Energy Efficiency in Buildings

Shops
## Contents

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Efficiency in Buildings: Shops</td>
<td>1</td>
</tr>
<tr>
<td>Recognising the Benefits</td>
<td>2</td>
</tr>
<tr>
<td>Types of Buildings Discussed in this Booklet</td>
<td>3</td>
</tr>
<tr>
<td>Assessing Current Building Performance</td>
<td>4</td>
</tr>
<tr>
<td>Calculating the Performance Indicator</td>
<td>5</td>
</tr>
<tr>
<td>PI Calculation Form for Retail Establishments</td>
<td>7</td>
</tr>
<tr>
<td>Comparing your Performance Indicator with other Buildings</td>
<td>8</td>
</tr>
<tr>
<td>How Savings Can Be Achieved</td>
<td>11</td>
</tr>
<tr>
<td>Appropriate Energy Savings Measures for Shops</td>
<td>11-12</td>
</tr>
<tr>
<td>Case Studies</td>
<td>13-16</td>
</tr>
<tr>
<td>Action Plan</td>
<td>17</td>
</tr>
<tr>
<td>Example Checklist</td>
<td>17</td>
</tr>
<tr>
<td>How to assess results</td>
<td>18</td>
</tr>
<tr>
<td>Summary</td>
<td>18</td>
</tr>
<tr>
<td>Obtaining Assistance</td>
<td>19-20</td>
</tr>
<tr>
<td>Other Sources of Help</td>
<td>20</td>
</tr>
<tr>
<td>Extra PI Calculation Form</td>
<td>21</td>
</tr>
</tbody>
</table>
Energy Efficiency in Buildings: Shops

**The Energy Efficiency Office**
Get more from your energy. It's a simple enough message and it's not difficult to achieve it with the right kind of help and guidance. That's where the Energy Efficiency Office comes in.

The Energy Efficiency Office was set up in 1983 to co-ordinate the Government's campaign for improved energy efficiency throughout the British economy. The country's fuel bills could be reduced cost effectively by 20 per cent, worth £8 billion a year. That kind of saving wouldn't just mean a more prosperous Britain, it would mean better profitability and lower costs for hundreds of companies and organisations, including your own.

The Energy Efficiency Office gratefully acknowledges the assistance given by the Building Services Research and Information Association in the preparation of this booklet and by the following organisations in providing information.

Asda Stores Ltd
Austin Reed Ltd
Oswald Bailey Group
The Boots Company Plc
Malcolm Campbell Ltd
Gateway Foodmarkets Ltd
Institute of Grocery Distribution
John Lewis Partnership
The Littlewoods Organisation Ltd
Marks and Spencer Plc
Safeway Food Stores Ltd
J. Sainsbury Plc
Savacentre Ltd
Tesco Stores Plc
W. H. Smith and Son Ltd
Waitrose Supermarkets

These organisations are not responsible for the use made of information they have provided in the preparation of the energy performance indicators, or for formulating the guidance set out in this publication.

Introduction
Energy efficiency in shops is important. The retail sector spends £700 million each year on energy, and it is estimated that 25 per cent of this sum is wasted through inefficient energy management. (Source: Energy efficiency in the retail industry, Institute of Grocery Distribution.) Wasteful buildings, whether poorly designed or badly run, can use many times more energy than similar efficient buildings.

This booklet is intended for managers of individual shops and supermarkets, but should also be of assistance to energy managers and managers of retail chains. It is designed to help in assessing the energy performance of retail premises ranging from small high street shops up to superstores and hypermarkets. Valuable savings will be achieved by carrying out the steps shown here, releasing money which can contribute to providing a good service at competitive prices, with opportunities for increased profitability.

The booklet shows you how to compare the energy consumption of an individual shop with those of a representative sample of similar retail outlets. This comparison will indicate how energy efficient your shop is and if significant improvements are possible. Also described are the kinds of measures which can be undertaken to save money. Many of these measures cost nothing to implement and can do much to enhance conditions in areas used by both customers and staff.
Recognising the Benefits

The Role of the Energy Manager

Every building should have someone to take responsibility for the energy used to run it. For small shops this could be the manager or shopkeeper himself. For larger businesses employing several people, the job could form part of the responsibility of a senior member of staff. Retail chains often appoint an energy manager to oversee energy use throughout the shops in the chain or a section of them. Energy management is now a high priority in large supermarket and department store companies, in which annual expenditure on energy may reach several million pounds. Energy efficiency is also important in small premises with much more modest energy costs and there still is a need for someone who works at the premises to look after day-to-day energy efficiency.

The person responsible will need to examine the energy consumption in the building and the ways in which energy is used on a regular basis. Where the energy manager does not have direct responsibility for maintenance or capital expenditure, a well reasoned and researched argument, supported by the techniques outlined in this booklet, can be a powerful submission to higher management.

In order to be successful the energy manager will need to obtain the active support of staff by keeping them fully informed. It is essential to establish and maintain good communications at all levels and to take positive action to remedy faults. Providing incentives and encouraging a general enthusiasm for energy efficient behaviour is an integral part of the task. These can by themselves contribute more to overall savings than many “high tech” capital intensive solutions.

When considering energy efficient investment opportunities, both the cost of the existing fuel and alternatives should be assessed along with the energy savings. Often the installation of an energy efficiency measure will offer the scope to change to a more economic fuel or tariff.

Who gets the benefit?

- Staff and customers. An efficiently controlled shop or store environment ensures that the often conflicting requirements of staff, customers and stock are met as nearly as possible. Carefully managed ventilation ensures that comparatively lightly clad staff are comfortably warm, while at the same time account is taken of the change to an indoor environment experienced by more heavily clad customers entering the shop from outside. Inefficient frozen food cabinets can have a chilling effect on customers as well as using more energy to operate.

- Management. While energy costs are very often only a small percentage of annual turnover of a supermarket chain, energy savings over a period of only a few years can equal the cost of building and equipping an entirely new store. Even in the case of a typical high street grocery business, quite simple energy efficiency measures can save 10% of the energy costs, resulting in a direct increase in profits otherwise only attainable through a much larger increase in annual turnover. Inefficient lighting will raise the temperature of the shop to uncomfortable levels or add to its cooling load, with possible detrimental effects on the shelf-life of produce.

- The Nation. The potential savings in the retail sector from good housekeeping measures alone amount to 10 per cent, worth £70 million a year. The retail sector also accounts for 58% of the total refrigeration energy in the UK and it is estimated that additional savings of about £50 million could be obtained from either heat recovery or improved plant efficiency in this area. Thus the savings possible by adopting the simple no-cost low cost measures described in this booklet would save the country more than these more capital intensive measures.
Types of Building Discussed in this Booklet

The information given in this booklet relates to department stores, supermarkets and superstores, smaller high street food shops and other non-food retail premises, with the following characteristics:

Department and chain stores.
Large town centre shops selling a wide range of non-food products, and often occupying several storeys with lifts and escalators for customer transportation. Some have food departments and restaurants.

Other non-food shops.
These include a wide range of types of small high street premises including those selling electrical goods, hardware, footwear and clothing, books and stationery. These shops may also be within covered shopping malls or precincts.

Note: Banks, building societies, estate agents and other services are covered in another booklet.

Superstores and hypermarkets.
These are stores which sell a wide range of food and non-food products, including clothing, household goods and appliances and DIY equipment. Sales areas are in excess of 2500m² and may extend to 10000m² or more, and there are generally extensive car parking facilities. Hypermarkets are at the higher end of this range and may incorporate other small shop units within the overall building complex.

Supermarkets.
Primarily large self service food stores, but increasingly stocking a range of non-food products such as small textiles, cleaning products, cosmetics and toiletries, household goods. Some of the larger premises now include on-site bakeries and restaurant facilities.

Sales areas are typically between 500 and 2500m², but may extend to over 5000m².

Small food shops.
Includes high street specialist food shops and small supermarkets, with a sales area of less than 500m².

It should be noted that the relative importance of energy costs may differ considerably from the energy used. For example, lighting often accounts for a high proportion of annual energy costs, because daytime electricity is one of the higher cost energy sources.

The following diagram illustrates how energy is used in a supermarket (with bakery).
Assessing Current Building Performance

Steps to assessing performance
This section shows how to calculate a number that indicates the energy performance of your shop. It is designed to give an equivalent 'miles per gallon' number that can then be used to compare your own shop with other similar shops. If your building is judged to be 'poor', then urgent measures should be taken; if it is 'good' then take the opportunity to seek further ways of improving performance, and in particular make sure that you have a method of checking that the situation does not deteriorate in the future.

What you will need to know

- The annual energy consumption of your shop. This information is most conveniently obtained from past bills, but take care that the figures collected represent actual energy consumed through a full year and are not 'estimated' by the utility. It may be helpful to look at more than one year's bills, provided that there have been no significant changes to the building or its use in that time. The numbers you require are the energy units consumed, not the money value. Include all fuels: natural gas, bottled gas, oil, solid fuel and electricity.

- The floor area of the shop. This should be the sales floor area, which is generally a better guide to the energy consuming area of the shop than total floor area. The difference between sales and total floor area, comprising storage space together with staff rest areas and public toilets, varies considerably between shops and typical factors are given later.* Take the internal floor area used for sales of merchandise on each storey of the shop including basements used for this purpose.

Other factors affecting performance.
Although hours of trading, weather conditions and the degree of exposure of the shop will all affect the energy required for heating, and to a small extent energy used for other purposes, corrections to the performance indicator for these factors are generally small enough to ignore. More important is the use made of energy consuming services in the shop, such as mechanical ventilation, air conditioning, refrigeration and bakeries. The following method of assessment is designed to enable you to compare your shop with the most appropriate category.

* If your non sales area is substantially larger than the average of our sample and has to be fully heated or air conditioned you may find the alternative total floor area yardsticks more applicable to your premises.
Calculating the Performance Indicator

The following notes will help you to carry out the calculation for the first time. You may find it convenient to enter the figures on the calculation form on page 7.

**Step 1. Convert energy units to kWh.**
Obtain the energy consumption for each fuel over a one-year period from your quarterly bills. The table below shows the conversion factors that you should use to convert most fuel types into units of kilowatt hours. If you use a fuel type not listed here then you should obtain this factor from one of the sources listed at the end of this publication. Add together the annual energy consumption at all fuels in kWh.

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Billed Units</th>
<th>To get kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural gas</td>
<td></td>
<td>multiply by</td>
</tr>
<tr>
<td></td>
<td>Therms</td>
<td>29.31</td>
</tr>
<tr>
<td></td>
<td>Cubic feet</td>
<td>0.303</td>
</tr>
<tr>
<td>Gas oil (35 sec)</td>
<td>Litres</td>
<td>10.6</td>
</tr>
<tr>
<td>Light fuel oil (290 sec)</td>
<td>Litres</td>
<td>11.2</td>
</tr>
<tr>
<td>Medium fuel oil (950 sec)</td>
<td>Litres</td>
<td>11.3</td>
</tr>
<tr>
<td>Heavy fuel oil (3500 sec)</td>
<td>Litres</td>
<td>11.4</td>
</tr>
<tr>
<td>Liquid petroleum gas (LPG)</td>
<td>Litres</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Tonnes</td>
<td>13900</td>
</tr>
</tbody>
</table>

**Step 2. Modify the total energy consumption to account for weather**
Using the map on page 6 select the weather correction factor applicable to the building. Multiply the total energy consumption by the weather correction factor.

**Step 3 Convert the floor area into units of square metres (m²).**
The total sales floor area or total shop floor area should be expressed in square metres.

The conversion factors given below should be used for this purpose.

<table>
<thead>
<tr>
<th>To convert from</th>
<th>multiply by to get m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square feet ft²</td>
<td>0.0929</td>
</tr>
<tr>
<td>Square yards yd²</td>
<td>0.836</td>
</tr>
</tbody>
</table>

**Step 4. Calculate the performance indicator (PI).**
Simply divide the annual energy consumption by the floor area in square metres.

\[ PI = \frac{\text{Normalized Annual energy consumption}}{\text{Floor area}} \]

**Step 5. Correction factor for airconditioned or mechanically ventilated shops where yardsticks are not provided.**
If over 60% of the premises have airconditioning or mechanical ventilation select the appropriate correction factor from page 10. For shops with less than 60% of the floor area airconditioned or mechanically ventilated reduced correction factors will apply. Find the actual % of the floor area airconditioned and calculate the revised correction factor using the formula provided. An example of this calculation is shown on page 10.

**Step 6 Calculate corrected yardstick.**
Apply the correction factor from Step 5 to the base yardsticks corresponding to your type of shop on page 8.

**Step 7 Partly airconditioned or mechanically ventilated shops.**

**Step 8. Calculate the corrected yardstick.**

**Step 9. Compare your performance indicator in step 4 with the relevant yardstick.**
This calculation provides you with the amount of energy consumed within your building under standard conditions, which can now be used to compare the performance of your building with a sample of similar buildings.
Correction factors for shop yardsticks
Regional weather variations

<table>
<thead>
<tr>
<th>Area</th>
<th>Correction factor, W</th>
</tr>
</thead>
<tbody>
<tr>
<td>South West England</td>
<td>1.07</td>
</tr>
<tr>
<td>Southern England, Thames Valley, Severn Valley and Wales</td>
<td>1.04</td>
</tr>
<tr>
<td>All other areas of England and N. Ireland</td>
<td>1.00</td>
</tr>
<tr>
<td>Scotland excluding North East</td>
<td>0.96</td>
</tr>
<tr>
<td>North East Scotland</td>
<td>0.93</td>
</tr>
</tbody>
</table>
Pi Calculation Form for Retail Establishments

1. Convert your energy use into kWh units

Add your quarterly or monthly use over one year for each fuel and enter below

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Conversion Factor</th>
<th>Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural gas</td>
<td>29.31</td>
<td>kWh</td>
</tr>
<tr>
<td>Gas oil (35 sec)</td>
<td>10.6</td>
<td>kWh</td>
</tr>
<tr>
<td>Light fuel oil (280 sec)</td>
<td>11.2</td>
<td>kWh</td>
</tr>
<tr>
<td>Medium fuel oil (950 sec)</td>
<td>11.3</td>
<td>kWh</td>
</tr>
<tr>
<td>Heavy fuel oil (3500 sec)</td>
<td>11.4</td>
<td>kWh</td>
</tr>
<tr>
<td>Coal</td>
<td>7600</td>
<td>kWh</td>
</tr>
<tr>
<td>Anthracite</td>
<td>9200</td>
<td>kWh</td>
</tr>
<tr>
<td>Liquid petroleum gas (LPG)</td>
<td>7</td>
<td>kWh</td>
</tr>
<tr>
<td>Electricity</td>
<td>1</td>
<td>kWh</td>
</tr>
</tbody>
</table>

Total energy use for the year = kWh

2. Adjust the energy used to account for weather

If necessary, apply a correction factor to the total energy consumption for regional weather variations as shown on page 6.

Regional weather factor = W

Adjust annual energy consumption = A x W = kWh

3. Find sales floor area in square metres

= m²

4. Find the Performance Indicator (PI) and compare with yardstick on page 8.

\[ \text{PI} = \frac{B}{C} = \frac{\text{kWh}}{\text{m}^2} \]

5. For an air conditioned or mechanically ventilated shop not listed in the yardsticks on page 8.

If at least 60% of the premises are air conditioned or mechanically ventilated, select the appropriate building services correction factor from page 10.

Factor = S

6. Find the corrected performance yardstick from:

Base Yardstick x S = x = kWh

7. If your shop is partly air conditioned or mechanically ventilated (i.e. less than 60% of the floor area)

Then find the percentage P of the area so treated and use the formula given below to calculate a reduced factor

\[ \text{Reduced factor} = (P \times S) + (60-P \times 1.0) \]

\[ \frac{60 \times X}{60} + \frac{60- x \times 1.0}{60} = F \]

S = full correction factor from page 10 for services additional to those for base yardstick chosen.

8. Find the corrected performance yardstick from:

D x F = G

9. Compare E or G with your calculated performance indicator (D)
Comparing your Performance Indicator with other Buildings

The table below gives yardsticks of performance for shops. Three bands of performance are shown.

**Good.** Buildings falling in this category have generally good controls and energy management procedures, but further energy savings are often still possible.

**Fair.** Building energy consumption in this band indicates reasonable controls and energy management procedures, but significant energy savings should be achievable.

**Poor.** Buildings in this band have unnecessarily high consumption and urgent action should be taken to remedy the situation. Substantial energy savings should result from the introduction of energy efficiency measures. There may be valid reasons why energy consumption is high, e.g., energy consumption equipment for dry cleaning, photographic processing, etc.

Performance Yardsticks for Shops (kWh/m² per year)

<table>
<thead>
<tr>
<th>Sales Floor Area</th>
<th>Energy Efficiency Rating</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of shop</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Department/chain store</td>
<td></td>
<td>less than 520</td>
<td>520-620</td>
<td>more than 620</td>
</tr>
<tr>
<td>(mechanically ventilated)</td>
<td></td>
<td>less than 280</td>
<td>280-320</td>
<td>more than 320</td>
</tr>
<tr>
<td>Other non-food shops</td>
<td></td>
<td>less than 720</td>
<td>720-830</td>
<td>more than 830</td>
</tr>
<tr>
<td>Superstore/hypermarket</td>
<td></td>
<td>less than 1070</td>
<td>1070-1270</td>
<td>more than 1270</td>
</tr>
<tr>
<td>(mechanically ventilated)</td>
<td></td>
<td>less than 1130</td>
<td>1130-1350</td>
<td>more than 1350</td>
</tr>
<tr>
<td>Supermarket, no bakery</td>
<td></td>
<td>less than 510</td>
<td>510-580</td>
<td>more than 580</td>
</tr>
<tr>
<td>(mechanically ventilated)</td>
<td></td>
<td>less than 400</td>
<td>400-450</td>
<td>more than 450</td>
</tr>
<tr>
<td>Supermarket with own bakery</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(mechanically ventilated)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small food shop — general</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>— fruit &amp; veg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:

1. The above yardsticks relate to heated and naturally ventilated shops, except where indicated differently. Multiplying factors to enable yardsticks to be determined for other situations are given on page 10.

2. The average percentage of total floor area given over to sales for the above samples are as follows:

| Department /chain store | 51 |
| Other non-food          | 67 |
| Superstore/hypermarket  | 61 |
| Supermarket no bakery   | 43 |
| Supermarket with bakery | 52 |
| Small food—general      | 70 |
| —fruit & veg            | 69 |
Alternative Performance Yardsticks for Shops (kWh/m² per year)
Total Floor Area

If non-sales areas are substantially larger than the average of our sample and are heated/air conditioned and illuminated to the same level as sales areas, then your performance indicator could be higher than the yardsticks given on page 8. If this is the case, an assessment of your Performance Indicator (PI) may be made on a 'total area' basis. Calculate the PI for your shop in kWh/m² of total floor area using the correction factors overleaf and compare it with the relevant yardstick below. These yardsticks may also have to be adjusted if your shop has air conditioning or mechanical ventilation.

<table>
<thead>
<tr>
<th>Energy Efficiency Rating</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of shop</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Department/chain store</td>
<td>less than 250</td>
<td>250-280</td>
<td>more than 280</td>
</tr>
<tr>
<td>(mechanically ventilated)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other non-food shops</td>
<td>less than 170</td>
<td>170-200</td>
<td>more than 200</td>
</tr>
<tr>
<td>Superstore/ hypermarket</td>
<td>less than 440</td>
<td>440-500</td>
<td>more than 500</td>
</tr>
<tr>
<td>(mechanically ventilated)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supermarket, no bakery</td>
<td>less than 470</td>
<td>470-560</td>
<td>more than 560</td>
</tr>
<tr>
<td>(mechanically ventilated)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supermarket with own bakery</td>
<td>less than 560</td>
<td>560-620</td>
<td>more than 620</td>
</tr>
<tr>
<td>(mechanically ventilated)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small food shop — general</td>
<td>less than 360</td>
<td>360-400</td>
<td>more than 400</td>
</tr>
<tr>
<td>— fruit &amp; veg</td>
<td>less than 280</td>
<td>280-310</td>
<td>more than 310</td>
</tr>
</tbody>
</table>

Notes 1 and 2 (page 9) also apply to these yardsticks.
Building services

Heating & natural ventilation
Mechanical ventilation
Air conditioning (relative to naturally ventilated yardsticks)
Air conditioning (relative to mechanically ventilated yardsticks)

(Source: CIBSE Energy Code Part 4)

The factors for mechanical ventilation and air conditioning apply where at least 60% of the total floor area is served by this plant. Where less than 60% of the floor area is served, the factor should be reduced in proportion to the area served. Thus the following formula applies in cases where less than 60% of the total floor area is air conditioned or mechanically ventilated:

\[
F = \frac{(P \times S) + (60-P \times 1.0)}{60} \]

\(F\) = Reduced factor to be applied to the performance yardstick to account for air conditioning or mechanical ventilation.

\(S\) = Factor given in the table where at least 60% floor area is so served.

\(P\) = Percentage of floor area to which these services are applied.

**Example:**
Where 20% of a non-food shop is air conditioned and the rest heated and naturally ventilated, \(P = 20\), \(S = 1.4\), so that the correction factor becomes

\[
\frac{(20 \times 1.4) + (40 \times 1.0)}{60} = 1.13
\]

To provide the basis for assessing the shop's actual performance, the yardsticks for a non-food shop with 20% air conditioning becomes:

280 x 1.13 to 320 x 1.13
i.e. 316 to 361 kWh/m²

The revised yardsticks for a fully air conditioned non-food shop would be:

280 x 1.4 to 320 x 1.4
i.e. 392 to 448 kWh/m²

Similarly a yardstick for a fully or partially air conditioned shop could be derived from a yardstick for a mechanically ventilated shop of similar type by multiplying by the appropriate factor.

The factor for mechanical ventilation applies to those shops where ventilation is used for comfort cooling and not simply to meet basic fresh air requirements.

The following section 'How savings can be achieved' will help you decide on ways to improve the energy efficiency irrespective of the performance indicator, but will be of particular assistance for buildings with a high PI.
Savings can be achieved in four main ways:

1. By altering the physical construction of a building to reduce its heat loss characteristics.
2. By replacing or upgrading the energy consuming equipment and controls to make it more efficient.
3. By changing or modifying energy consuming equipment to use a less expensive form of energy or more advantageous tariff.
4. By continuous assessment of consumption. This can be used to check that both the plant and controls continue to operate as intended, and also ensure that the occupants behaviour is not unnecessarily affecting energy use. This is often known as good housekeeping.

A list of potential opportunities for reducing energy costs in shops is given below. This is followed by some typical case studies of energy efficiency programmes already successfully carried out in shops to illustrate the application of the basic principles described in this booklet.

### Appropriate Energy Savings Measures for Shops

<table>
<thead>
<tr>
<th>Improvement Area</th>
<th>Aim</th>
<th>Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Improve thermal insulation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Avoid overheating</td>
<td>Reduce space heating thermostat settings where possible. Fit more accurate thermostats. Use frost protection thermostats outside opening hours. Fit weather compensation controls to warm air curtains.</td>
</tr>
<tr>
<td>Space heating</td>
<td>Reduce heating period</td>
<td>Fit time controls to heating plant. Switch off heating before closing time where possible. Install optimum start controls.</td>
</tr>
<tr>
<td></td>
<td>Reduce heating loads</td>
<td>Utilise heat recovery from refrigeration and other sources for space heating.</td>
</tr>
<tr>
<td></td>
<td>Improve plant efficiency</td>
<td>Institute regular maintenance checks. Improve thermal insulation of boilers and pipework.</td>
</tr>
<tr>
<td>Refrigeration</td>
<td>Maintain performance</td>
<td>Planned maintenance. Minimise defrost cycles. Ensure defrost is effective. Check thermostat setting and operation.</td>
</tr>
<tr>
<td></td>
<td>Reduce losses</td>
<td>Fit night blinds to freezer cabinets. Install heat recovery systems. Consider centralised refrigeration packs with heat recovery where practicable.</td>
</tr>
<tr>
<td>Lighting</td>
<td>Improve lighting efficiency</td>
<td>Install more efficient lighting sources; e.g. keep luminaires and lamps clean.</td>
</tr>
<tr>
<td></td>
<td>Avoid unnecessary lighting</td>
<td>Switch off lights when not required. Fit automatic lighting controls for intermittently used areas, e.g. stores.</td>
</tr>
</tbody>
</table>
### Appropriate Energy Savings Measures for Shops

<table>
<thead>
<tr>
<th>Improvement Area</th>
<th>Aim</th>
<th>Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lighting</td>
<td>Reduce lighting level</td>
<td>Reduce general lighting level where possible. Use spot lighting for specific displays. Consider automatic voltage reduction after start up. Use reduced lighting for cleaning and shelf stocking periods.</td>
</tr>
<tr>
<td>Electrical services</td>
<td>Reduce running costs</td>
<td>Check tariffs and maximum demand ratings are still appropriate.</td>
</tr>
<tr>
<td>Mechanical ventilation</td>
<td>Maintain performance</td>
<td>Regular filter and other maintenance checks.</td>
</tr>
<tr>
<td></td>
<td>Reduce fan power</td>
<td>Introduce variable speed fan controls. Reduce running times of ventilation plant where possible.</td>
</tr>
<tr>
<td>Air conditioning</td>
<td>Maintain performance</td>
<td>Regular maintenance checks including cooling tower condition and descaling chiller condenser tubes. Ensure correct water treatment. Check control settings and operation.</td>
</tr>
<tr>
<td></td>
<td>Reduce cooling loads</td>
<td>Use free cooling from outside air when conditions allow.</td>
</tr>
</tbody>
</table>
Case Study 1.

W. H. Smith’s Store.
Weather compensated door air curtains and other measures

Site description: In November 1981, W. H. Smith & Son opened a new store in Rotherham into which six energy-saving measures had been incorporated.

The store has a gross floor area of 1,119m² on 3 levels which includes 357m² of sales area and occupies a city centre corner site. In stores of this type space heating, cooling and lighting are the main uses of energy. W. H. Smith felt it was possible to reduce energy consumption whilst maintaining an attractive selling environment for customers and staff and decided to use the Rotherham site as a test bed for several energy saving measures.

Estimated energy consumption before the measures were introduced: Since the site was purchased as a shell no monitored energy performance before the introduction of the measures existed. A computer model of the store was therefore developed by the design consultants and each measure was separately monitored over the period 1984/85 and the energy savings analysed either directly or by inputting some of the data into the computer model. In this way it was possible to take into account interactions between different measures or environmental systems.

The measures: Six energy saving measures were investigated as follows:

<table>
<thead>
<tr>
<th>Measure</th>
<th>Monitored Savings kWh/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air handling light fittings</td>
<td>650</td>
</tr>
<tr>
<td>Free air cooling</td>
<td>3400</td>
</tr>
<tr>
<td>Exhaust heat recovery to stockroom</td>
<td>2800</td>
</tr>
<tr>
<td>Office ventilation exhaust heat recovery</td>
<td>8900</td>
</tr>
<tr>
<td>Weather compensated door air curtains</td>
<td>9000</td>
</tr>
<tr>
<td>Optimum start/stop control</td>
<td>11900</td>
</tr>
</tbody>
</table>

One of these measures is described in detail.

Weather compensated door air curtains:

The warm air curtains over the four entrance doors to the store are supplied with heat from the low pressure hot water space heating system. In order to reduce their energy consumption an external air temperature sensor was installed to operate a three-way valve to reduce the flow temperature of the water to the air curtains as outside air temperature increases. This is done by mixing return water from the air curtains with the supply from the heating system. Besides reducing the heating energy used by the curtains it was also expected that the cooling load on the sales area air conditioning system would also be reduced. This is a good example of how the conflicting requirements of customers entering the store and staff and customers in the store can be met economically.

Energy savings achieved:

The total monitored savings from all the measures amount to 36650 kWh. The metered energy consumption for the period April 1984 to March 1985 subsequent to the completion of the installation was 216119 kWh. Thus the savings amount to 14% of the estimated initial consumption. The 9000 kWh monitored savings due to the compensated warm air curtains could probably be improved upon in the light of operating experience but the measure represents a contribution of 4% to the total monitored savings. The total energy consumption for the store for 1984/85 gives a performance indicator of 193 kWh/m², based on the total floor area. This is 'good' compared with the yardstick for a non-food shop with 32% air conditioning (total area' yardstick 227-259 kWh/m²). The 'sales area' performance indicator of 605 kWh/m² is inappropriate in this case because of the large area of offices and stockroom in this store which is also heated and cooled.

Sources: Report: Monitoring and Energy Saving Measures at W. H. Smith & Sons, Rotherham by B.D.P. Energy & Environment, Manchester. For ETSU
Case Study 2.

Leeds

The site: The Safeway store at Oakwood was constructed some 14 years ago, just before the 1973 fuel crisis trebled the price of fuel almost overnight. Its metal frame construction with brick infill and pitched roof are substantially below the thermal insulation standards set by the current Building Regulations. The store opened for trading in April 1973 with a total store area of 1429m$^2$ and a sales area of 959m$^2$.

The sales area was heated by a ducted warm air system supplied by a 300 kW (1 million Btu/h) gas fired floor standing unit. In the original design there were no provisions for an air recirculation system; hence, all air passing through the unit had to be heated.

Energy efficiency measures carried out:

Three measures were undertaken:

1. Fitting glass doors to multideck refrigerated display cabinets.

A large number of the refrigerated display cabinets at the store are multi-deck frozen food and meat cases. With this type of case there is a large spillage of cold air from the cabinets. During August 1985, Safeway fitted glass doors to these multi-deck cases reducing spillage considerably.

2. Warm air recirculation with heat recovery.

In May of the same year, Safeway modified the heating ductwork in the store to give an air recirculation system. They also installed a heat recovery system for the heat rejected from the refrigeration plant. This consisted of a heat reclaim coil having the duty of 56 kW (190000 Btu/h) at an air volume of 3.8 m$^3$/s (8000 cfm).

3. Replacement heating system for non-sales area.

The ducted warm air system in the areas behind the store, i.e. canteen, toilets, offices, etc., was replaced by a gas fired low pressure hot water system feeding thermostatically controlled radiators. This system gave better comfort and heating control in these areas.

The steady increase in space heating energy consumption over the four year period made the site an obvious choice for investigation and energy efficiency improvements.

Energy consumption before efficiency improvements were carried out:

Energy consumptions for space heating for the four years prior to improvements were:

<table>
<thead>
<tr>
<th>Year</th>
<th>kWh</th>
<th>therms</th>
</tr>
</thead>
<tbody>
<tr>
<td>1981-1982</td>
<td>770853</td>
<td>26300</td>
</tr>
<tr>
<td>1982-1983</td>
<td>941349</td>
<td>32117</td>
</tr>
<tr>
<td>1983-1984</td>
<td>988802</td>
<td>33736</td>
</tr>
<tr>
<td>1984-1985</td>
<td>1031566</td>
<td>35195</td>
</tr>
</tbody>
</table>

The total energy consumption for 1984-1985 was 2019220 kWh so that the performance indicator for the store at that time was 2105 kWh/m$^2$ based on the sales floor area.
Energy consumption after energy efficiency measures: Without the installation of separate metering equipment it is not possible to quantify savings for each measure. However, it is estimated that fitting glass doors to refrigerated display cabinets has made savings of between 5 and 7.5% in electricity consumption. Total energy consumption was significantly reduced after the measures were carried out. For the 12-month period October 1985 to September 1986, the total energy consumption was 1,451,048 kWh — an overall saving of some 28% over the previous year.

For the same period the energy consumed for space heating was 458,145 kWh, a reduction of some 50%. The performance indicator has been reduced to 1513 kWh/m², which is still 'poor' compared with the sales floor area yardstick for a supermarket with no bakery, indicating that further improvements could be made to reduce the overall energy consumption of the building.
Relamping at Debenhams:

Site details: A substantial part of the electricity consumption in department stores is accounted for by fluorescent luminaires and tungsten display lighting. It is important that the implementation of energy efficiency measures in lighting does not involve a reduction in the quality of the sales environment. The relamping scheme at Debenham’s store in Guildford achieved better lighting at lower cost.

The old lighting scheme: Consisted of 410 luminaires each containing six tubes, with dished plastic louvres. These had become yellow causing colour distortion.

The project: A new diffuser, incorporating reflectors, was designed which allowed two tubes to be removed from each luminaire. The four remaining tubes were repositioned and the new diffuser was very simply slotted into the existing fitting in two pieces with minimum disruption to the store.

The benefits: Comparison of old with new lighting schemes.

<table>
<thead>
<tr>
<th></th>
<th>Old scheme</th>
<th>New scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installed lighting load (background only) kWh</td>
<td>196.8</td>
<td>131.2</td>
</tr>
<tr>
<td>Measured illuminance below luminaire lux</td>
<td>450</td>
<td>500</td>
</tr>
<tr>
<td>between luminaires lux</td>
<td>250</td>
<td>450</td>
</tr>
</tbody>
</table>

- A 33% saving in energy per luminaire.
- A 28% improvement in illuminance with increased uniformity.
- A 33% saving in lamp replacement costs at the next relamping.
- 820 spare tubes with two thirds of their life remaining available as replacements.
- Improved colour rendering.
- Reduced load on the air conditioning system during the summer.

Sources: ‘Electrical Review’ vol. 214 no. 3, 27 January 1984, 23
Mr. Trevor Barden, Mechanical & Electrical Controller, Burton Group, 2-4 Dean Street, London W1.
Mr. Wyatt, Surelux Lighting, Lighting Equipment Manufacturers, Hollins Mill, New Hay Road, Huddersfield.
**Action Plan**

**How to implement a course of action**

1. Appoint a person who will carry ultimate responsibility for energy management to whoever is in overall charge of the building. It is important that his/her duties are clearly established. If your shop is part of a large retail chain, you will need to liaise closely with the group or area energy manager.

2. Set up a monitoring system. Obtain invoices and bills from the previous 12 months in order to initiate the system and provide a basis for comparison. On prepared forms record the monitored consumption for each fuel in a standard unit, i.e. kWh.

3. Prepare and use checklists. These are the principal instruments of good housekeeping. An example checklist is shown in the next column.

4. Carry out, or authorise your energy manager to carry out an energy survey. Break down energy consumption into the main areas of use, e.g. sales, services, office, storage, etc. Break down building services systems into energy consuming units. Repeat the survey at regular intervals.

5. Identify waste. Analyse the survey results and look for abnormal consumptions. Establish the reasons for abnormally high consumptions.

6. Select and calculate a performance indicator for your premises and set a target to reduce it.

7. Obtain assistance. Seek specialist advice on technical aspects of the measures described, particularly where these involve physical alterations to the building fabric or plant. Have an energy survey carried out by an independent consultant. Seek advice from your Regional Energy Efficiency Officer whose name and address is on page 19.

---

**Example Checklist**

**Measurements and records**

Measure and record fuel consumption. Examine records to highlight any radical change in energy consumption. Evaluate the effect of energy efficiency actions from records.

**Planning and training.**

Appoint someone to be responsible for energy use on the premises. Plan short-term energy efficiency actions — mainly good housekeeping. Allocate savings to finance longer term actions. Prepare a long term programme for improvements in energy efficiency. Estimate capital requirements and identify projected savings. Set energy efficiency targets for each shop to achieve a 10% saving in energy consumption over the year. Send the person responsible for energy use to meetings of the local energy manager’s group. Keep staff fully informed and involved in the energy efficiency programme. Display improvements using progress charts and use posters as reminders.

**Good Housekeeping**

Check settings of heating and hot water controls. Check on lights left on in unoccupied spaces. Minimise opening of goods inwards and other non customer access doors. Check taps in washrooms/toilet areas are switched off. Check thermostat settings on freezer and refrigerated cabinets. Clean filters in mechanical ventilation and air conditioning systems.
How to assess results

A simple but effective way of demonstrating continued progress in improving energy efficiency is by means of an energy profile. An example of a total energy profile for a supermarket is shown below. If submetering of individual building services is installed then a more detailed profile can be obtained, showing energy savings in each service.

Summary

Now that you know how to assess the performance of your shop, you should start your own Action Plan. An Action Plan for improving energy efficiency on your premises will lead to reduced running costs, an improved standard of service and increased profitability.
Obtaining Assistance

Organisations aiming to improve the energy efficiency of their premises can obtain advice and information through the Energy Efficiency Office and other organisations.

1. Free Advice and Information

Regional Energy Efficiency Officers

Within the Department of Trade and Industry’s regional offices – and in the Welsh and Scottish Offices and the Northern Ireland Department of Economic Development - a specialist and senior member of staff is available to advise firms on all aspects of energy efficiency. Contact your local REEO at the address below:

NORTHERN REGION
Arthur Hoare
Energy Efficiency Office
Stanegate House
2 Groat Market
Newcastle upon Tyne NE1 1YN
Tel: Newcastle (091) 232 4722

NORTH WESTERN REGION
Robin Gardner
Energy Efficiency Office
Sunley Tower, Room 2104
Piccadilly Plaza
Manchester M1 4BA
Tel: Manchester (061) 236 2171 ext 5330

YORKSHIRE & HUMBERSIDE REGION
David Harrison
Energy Efficiency Office
Priory House
3-5 Park Row
Leeds LS1 5LF
Tel: Leeds (0532) 443171

WEST MIDLANDS REGION
Don Bennett
Energy Efficiency Office
Ladywood House
Stephenson Street
Birmingham B2 4DT
Tel: Birmingham (021) 631 6109

EAST MIDLANDS REGION
Ian Wright
Energy Efficiency Office
Severns House
20 Middle Pavement
Nottingham NG1 7DW
Tel: Nottingham (0603) 506181 Ext 360

SOUTH EASTERN REGION
Allan Franklin
Room 217, Bridge Place
88/89 Eccleston Square
London SW1V 1PT
Tel: London (01) 215 0619

EASTERN AREA
Godfrey Smith
Room 217, Bridge Place
88/89 Eccleston Square
Tel: London (01) 215 0610

SOUTHERN AREA
Iain Ure
Room 217, Bridge Place
88/89 Eccleston Square
Tel: London (01) 215 0609

SOUTH WESTERN REGION
Rodney Youlton
Energy Efficiency Office
The Pitney
Bristol BS1 2PB
Tel: Bristol (0272) 272666

SCOTLAND
Eddie Gowans
Industry Department for Scotland
Energy Division Room 6/41
New St Andrews House
St James Centre
Edinburgh EH1 3TA
Tel: Edinburgh (031) 244 4665

WALES
Jeff Wallington
Welsh Office
Industry Department
Cathays Park
Cardiff CF1 1NO
Tel: Cardiff (0222) 823126

NORTHERN IRELAND
Danny Austin
Department of Economic Development
Netherleigh
Massey Avenue
Belfast BT4 2JP
Tel: Belfast (0232) 63244

Technical Advice

Buildings and buildings services (excluding heat pumps, small scale combined heat and power and building energy management systems)

Enquiries Bureau
Building Research Energy Conservation Support Unit (BRECSU)
Building Reasearch Establishment
Garston
Watford
Herts WD2 7JR
Tel: 0923 664746

All other areas

Enquiries Bureau
Energy Technology Support Unit (ESTU)
Building 156
Harwell Laboratory
Didcot
Oxon OX11 0RA
Tel: 0235 834621 Ext. 3530

Technical Sales Data Service

Three separate Technical Sales Data Service modules are available, covering buildings, industrial processes and consultants. For further information contact the Energy Information Centre, PO BOX 147, Grosvenor House, High Street, Newmarket CB8 9AL
Tel: 0638 663030.
2 Publications from the EEO

Energy Management
Published monthly and mailed free to all those interested in energy economy, 'Energy Management' provides the latest information on cost-effective ways of reducing energy consumption. Every issue of 'Energy Management' contains a table of Degree Days giving regional temperature variations.

Fuel Efficiency Booklets
These give guidance on the efficient operation of building services and utilities, on insulation and on auditing energy use.

Energy Technology Series
This series examines the current state of particular technologies and outlines their potential use in encouraging the adoption of energy-efficient techniques.

These publications are available from:
Energy Efficiency Office,
Department of Energy,
Blackhorse Road,
London SE99 6TT.

3 Financial Support

Support for collaborative research
The exploitation of successful research and development can be further assisted, in appropriate cases, through the Department of Trade and Industry's programme of support for collaborative research. The assistance can apply to both general and advanced technology programmes.

For further information contact your nearest DTI Regional Office, or the Scottish or Welsh Office.

4 Monitoring and Targeting

Monitoring and targeting (M&T) is a structured and disciplined approach to the management of energy. The E.E.O. is sponsoring, often through trade associations, the development of M&T systems for all major sectors of industry. For more information about M&T, contact your Regional Energy Efficiency Officer.

Other Sources of Help

6. British Gas Plc, Commercial Gas Centre, 139 Tottenham Court Road, London W1 9LN. 01-242 0789.
7. Contact your local Electricity Board (number in telephone directory).
8. Independent Energy Consultants Group Energy Systems Trade Association Ltd., PO. Box 16, Stroud, Gloucestershire GL5 5EB. Tel: 0453 387 3568
The Hevac Control Manufacturers Association, Automatic Controls Group (HEVAC), Sterling House, 6 Furlong Road, Bourne End, Bucks SL8 5DG (Tel: 06285 311867/7)
The Heating & Ventilating Contractors’ Association (HVCA), Esca House, 34 Palace Court, London W2 4JG (Tel: 01-229 2488)
Glass & Glazing Federation (GGF), 44-48 Borough High Street, London SE1 1XP (Tel: 01-403 7177)
Cavity Foam Bureau, PO Box 79, Oldbury, Warley, West Midlands B69 4PW (Tel: 021 544 4949)
National Cavity Insulation Association (NCIA)
External Wall Insulation Association (EWIA)
National Association of Loft Insulation Contractors (NALIC)
Draughtproofing Advisory Association (DPAA)
Builders Merchants Federation, 15 Soho Square, London W1V 5FB (Tel: 01-439 1753)
**PI Calculation Form for Shops**

1. **Convert your energy use into kWh units**

   Add your quarterly or monthly use over one year for each fuel and enter below

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Conversion Factor</th>
<th>Interchange Unit</th>
<th>kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural gas</td>
<td>Therms x 29.31 =</td>
<td></td>
<td>kWh</td>
</tr>
<tr>
<td></td>
<td>Cubic feet x 0.303 =</td>
<td></td>
<td>kWh</td>
</tr>
<tr>
<td>Gas oil (35 sec)</td>
<td>Litres x 10.6 =</td>
<td></td>
<td>kWh</td>
</tr>
<tr>
<td>Light fuel oil (290 sec)</td>
<td>Litres x 11.2 =</td>
<td></td>
<td>kWh</td>
</tr>
<tr>
<td>Medium fuel oil (950 sec)</td>
<td>Litres x 11.3 =</td>
<td></td>
<td>kWh</td>
</tr>
<tr>
<td>Heavy fuel oil (3500 sec)</td>
<td>Litres x 11.4 =</td>
<td></td>
<td>kWh</td>
</tr>
<tr>
<td>Coal</td>
<td>Tonnes x 7600 =</td>
<td></td>
<td>kWh</td>
</tr>
<tr>
<td>Anthracite</td>
<td>Tonnes x 9200 =</td>
<td></td>
<td>kWh</td>
</tr>
<tr>
<td>Liquid petroleum gas (LPG)</td>
<td>Litres x 7 =</td>
<td></td>
<td>kWh</td>
</tr>
<tr>
<td></td>
<td>Tonnes x 13900 =</td>
<td></td>
<td>kWh</td>
</tr>
<tr>
<td>Electricity</td>
<td>kWh x 1 =</td>
<td></td>
<td>kWh</td>
</tr>
</tbody>
</table>

   Total energy use for the year = kWh **A**

2. **Adjust the energy used to account for weather**

   If necessary, apply a correction factor to the total energy consumption for regional weather variations as shown on page 6.

   Regional weather factor = **W**

   Adjust annual energy consumption = A x W = **B**

3. **Find sales floor area in square metres**

   = m² **C**

4. **Find the Performance Indicator (PI) and compare with yardstick on page 8.**

   \[ \text{PI} = \frac{B}{C} \]

   = kWh/m² **D**

5. **For an air conditioned or mechanically ventilated shop not listed in the yardsticks on page 8.**

   If at least 60% of the premises are air conditioned or mechanically ventilated, select the appropriate building services correction factor from page 10.

   Factor = **S**

6. **Find the corrected performance yardstick from:**

   Base Yardstick x S = x **E**

7. **If your shop is partly air conditioned or mechanically ventilated (i.e. less than 60% of the floor area)**

   Then find the percentage P of the area so treated and use the formula given below to calculate a reduced factor

   Reduced factor = \( \frac{(P \times S) + (60-P \times 1.0)}{60} \times \frac{60}{60} + \frac{60}{60} \times 1.0 \) **F**

   S = full correction factor from page 10 for services additional to those for base yardstick chosen.

8. **Find the corrected performance yardstick from:**

   D x F = **G**

9. **Compare E or G with your calculated performance indicator (D)**