexibility in the selection of appropriate lighting, eg for reduced levels during cleaning and restocking periods. Existing wiring must be modified to suit, new wiring should conform to this as a minimum.
- **Time switching** – varies lighting by switching off lights out of hours and varying the levels throughout the day.
- **Daylight linking by on/off or dimming control** – varies lighting automatically throughout the day in response to changing levels of natural light. Modern fluorescent lamps equipped with high-frequency control gear can be readily dimmed in this manner.
- **Occupancy linking** – is suitable for stockrooms and ancillary areas (staffrooms, corridors, etc). This method is not recommended for sales areas.



## Case study

### BOOTS PLC

Boots has around 1200 retail stores in the UK, and an annual group turnover of £4.1 billion. Boots' store development group identified 119 stores in need of relighting from the summer of 1993. Pilot schemes were installed in two stores in Doncaster and Reigate. The schemes were designed to improve the quality of lighting at maximum efficiency and minimum running costs and to be simple and quick to install, in order to minimise disruption to trading.

The new lighting was based around high-frequency triphosphor fluorescent tubes in a semi-specular aluminium louvre, which was selected to fit the existing luminaire bodies. Time and photocell controls were also fitted to vary light outputs during high and low trading periods and cleaning/restocking hours. Lighting in the stockrooms was also fitted with occupancy detector controls to reduce the light output when unoccupied, and to bring it back up to full strength when staff enter the storage areas.

Electrical energy used for lighting was subsequently reduced by 70%, along with reductions in maximum demand. Additional benefits included a doubling of fluorescent tube life and elimination of flicker. The scheme is now being extended to the remaining stores, and will be used in future new projects and refurbishment. The projected savings are £7 million over the next 10 years.

### 3 INTRODUCING ENERGY EFFICIENCY

#### SAVINGS IN EXISTING RETAIL STORES

When reviewing an existing retail store lighting scheme it is usual to carry out a 'walkround' survey to identify possible opportunities for savings. The lighting survey checklist insert at the back of this Guide indicates the main areas for investigation. The checklist is not exhaustive since there are a wide variety of possibilities in the sector, but it shows the most common areas where savings can be made.

Typical measures might include replacing old lamp types and luminaires with modern, higher efficacy equivalents, updating lighting controls and switching arrangements, and improving maintenance.

External signage and floodlighting should not be ignored – an unnoticed pair of 500 W tungsten lamps in the delivery bay can use as much electrical energy as the rest of a small store.

#### Refurbishment and retrofit

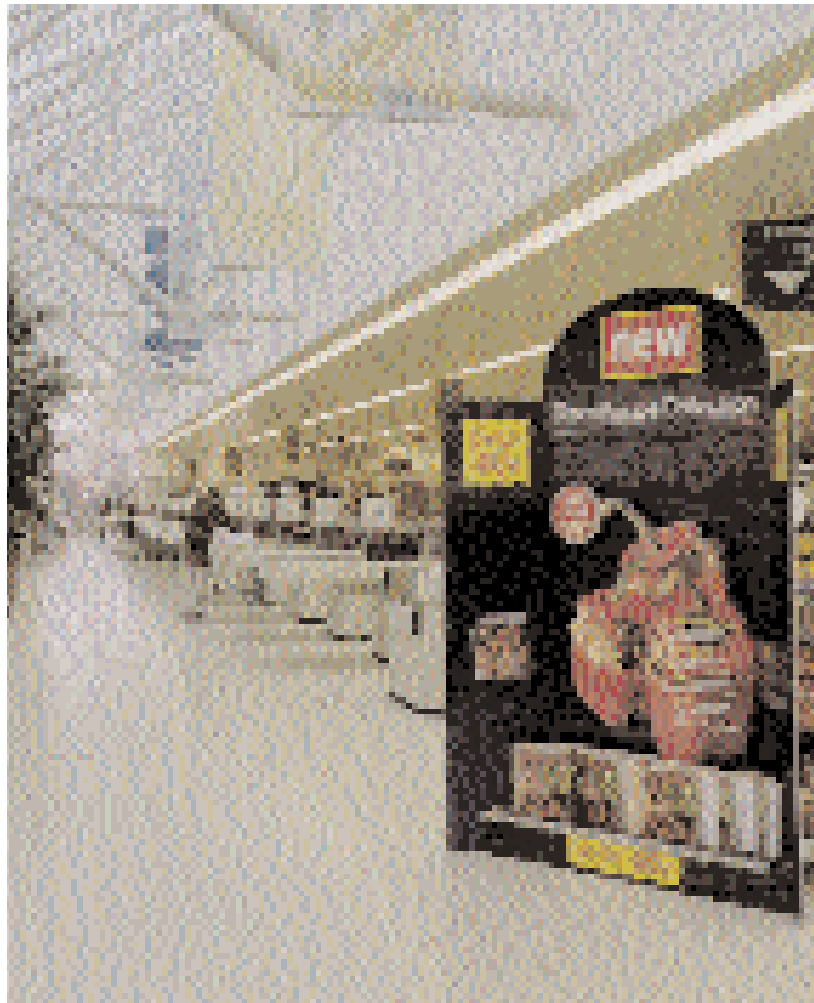
Store refurbishment presents an ideal opportunity for many energy efficiency measures to be incorporated into an existing retail outlet.

The options presented will be influenced by the type of store and its displays. In addition to improving light levels and saving energy, it is possible to alter the look of an entire building by the choice of luminaires. This is an important consideration in costing lighting schemes – relamping schemes which may not be profitable on energy savings alone, may be able to increase turnover through the change in focus of the store.

Again, it is important to achieve the minimum standards of energy conservation required by the Building Regulations.

Principal areas for consideration should address the basic lighting philosophy.

- Would the presentation of merchandise benefit from an increased level of display or accent lighting and a reduction in background lighting?
- Could customers be directed around the shop by 'corridors' identified by lower levels of light?



Modern lighting controls can allow the intensity of electric light to be varied in response to the amount of daylight available – a neat solution which results in significant savings in lighting costs.

*Tesco Brent Cross – mall entrance*

*See the companion Good Practice Guide 201, 'Energy efficient refurbishment of retail buildings' (GPG 201) for further information on energy efficient refurbishment, covering all areas of energy use*

## INTRODUCING ENERGY EFFICIENCY

## Case study

**THE HARVEY CENTRE, HARLOW**

The Harvey Centre was opened in 1982. The original lighting concept allowed for only a subdued level of lighting in the central mall, with light spilling over from individual shops providing the 'sparkle' to attract customers. However, subsequent additions and alterations to stores did not always fit the original concept, and the result has been an underlit atmosphere bordering on the gloomy.

Following the recommendations of an energy survey in 1993, 400 original PAR 38 tungsten downlighters over walkways were replaced with compact fluorescent lamps in reflective bezel luminaires, designed to slot straight into existing luminaire mounting points. Resultant annual savings are approximately £10 000, plus a further £8000 saving in availability charges, giving a payback of less than three months, along with improved levels of light and visual appeal.

A further refurbishment of the common areas of the Centre was begun in May 1995, to include new lifts, furniture and improved lighting levels designed to enliven the central mall and highlight the architectural features. This project is ongoing.

**NEW BUILDINGS**

Retail displays tend to change on a regular basis. It is therefore essential that the initial lighting scheme allows a reasonable degree of flexibility in luminaire positioning for future alterations, while taking account of those aspects of the store layout which are unlikely to undergo significant change.

Key components are:

- maximise the availability of natural light
- identify correct levels of illuminance for the different areas of the store, eg circulation areas, checkouts, display aisles
- enhance building layout for contrast effects
- design for ease of maintenance and monitoring
- provide user-friendly control systems for time of day variation
- provide adequate electrical connections for future flexibility
- incorporate safety and security requirements into the initial design
- conform with the legal requirements of the Building Regulations 1995, Part L.

With careful attention paid to illuminance levels and lamp and luminaire types, attractive and individual lighting schemes can be created which have minimum energy and maintenance costs.

Detailed advice on the techniques of lighting design and selection of appropriate lamps and luminaires can be found in the Chartered Institute of Building Services Engineers (CIBSE) publications.

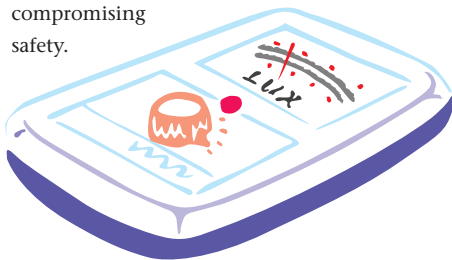
## 4 APPLYING GOOD PRACTICE

**GOOD HOUSEKEEPING**

The importance of good housekeeping practice should never be overlooked. It costs little or nothing to implement and can result in considerable savings. Effort should be made to stimulate the interest of the staff. Once consumption begins to fall, the use of graphs posted on staff notice boards showing weekly or monthly energy consumption can provide a useful means of illustrating that the efforts of your staff have had an impact.

The following areas are proven to be effective in reducing energy consumption.

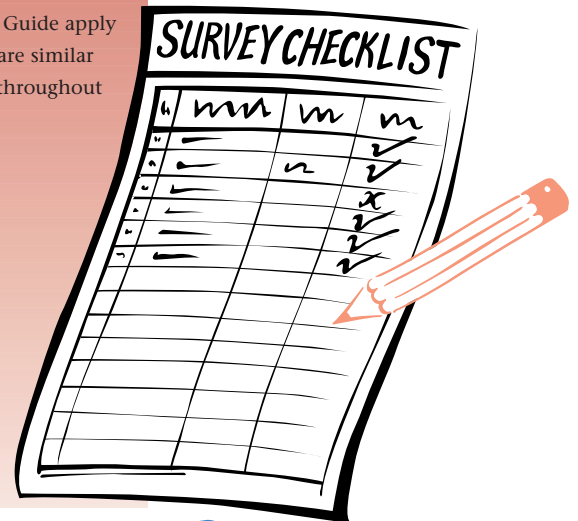
- If possible, appoint a member of staff with responsibility for ensuring lights are switched on and off in each area of the shop at the appropriate times.
- Use labelling or colour coding of switches where the installed lighting falls into several, separately switched functions, eg security, cleaning and maintenance, general or background, internal display, window display, and external and signboard lighting.
- Make best use of daylighting, particularly in non-sales areas, by keeping windows and roof lights clean. Use work areas close to windows where possible. Encourage staff to turn off lighting when daylight is good.
- Turn off interior display lighting out of opening hours.
- Use reduced lighting levels during cleaning and shelf-stocking periods.
- Ensure display lighting is not left on when the associated displays have been removed.
- Check lighting levels in corridors and non-sales areas. If excessive, check if some lamps can be removed to reduce the lighting levels without compromising safety.



Remember – the messages of this Guide apply not only to the sales floor; there are similar opportunities for energy savings throughout the store.

Have you considered:

- administration offices
- staffrooms
- toilets
- staff and public restaurants
- kitchens
- corridors
- stockrooms and warehouses
- loading bays
- car parks?

**SPECIALIST RETAILERS**

Each sector of the retail trade has different requirements, but the basic principles of good practice in energy efficient lighting remain the same.



The following examples suggest measures which can be employed within a store or organisation to improve the efficiency of the lighting.

**Discount stores**

In older stores the illuminance levels are often over 1000 lux (lumens/m<sup>2</sup>). This has traditionally been achieved using fluorescent halophosphate lamps in batten fittings and tungsten filament lamps where spot lighting is required.

- Experiment with lower levels of background lighting – 750 lux is suggested.
- Aim to use lamps with the highest efficacy and most acceptable colour performance.
- The first choice should be krypton-filled T8 fluorescent lamps.
- Replace older argon-filled lamps with krypton equivalents where the fitting type allows (switchstart-type fittings).
- Consider fitting higher efficiency luminaires to give better directional control of light output and to avoid glare.

*Consult the parallel document in this series, Good Practice Guide 190 'Energy efficiency action pack – for retail premises' (GPG 190) for further information on good housekeeping in other areas of energy use*

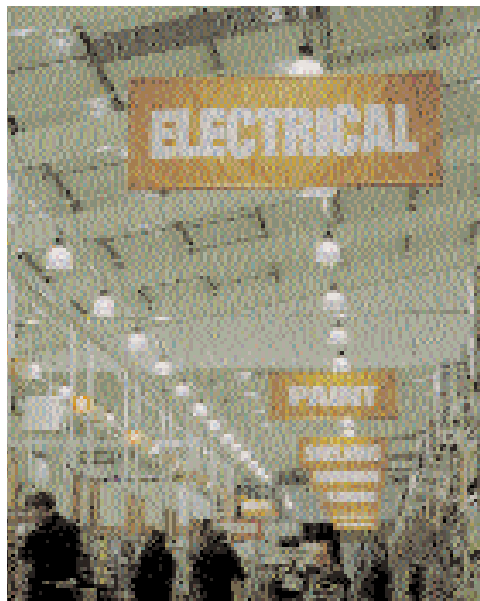
## APPLYING GOOD PRACTICE

- High-frequency control gear should be considered for fluorescent lighting. This reduces energy use and can allow lighting levels to be reduced by dimming, either manually or automatically in response to changing requirements.
- Reduce illuminance levels out of normal shopping hours, and during cleaning and restocking periods.

### DIY stores

Modern DIY stores are typically of the 'shed' type and require suitable high bay fittings to give high levels of illuminance.

- Background lighting levels should be no higher than 500 lux.
- High pressure sodium lamps (or new 'white SON' lamps for improved colour rendering) are the most efficient choice for these applications, and have the added benefit of a longer service life giving reduced maintenance costs.
- Compact fluorescent or metal halide lamps can be used to highlight individual displays.



B+Q, Luton

- For external areas use the highest efficiency lamps available, fitted with time switch and/or light-sensitive controls. For instance, car park areas benefit most from sodium lamps; low pressure use less energy, but high pressure gives a 'whiter' light which may be more acceptable. Be careful to minimise light pollution by careful selection of luminaires.

### Corner shops, confectionery, tobacco and news stores

It is common for corner shops to have high levels of illumination in order to attract customers from mixed street surroundings. The display lighting is often also the general illumination.

- For general illumination use krypton-filled T8 fluorescent lamps or compact fluorescent lamps.
- High-efficiency luminaires may be used to give better directional control of light output and to avoid glare.
- Use metal halide lamps to give added 'sparkle' to particular displays.

### Supermarkets and superstores

Modern superstores typically use a high level of background illumination, but of a type that allows detail of the display to be highlighted.

- Background lighting levels should be no higher than 1000 lux. It may be possible to use still lower levels, especially where highlighting is used for display purposes.
- Aim for horizontal and vertical illumination, using high-efficiency luminaires to give good directional control of light output and to avoid glare.
- The recommended lamp type for general areas is tri-phosphor fluorescent lamps.
- Consider using high-frequency control gear on fluorescent lighting. This is more efficient, and can also enable the lighting levels to be adjusted, with appropriate dimming controls, to match the time of day and sales levels.
- Feature lighting should be provided by compact fluorescent lamps or discharge lamps, for example, metal halide or white SON lamps.
- Filament lamps should be avoided.

## APPLYING GOOD PRACTICE

## Case study



*Tesco Brent Cross – vegetable gondola*

- Entrances and staircases are best illuminated by tubular or compact fluorescent lamps in suitable fittings.
- For external areas use the highest efficiency lamps that are appropriate, fitted with time switch and/or light-sensitive controls.
- Car park areas benefit best from sodium discharge lamps – low pressure lamps use less energy, but high pressure gives a ‘whiter’ light which may be more acceptable. Compact fluorescent lamps in suitable luminaires may also be used. Minimise light pollution by careful selection of luminaires.

#### **Banks, building societies and high street agencies**

The banking sector use a wide range of approaches based on the individual corporate style and the architectural features of the building. There is a tendency towards subtle lighting to make clients feel more at ease. The absence of displayable merchandise places a greater emphasis on the need for attractive lighting to draw the customer inside.

- Low levels of background lighting can be used to create an atmosphere of intimacy and privacy – 500 lux is suggested.
- Use krypton-filled T8 fluorescent tubes or compact fluorescent lamps in downlighters in general office areas.
- Compact fluorescent lamps in suitable downlighter-type luminaires are an effective and attractive choice in the banking hall.

#### **NATIONAL WESTMINSTER BANK PLC**

The Southern Region of the National Westminster Bank has recently carried out a programme of lighting refurbishments in 21 of its branches. Improvements include:

- replacing tungsten lamps with higher efficiency equivalents, eg compact fluorescent lamps
- installing T8 (26 mm) fluorescent lamps with high-frequency control gear and ballasts wherever possible
- reducing numbers of lamps by the use of high-performance reflectors.

The result has been an overall reduction in lighting load of nearly 126 kW, saving almost £24 000 per year for the bank, at an average payback of 3.9 years.

The programme shows that modern, high-efficiency lighting can be brought cost-effectively to individual branches. Energy savings can be generated while bringing the installed lighting up to EC Workplace Directive standards. All existing workplace interiors were to be brought up to the standard by the end of 1996. This successful programme represents a model which will now be replicated throughout the bank.



- Install high-efficiency luminaires to improve directional control and avoid glare.
- Metal halide or white SON high pressure sodium lamps can be used for display lighting.
- Minimise the use of low voltage tungsten halogen lamps for display purposes.
- Consider the use of lighting controls to vary lighting levels in response to changing requirements.

## APPLYING GOOD PRACTICE

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### Department stores

Department stores tend to use a lower level of illumination to make people feel at home. There is a greater emphasis on warmth and colour. Display lighting is important, especially when merchandising is franchised, for example, perfumes, furniture, and clothing.

- The suggested lighting level is 500 lux.
- Normally, the full range of lamps will be used with the emphasis on 'warm' colours.
- T8 fluorescent lamps, compact fluorescent lamps, and metal halide spotlights are the most efficient choices.
- Many stores have unique architectural features and these will require specific highlighting.
- Use high pressure sodium lighting for car parks and external areas.

In many instances, maintenance of luminaires will be a major consideration, particularly where access is difficult. In these cases, lighting systems offering extended life, and low maintenance technologies such as fibre optics, are particularly attractive.

### Specialist shops, fashion, jewellery

This sector has the clearest demand for display lighting and control, and usually the most complex lighting arrays. Tungsten halogen lamps have generally replaced the filament spotlight, and although these lamps are more efficient than the traditional lamp, they still have an efficacy several times lower than that of metal halide or compact fluorescent.

- The suggested maximum lighting level is 750 lux. Where display lighting is used extensively, try reducing background lighting levels still further to 500 lux.
- Display lighting should achieve the correct balance between the level of illumination and colour rendering and contrast.
- Use compact fluorescent lamps to achieve display lighting effects.
- Metal halide and newly developed high pressure sodium lamps can give excellent colour rendering and should be used in place of filament lamps for display lighting.



*A typical garden centre*

Cover photograph: Bentalls Shopping Centre  
*BDP Architects*  
*Photograph courtesy of Dennis Gilbert*

**The pocket of this Guide contains the following inserts:**

- A guide for senior executives
- Economic appraisal of lighting
- Lighting survey checklist
- Lighting design aide-memoire
- Comparison of lamp types
- Maintenance of lighting systems
- Glossary



*Photograph courtesy of Dennis Gilbert*

## FURTHER INFORMATION AND ADVICE

## FURTHER INFORMATION

**'Making a Corporate Commitment' campaign**

The MACC campaign seeks board level commitment to energy efficiency. It encourages directors to sign a Declaration of Commitment to responsible energy management, prepare a business plan for energy efficiency and ensure that it becomes an item which is considered regularly by the main board. Further information is available from the Department of the Environment, telephone 0171 276 4613.

**MACC Publications:**

- Chairman's Check List
- Executive Action Plan
- Energy, Environment and Profits – six case studies on corporate commitment to energy efficiency

The Department of the Environment has also produced a series of 15-minute videos under the 'Managing Energy' series, covering a range of topics. Those of particular interest are:

- Look at Lighting
- Retail

A video order form can be obtained from:  
Department of the Environment, Blackhorse Road,  
London SE99 6TT

**Regional environmental and energy management contacts**

A local point of contact for information and advice.

North East	0191 202 3614
Yorkshire & Humberside	0113 283 6376
North West	0161 952 4282
East Midlands	0115 971 2476
West Midlands	0121 212 5300
Eastern	01234 796194
South West	0117 900 1700
South East	01483 882255
Scotland	0131 244 7130
Wales	01222 823126
Northern Ireland	01232 529900

## PUBLICATIONS

**The Chartered Institute of Building Services**

**Engineers (CIBSE)**, Delta House,  
222 Balham High Road, London, SW12 9BS.  
Tel 0181 675 5211

- CIBSE Code for Interior Lighting 1994
- CIBSE Retail Lighting Guide (in preparation)

**The Lighting Industry Federation,**

Swan House, 207 Balham High Road,  
London, SW17 7BQ. Tel 0181 675 5432

- LIF Lamp Guide 1994

Available from The Stationery Office Publications  
Centre, PO Box 276, London, SW8 5DT:

- The Building Regulations 1991, Part L
- Conservation of Fuel and Power.

**DOE ENERGY EFFICIENCY BEST PRACTICE PROGRAMME DOCUMENTS**

The documents listed below and other Energy Efficiency Best Practice publications are available from BRECSU and ETSU. Contact details are given below.

Introduction to energy efficiency in shops and stores.

DOE, London, 1994 (BRECSU)

Introduction to energy efficiency in catering establishments (EEB2). DOE, London, 1994 (BRECSU)

Introduction to energy efficiency in post offices, banks, building societies and agencies (EEB10). DOE, London, 1994 (BRECSU)

**The Government's Energy Efficiency Best Practice programme** provides impartial, authoritative information on energy efficiency techniques and technologies in industry and buildings. This information is disseminated through publications, videos and software, together with seminars, workshops and other events. Publications within the Best Practice programme are shown opposite.

Visit the website at [www.energy-efficiency.gov.uk](http://www.energy-efficiency.gov.uk)  
Call the Environment and Energy Helpline on **0800 585794**

**For further specific information on:**

Buildings-related projects contact:  
Enquiries Bureau

**BRECSU**

BRE  
Garston, Watford WD25 9XX  
Tel 01923 664258  
Fax 01923 664787  
E-mail [brecsuenq@bre.co.uk](mailto:brecsuenq@bre.co.uk)

Industrial projects contact:

Energy Efficiency Enquiries Bureau

**ETSU**

Harwell, Oxfordshire  
OX11 0RA  
Tel 01235 436747  
Fax 01235 433066  
E-mail [etsuenq@aeat.co.uk](mailto:etsuenq@aeat.co.uk)

**Energy Consumption Guides:** compare energy use in specific processes, operations, plant and building types.

**Good Practice:** promotes proven energy-efficient techniques through Guides and Case Studies.

**New Practice:** monitors first commercial applications of new energy efficiency measures.

**Future Practice:** reports on joint R&D ventures into new energy efficiency measures.

**General Information:** describes concepts and approaches yet to be fully established as good practice.

**Fuel Efficiency Booklets:** give detailed information on specific technologies and techniques.

**Introduction to Energy Efficiency:** helps new energy managers understand the use and costs of heating, lighting, etc.

**A GUIDE FOR SENIOR EXECUTIVES****BENEFITS OF GOOD LIGHTING**

Efficient lighting:

- minimises energy costs
- contributes to profit margins
- reduces maintenance costs
- improves the distribution and control of lighting
- increases customer and staff satisfaction
- reduces heat gain, and as a consequence the demand for air-conditioning
- helps you to comply with current legislation
- enhances the environmental image of your organisation.

**LIGHTING COSTS AND PROFITS**

Lighting is a major expenditure for the retail trade, typically accounting for 40% of its total energy costs. Improved lighting can often halve the energy costs while at the same time enhancing the store's appearance and helping to increase sales.

Energy costs directly affect profit margins, so a significant competitive advantage can be established by investing in energy efficient lighting.

**ENVIRONMENTAL BENEFITS**

The retail sector uses about 7% of all energy consumed by buildings in the UK, emitting 31 million tonnes of carbon dioxide (CO<sub>2</sub>) – one of the main greenhouse gases contributing to global warming.

The UK is committed to reducing CO<sub>2</sub> emissions to 1990 levels by the year 2000. Retailers are in a prime position to contribute to this process by incorporating better lighting. At the same time they will improve their environmental image among increasingly sophisticated customers.

**STAKEHOLDERS**

Best practice lighting does not just mean lower energy consumption; it also means better working conditions for staff and increased comfort for customers. Furthermore, shareholders are likely to perceive the advantages, and reap the benefits in terms of company performance.

**INCORPORATING ENERGY EFFICIENT LIGHTING**

Good Practice Guide 210 (GPG 210) 'Energy efficient lighting in the retail sector' advises you of the benefits available through modern lighting technology and practice. If you suspect that your energy costs are high compared to current Best Practice figures, it is worth spending a few minutes to assess the options. The guidance given will help your project manager brief the consultant and contractor.

GPG 210 is one of a series of publications produced as part of the Department of the Environment's (DOE) Energy Efficiency Best Practice programme. The Guides are designed to help you advise your staff on the benefits of good practice in energy efficiency. They will help you to appraise the overall performance of your store or chain of stores easily, and to point the way to increased energy efficiency and profitability.

**HOW TO TAKE FURTHER ACTION**

Request a copy of the full Guide or any of the companion Guides by using the fax form on the reverse of this sheet and pass them to your project or store manager.

**A GUIDE FOR SENIOR EXECUTIVES**

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**MAKING A CORPORATE COMMITMENT**

Companies and public sector organisations may join over 1600 others in the DOE's Making a Corporate Commitment (MACC) campaign to achieve financial and environmental benefits from responsible energy management. On joining the campaign, a senior board member signs a Declaration of Commitment which covers a

number of elements, eg publishing a corporate policy, appointing an energy manager, setting performance targets and increasing energy awareness among staff. Further information is available from the Department of the Environment, telephone 0171 276 4613 (from June 0171 890 6616).

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**FAX REQUEST FORM**

**BRECSU Enquiries Bureau: Fax 01923 664787**

Please send me the following documents:

- Energy efficiency action pack - for retail premises (GPG 190)
- Energy efficient lighting in the retail sector (GPG 210)
- Energy efficient refurbishment of retail buildings (GPG 201)
- Energy efficiency in shopping centres (GPG 134)
- Making a Corporate Commitment – energy on the boardroom agenda

Title Mr/Mrs/Ms \_\_\_\_\_ Initial \_\_\_\_\_ Surname \_\_\_\_\_

Company \_\_\_\_\_

Position/profession \_\_\_\_\_

Address \_\_\_\_\_

\_\_\_\_\_ Postcode \_\_\_\_\_

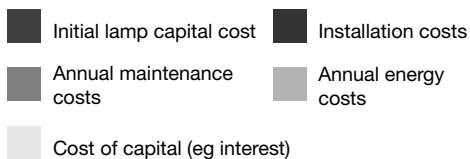
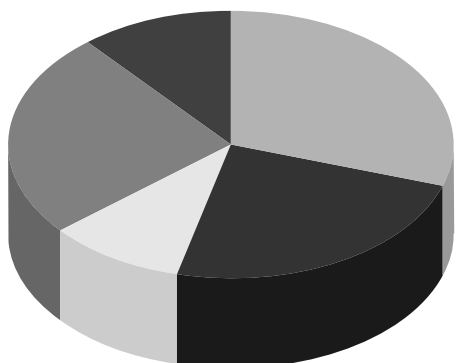
Telephone \_\_\_\_\_ Fax \_\_\_\_\_

## ECONOMIC APPRAISAL OF LIGHTING

The cost of a lighting scheme can be divided into capital and revenue components. The emphasis on each component varies according to the overall requirements of the project. For example, initial costs are particularly important for the rapidly changing environment of a fashion shop, where a redesign of the layout may be required every one to three years. A more traditional department store is likely to look at the running costs over at least five years, rather than at the initial costs.

Other features likely to affect your decision are leasing periods, franchising of floor space, and security and safety.

The typical basic components of the financial implications are illustrated below.

**LIFE CYCLE COSTING**

While it is common business practice to use the initial purchase price of a lighting scheme as a comparable starting point, a truer picture of the total investment required is revealed by looking at the costs over the expected life.

**Initial costs**

All costs involved in installation should be recognised, whether the installation is new or refurbished. These will include a number of factors, including:

- design costs, fees, surveys, drawings and tenders
- luminaires, components, control gear, lamps
- installation costs, wiring, fixing, switchgear and power supply
- controls, such as photocells, time switches, building energy management system (BEMS)
- building alterations and decorations
- commissioning and testing, making good.

It is important that the main installation costs are not overlooked. Special trims to ceilings and up-rating of electrical distribution costs can add substantially to a final budget.

**Owning and operating costs**

The annual costs of operating a system, in addition to the interest charges and sales-related costs, can be surprisingly high. The main items to be costed include:

- the cost of electricity including demand charges
- lamp and component replacement on failure or loss of performance
- regular cleaning of lamps and luminaires
- servicing labour costs for lamps and components.

Costs can be reduced by careful thought being given to cleaning and maintenance schedules. This allows lamps to be replaced at the end of their effective life as part of a planned schedule rather than on failure at some inconvenient time.



**ECONOMIC APPRAISAL OF LIGHTING**

**EXAMPLE**

In this example it is assumed that the objectives of each lighting scheme are equally met so that only directly related costs are compared.

A multiple-outlet department store wishes to replace the lighting on its trading floors, commencing with a single store built 20 years ago. If successful, the scheme will be replicated at the remaining 35 stores as part of a rolling programme.

The existing scheme:

- 120 banks of four 58 W fluorescent tubes in white metal reflectors with prismatic diffusers
- sixty 150 W tungsten spotlights used to highlight display areas
- lighting levels vary between 600 and 900 lux
- average lamp life is two years for fluorescent tubes, three months for the tungsten lamps
- store trading time is 59.5 hours per week, including one late night and limited opening on Sundays
- an additional 21 hours per week for cleaning, re-stocking and staff training, when some (but not all) lights are used.

The proposed scheme:

- 130 luminaires incorporating polished aluminium reflectors, with each luminaire fitted with two 58 W triphosphor fluorescent tubes
- high frequency control gear
- time controls to vary the light output throughout the day according to the level of in-store activity
- sixty 18 W compact fluorescent lamps in downlighters with polished aluminium reflectors in display areas
- thirty 35 W metal halide spotlights used for highlighting
- design illuminance level 500 lux
- work to be carried out during the evenings and overnight to minimise disruption to the store
- existing suspended ceiling and luminaire mounting points to be retained
- some re-wiring necessary due to the age of the existing wiring and different requirements of the new scheme.

Item	Existing scheme	Proposed scheme
Installed load (kW) (including circuit watts)	41	18.5
Reduction in maximum demand (kW)	–	22.5
Annual running costs (£)	7375	2470 <i>(projected)</i>
Annual maintenance costs (£)	2245	1225
Total annual costs (£)	9620	3695 <i>(projected)</i>
Savings (inc. reduction in demand charges) (£)	–	6415
Installation cost (£)	–	18 500
Simple payback (years)	–	2.9

The table above shows a simple payback period on the investment of 2.9 years.

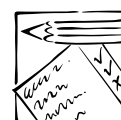
If the store operates on a 5% profit margin, then an increase in sales of £128 300 would be required to secure profits of the same order as the savings achieved by this scheme.

More complex financial analysis methods, such as net present value and discounted cash flow would normally be applied to these types of scheme.

Details of these methods can be found in Good Practice Guide 69 ‘Investment appraisal for industrial energy efficiency’ (GPG 69).

**LIGHTING SURVEY CHECKLIST**

Area	What to look for	What you should do
General retail areas	<p>Lighting more than 10 years old. Fluorescent tubes with bayonet cap connections. Badly discoloured plastic diffusers.</p> <p>38 mm (1.5") diameter T12 fluorescent tubes in switchstart fittings.</p> <p>Tungsten filament bulbs.</p> <p>600 mm (2 ft) 40 W fluorescent lamps. Old 2.4 m (8 ft) 125 W fluorescent fittings. 'Deluxe' warm-tone fluorescent lamps.</p> <p>PAR 38 sealed beam reflector lamps. Reflector lamps.</p>	<p>High priority for replacement. Get an expert lighting survey carried out.</p> <p>Fit 26 mm (1") diameter T8 fluorescent tubes.</p> <p>Replace with compact fluorescent lamps in the same fittings, or, if necessary, renew the fittings. Replace with low voltage tungsten halogen lighting, metal halide discharge lighting or de luxe SON lighting.</p> <p>Replace with modern reflector or high performance prismatic lens fitting using triphosphor fluorescent lamps. High-frequency electronic or low-loss ballasts are most efficient. Metal halide and SON uplighters can be used for certain applications.</p> <p>Replace with low voltage tungsten halogen lighting, metal halide discharge lighting or de luxe SON lighting.</p>
'Warehouse' type retail premises	<p>Mercury fluorescent lamps (MBF type), blue mercury lights. Mercury/tungsten blended lamps (MBTF type). Old 8 ft 125 W fluorescent fittings. High wattage bulbs (300 to 1500 W filament lamps).</p>	<p>For most high bay applications, replace by high pressure sodium (SON) lighting. For low mounting heights, replace with either high pressure sodium (SON) lighting or modern fluorescent lighting.</p>
Lighting controls	<p>Large areas controlled by a switch near the door. Lighting ON outside normal working hours. Potential for increased use of daylighting.</p>	<p>Get an expert to survey how you use and control the lighting in your premises.</p>
External lighting	<p>Tungsten filament lamps. Signboard, security or car park lighting on during hours of daylight.</p>	<p>Install new lighting using SON high pressure sodium or SOX low pressure sodium lamps, or compact fluorescent lamps. Install automatic time and/or daylight-linking controls.</p>
Floodlighting	<p>High wattage filament light bulbs. Tungsten halogen floodlights.</p>	<p>Replace with SON high pressure sodium or mercury discharge lighting.</p>
Staffrooms, stockrooms and utility rooms	<p>Check lights not left on when unoccupied.</p>	<p>Post reminder notices near switches and on notice boards. Appoint member of staff with responsibility for checking. Consider installation of automatic lighting controls using time switches and/or occupancy sensors to vary light outputs according to use.</p>
Good housekeeping	<p>Are lamps and luminaires clean and unobstructed? Are the staff aware of the need for energy efficiency?</p>	<p>Ensure maintenance schedule includes regular lamp and fitting cleaning routines. Instigate information and energy awareness campaign among staff.</p>



## LIGHTING DESIGN AIDE-MEMOIRE

**LIGHTING DESIGN AIDE-MEMOIRE**

This summary sheet will assist the project manager in the preparation of a brief for the in-house design team, external consultant or contractor.

It provides a summary of those things that should be borne in mind when considering new lighting, together with the benefits of choosing the best options.



Issues to consider	Benefits
<p><b>Lighting type</b></p> <p>Choose the most efficient lamp type for the application. See insert on 'Comparison of lamp characteristics'.</p>	<p>Savings of 5 to 80% over alternative schemes using less efficient lamp types.</p>
<p><b>High-frequency fluorescent lighting</b></p> <p>Consider installing high-frequency control gear for fluorescent lighting.</p>	<p>Typical savings in consumption of about 20% over conventional fluorescent lighting.</p> <p>Elimination of flicker, reduced eye strain. Ability to introduce dimming control to lighting.</p>
<p><b>Lighting philosophy</b></p> <p>Consider carefully the type of store and the impression you wish to create. See section on 'Lighting retail stores' in GPG 210.</p>	<p>A low background level of lighting with highlights throughout the store, eg on merchandise displays and customer 'focal points', can save energy, as well as creating a pleasing atmosphere.</p>
<p><b>Lighting levels generally</b></p> <p>Ensure lighting levels are appropriate to the usage. Be mindful of the requirements of security and emergency lighting.</p>	<p>Avoidance of glare and overbrightness. Reduced energy consumption.</p>
<p><b>Lighting zones</b></p> <p>Ensure that switching arrangements take account of the various zones and differing uses of the store space. As well as the geographical requirements of the store, light switching should be arranged according to the various functions undertaken, eg display lighting, general background lighting, task lighting at checkouts, re-stocking, cleaning, security lighting.</p>	<p>It is more likely that only the lighting required for each task is used at the appropriate times. For example, many large supermarkets are restocked overnight. Provision of a suitable level of light to enable this task to be undertaken safely and efficiently does not necessarily require full lighting of the store.</p>
<p><b>Controls</b></p> <p><b>Time controls</b> – for display, signboard, re-stocking, security and external lighting.</p> <p><b>Occupancy controls</b> – for non-sales areas, eg stockrooms, staffrooms, offices, corridors, etc.</p> <p><b>Daylight controls</b> – to vary lighting levels in response to changing daylight levels throughout the day. For example, window lighting and lighting arrays near windows may be switched off in response to periods of direct sunlight.</p>	<p>Lighting is used only when space is occupied.</p> <p>Lighting is tailored to the required levels, with reduced levels when daylight is adequate.</p> <p>Lighting use may be more carefully monitored and remote adjustments made possible</p>

## LIGHTING DESIGN AIDE-MEMOIRE







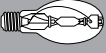


Issues to consider	Benefits
<p>(Controls continued)</p> <p><b>Building Energy Management Systems (BEMS)</b> – specify linking of controls and switching to the BEMS, if included in the design.</p>	<p>Lighting is used only when needed</p>
<p><b>Daylighting</b></p> <p>Can daylight be incorporated into the design? Atria and rooflights are finding increased favour as architectural features.</p>	<p>Substantial savings can be made by capitalising on the availability of natural light, while creating a pleasant, airy atmosphere which is favoured by shoppers.</p>
<p><b>'New' technologies</b></p> <p>Explore the wealth of new lighting technologies entering the market place – investigate the opportunities for using fibre optic lighting or induction lighting, both of which can have significant benefits in both energy consumption and maintenance requirements.</p>	<p>New lighting types can be used to enhance the appearance of a store or shopping centre, while significantly reducing energy and maintenance costs.</p>
<p><b>Lighting loads and their effect on air-conditioning</b></p> <p>Remember that a high level of installed lighting will generate a large amount of heat. In air-conditioned environments this may pose a load on the systems which results in a net increase in energy consumption. More efficient lamp types generate less surplus heat.</p>	<p>Savings in air-conditioning and ventilation systems running costs, as well as lighting.</p>
<p><b>Emergency lighting</b></p> <p>Do not forget the requirements of the law. Investigate fully the range of modern fittings on the market which combine attractive luminaire designs and efficient lamp compatibility with emergency lighting capability.</p>	
<p><b>Design for maintenance</b></p> <p>In order to be effective, a lighting system must undergo regular, routine maintenance, as well as unplanned lamp replacements. Keep this in mind when drawing up the design brief, as the savings gained can be significant.</p>	<p>Maintenance costs can represent a large proportion of the running costs for a store or shopping centre, particularly where access is difficult. Hiring scaffolding and paying a maintenance crew out-of-hours can be very expensive. Compact fluorescent lamps, for example, can last up to eight times longer than their tungsten equivalents, and the savings to be gained are obvious.</p>

**COMPARISON OF LAMP TYPES**

This table gives an at-a-glance comparison of the wide choice of lamp types available to the retail lighting designer. It is by no means exhaustive

and individual manufacturers should be consulted for precise data on lamp specifications.

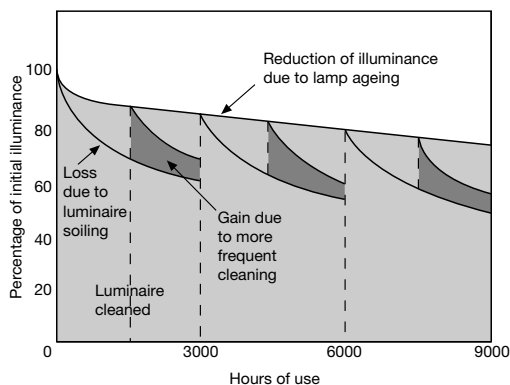


TYPES OF LAMP	CHARACTERISTICS							Applications
	Efficacy (lumens/watt)	Economic life (hours)	Dimming control	Re-strike time	Colour rendition	Comparative installation costs	Comparative operating costs	
Incandescent 	14-20	1000	Excellent	Prompt	Good	Low	Very high	Display lighting
Tungsten halogen 	18-30	2000 - 4000	Excellent	Prompt	Good	High	High	Display lighting
Mercury vapour 	40-60	14 000 - 28 000	Not possible	4-7 min	Poor to good	Moderate	Low to moderate	Large area lighting, becoming obsolete
Compact fluorescent 	50-80	8000 - 10 000	Good (depending on lamp choice)	Prompt	Good	Low	Low	General and display lighting
Fluorescent 	50-100	10 000 - 16 000	Good	Prompt	Good	Low	Low	General lighting
Induction 	65	60 000	Not possible	Prompt	Good	High	Low	Areas where access for maintenance is difficult
Metal halide 	70-100	6000 - 16 000	Technically possible but not practical	5-15 min	Good	High	Generally low	Shopping malls, large commercial applications including display lighting
High pressure sodium (standard) 	80-130	24 000	Technically possible but not practical	1 min	Fair	High	Low	Car parks and outside applications
High pressure sodium (de luxe) 	125-180	6000	Technically possible but not practical	1 min	Good	High	Low	Commercial interiors

## MAINTENANCE OF LIGHTING SYSTEMS



Lighting systems require ongoing maintenance to ensure efficient operation, not simply replacing a bulb or cleaning fittings when they are obviously dirty. In fact, the light output of an installation reduces over its lifetime and although a lamp may be working, the output of light can be as low as 50% of the original light output. This is illustrated by the diagram below.



#### Cleaning can increase light output

The rate at which the output from a lamp reduces depends on the type of lamp and its location. The rate of reduction for a particular type of lamp is usually predictable and is given in manufacturers' published literature. This is known as the expected life of a lamp. Many factors, such as overheating, frequent switching and voltage fluctuations, can affect the life of a lamp, and replacement decisions should be based on the practicality of changing the lamp as well as the falling level of illumination.

- Ensure that the correct cleaning materials and techniques are used to prevent losses caused by chemical action, or scratching of optics and electrostatic dust accumulation.
- Plastic diffusers or prismatic controllers discolour with age, and contribute to the gradual loss of light over a period of time. Replacement of aging diffusers can lead to a significant improvement. Acrylic plastics generally have the longest useful life.

- Where access to the lamps is difficult, typically involving out-of-hours working, ladders or platforms, it is usually cheaper to replace lamps on a group basis. If access is easy to arrange and uniform illumination less important, eg in stockrooms, replacing on failure is usually acceptable.
- Maintenance aspects should be given prime consideration at the design stage since, if access is difficult, maintenance could be neglected. Allowance should also be made for removal of luminaires without causing damage to the display, ensuring that the quality of the installation is not affected by the maintenance operations.
- Selection of lamp types with long service lives will obviously ease maintenance problems. For example, compact fluorescent lamps have a service life of 8000 hours compared to only 1000 hours for an equivalent tungsten filament lamp. Novel lighting techniques such as fibre optics and induction lighting have distinct advantages in terms of maintenance.
- Take care in the disposal of lamps. They may contain a variety of chemicals which are environmentally damaging and harmful if released by breakages.

#### Low maintenance lighting

When the access to a luminaire is difficult or involves expensive scaffolding, it is worthwhile considering an alternative approach.

Induction lamps are initially more costly than the simpler alternatives, but with a maintained life of 60 000 hours, the lamp will require minimal access once installed.

The use of a fibre optic cable to transmit the light over a distance allows the lamp to be installed remote from the point of use, at an easily accessible location. Heat is not released into the display area, and therefore the lamp can be kept cool and well maintained. It is unlikely that, once installed, the fibre optic cable will require attention.



## GLOSSARY

**Accent lighting**

Highlighting of displayed merchandise or the features of a shop or building.

**Availability charge**

A charge made by the electricity supplier for each kVA of installed electrical capacity, agreed in advance with the user.

**Average illuminance**

The illuminance averaged (lux) over an area, which could be a display area or a store room.

**Ballast or control gear**

Part of the control equipment of fluorescent or discharge lamps to stabilise the current. The older traditional mains frequency ballast can consume up to 20% of the total lamp current. Modern electronic ballast working at high frequency uses about 30% less current and can be used to regulate or dim the lamp output.

**Colour appearance**

This is an indication of the warmth or coolness of the lamp and is usually referred to by the colour temperature. Less than 3000 K is warm (reddish hues) whereas 4000 K and above (bluish) is cool. The colour appearance is quite separate from the colour rendering of the lamp.

**Colour rendering**

A comparison reference for the appearance of a coloured object under a lamp compared to that colour under a standard reference source of light. Colour rendering is a repeatable and measurable index used for special applications, eg colour matching, unlike colour appearance which is generally a matter for preference.

**Demand charges**

Electricity bills for commercial customers usually include charges for the instantaneous demand kW as well as the power used per kWh. These charges can be fixed, as in the availability charge, or variable as in the metered maximum demand charges.

**Dichroic reflectors**

Lamp reflectors used for display lighting that allow heat to pass through the reflector while reflecting the light in a cool beam that does not heat the display.

**Discharge lamps**

Lamps which produce light by discharging an electric current through a gas (neon, argon, krypton) or a gas/metal vapour mixture (mercury, sodium). The output of light is increased by a coating on the glass that is activated by the electrical discharge. The type of coating determines the colour of the light emitted.

**Efficacy**

A measure of the effectiveness of a lighting installation in converting electrical power to light. The units are lumens/watt.

**Emergency lighting**

Lighting provided as a separate system for use when the main lighting fails.

**Energy efficiency**

The means of providing a service which meets the accepted standards but with minimum energy consumption and running costs.

**Extra low voltage lamps**

Small tungsten halogen lamps producing two or three times the light output of conventional filament lamps. Normally powered from a separate 12 V source. Apart from increased efficiency and lamp life, the heating effect is much lower, which is ideal in display lighting.

**Fibre optic lighting**

A type of luminaire that uses a fibre optic cable to transmit the light from a lamp to a point of use. The lamp is therefore remote from the application, allowing ease of access for maintenance etc.

**Flicker**

A visible oscillation in the luminous flux.

**Glare**

Discomfort experienced when lighting is excessively bright against the surroundings. Often the result of inadequately shielded lamps (see **louvres**).

**Illuminance**

The level of light on a surface. Measured in units called lux (equal to one lumen per square metre), this term used to be called the illumination value and can be used as a reference measurement of the performance of a lighting system as related to the activity. (See **lux** and **maintained illuminance**).

## GLOSSARY

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### **Incandescent lamp**

A lamp in which light is produced by a filament heated to very high temperature by an electric current.

### **Indirect lighting**

Lighting which is used to illuminate an area only after reflection from other surfaces.

### **Initial light output**

The luminous flux from a lamp after 100 hours of operation.

### **Installed power density**

The power needed per square metre of floor to achieve an illuminance of 100 lux on a horizontal plane with general lighting. Units are  $W/m^2/100$  lux.

### **Kilowatt hour**

The standard measurement of electrical consumption, equivalent to one kilowatt of electrical demand for one hour (kWh). Also known as a 'unit' of electricity.

### **Light pollution**

Many older luminaires serving roads and car parks lose light skywards causing the all-too-obvious night-time glow. Apart from wasting energy, the appreciation of the night sky is lost and astronomical observation is more difficult. Modern luminaires have much reduced effect on the night sky.

### **Load factor**

The ratio of average demand to maximum demand over a set time period.

### **Louvre**

An open grid attached to a luminaire to control the light output, the prime purpose being to prevent the lamp being seen from normal viewing angles. These angles are normally established from recognised factors appropriate to the design of the luminaire and the purpose of the illuminated area.

### **Lumen**

The SI unit of luminous flux describing the quantity of light emitted by a lamp or received at a surface.

### **Luminous efficacy**

The ratio of the luminous flux emitted by the lamp to the power consumed by the lamp. Normally this would include the control gear and is called the lamp circuit luminous efficacy. The units are lumens per circuit watt.

### **Lux**

The SI unit of illuminance or amount of light on a surface. One lux is equal to one lumen per square metre.

### **Maintained illuminance**

The illuminance at the time when maintenance should take place. Most values of illuminance which are quoted as applicable to a store, ie 500-1000 lux, refer to this value. The time taken to reach the maintained illuminance level would depend on the lamp types and application.

### **Maximum demand**

A type of electrical tariff where a special meter records the maximum demand for electricity in each half hour period. A monthly charge is made per kilowatt of maximum demand, based on twice the monthly maximum recorded. Units are kilowatts (kW).

### **Power factor**

This is a measure of the phase difference between the voltage and current in an ac supply. It is usually represented by the cosine of the phase angle between the applied voltage and the applied current. Ideally, the power factor should be as close to unity as possible.

### **Regulation**

Another word for dimming, usually associated with high frequency control gear.

### **Re-strike time**

The time period between switching a lamp on and it achieving full brightness from a 'hot start', ie the lamp has just been switched off.

### **Run-up time**

The time period between switching on a lamp and it achieving full brightness from a cold start. The time can vary between seconds for a tungsten filament lamp to several minutes for a mercury vapour lamp.

### **Service period**

The average lifetime of tungsten lamps, or the period by which replacement is due for fluorescent or discharge lamps.