Guide 36

Energy Efficiency in Hotels – A Guide for Owners and Managers

Luxury Hotel
Typically this will be in a city centre location; it might, for example, be of Edwardian grandeur or modern. The reception and circulation areas are generous, and there are restaurant, conference and leisure facilities. The average floor area is likely to be between 70 and 90 square metres per bedroom. The number of bedrooms ranges from 100 to 500 or more.

Business or Holiday Hotel
This will be a three or four star purpose-built hotel catering principally for the business or holiday trade. There is a restaurant, conference rooms and leisure facilities. The average floor area is likely to be in a relatively narrow band of 40 to 60 square metres per bedroom. The size is generally between 50 and 150 bedrooms.

Smaller Hotel
Usually this will be a two star hotel occupying an older, probably converted, building, usually having between 20 and 100 bedrooms. The floor area can vary widely, and room sizes tend to be large, giving an average floor area of around 60 to 70 square metres per bedroom. The facilities will vary amongst hotels.

This Guide is intended for hotel owners and operators who are responsible for managing premises. It contains data which will allow you to see how your premises compare with industry norms in terms of:

- energy consumption
- energy costs.

In addition, it contains advice on:

- controlling energy better
- using energy more efficiently
- reducing avoidable waste while adding to customer comfort.

The Guide is based on the results of energy surveys and the monitoring of energy use by hotel operators. It sets out performance criteria for the three hotel types described above:

- luxury hotel
- business or holiday hotel
- smaller hotel.

For each type it shows typical consumptions which will enable you to see whether your hotel's performance is *good, fair* or *poor.*

The advice on energy efficiency describes some of the main managerial and technical actions which you should consider to improve performance. Many cost little or nothing to implement.

The estimated savings from these energy efficiency measures can typically be:

- upwards of 5% for good housekeeping measures, and
- around 10% for low cost measures.

Greater capital investment in energy efficiency measures can achieve larger savings still.

Managing energy better, and making sure it is used efficiently, will reduce your fuel bills and add directly to your hotel's operating profit.

BEST PRACTICE PROGRAMME

ENERGY EFFICIENCY
DEPARTMENT OF THE ENVIRONMENT

> ***"Managing energy better will add directly to your hotel's operating profit."***

HOW THE GUIDE WAS COMPILED

Energy use in hotels

The information in this Guide is based on data from over 300 hotels of various kinds – ranging from small hotels with fewer than 20 bedrooms right through to fully air-conditioned international standard hotels with 500 or more rooms. Information about energy use is presented in two basic units – consumption in kWh per square metre per year, and cost in £ per bedroom per year based on 1993 prices. Electricity is shown separately from fossil fuels (natural gas, oil, LPG, and solid fuel). Conversion factors to turn fossil fuel delivered units into kWh are given below. Fossil fuel costs in table 2 and figure 3 assume that natural gas is used.

Annual delivered energy consumption can range from 200 kWh/m^2 to over 1000 kWh/m^2. Annual energy costs can range from £300 per bedroom to well over £1000.

The charts and tables show energy consumption and cost data for each of the three hotel types. Three bands of performance have been established – *good*, *fair* and *poor*. These bands have been derived so that the 25% of hotels in the sample with the lowest energy consumption (kWh/m^2) or cost (£/bedroom) comprise the *good* band, while the 25% with the highest energy or cost comprise the *poor* band. The remaining 50% comprise the *fair* band.

It should be noted that: (a) for clarity and ease of use, the values given in the tables are rounded to the nearest ten units; for practical purposes, consumption values of (for example) 76 and 84 kWh/m^2 are the same, and **(b)** for different hotel types, the average room size varies, as does the relationship between number of rooms and total floor area; this explains why there is not a constant relationship between the kWh/m^2 and the £/bedroom values throughout the tables.

Who benefits from energy efficiency?

- Hotel owners and management benefit because efficiently run buildings cost less to operate.
- Guests benefit because an efficiently controlled hotel satisfies their needs and leads to repeat business.
- Staff benefit through improved morale and better motivation, which in turn increase productivity.
- The environment benefits because using energy efficiently reduces adverse effects on the environment and preserves non-renewable resources for future generations.

Notes on delivered energy units

Energy units used in this Guide are in kilowatt hours (kWh), the unit in which electricity and gas are both billed. Conversion factors are:

1 Therm = 29.3 kWh
1 kWh = 3.6 MJ (Megajoules)

Approximate gross calorific values of fuels are:

NATURAL GAS
30 kWh/hundred ft^3

LPG
13 780 kWh/tonne

OIL

Gas oil (35 sec)	10.6 kWh/litre
Light fuel oil (200 sec)	11.2 kWh/litre

Fuel costs

Fuel costs vary with hotel size, type, region, contract and load profile. Unit prices tend to be lower for larger and more intensively serviced buildings. These are more likely to be supplied at a higher voltage and have better load factors.

A full discussion of tariffs is beyond the scope of this Guide. Electricity bills will usually be based on a maximum demand tariff.

Always consult the supply company, or obtain independent advice, to ensure you are on the best possible tariff for your business and consumption pattern.

Energy and the environment

The burning of fossil fuels to generate energy, releases gases into the atmosphere. These include sulphur dioxide that gives rise to acid rain, and carbon dioxide that is the main contributor to the threat of global warming.

Factors to convert consumption of fuels to emissions of carbon dioxide, in kg of carbon dioxide produced per kWh of fuel used are:

gas	0.21
oil	0.29
electricity	0.72

A typical hotel releases annually about 160kg of CO_2 per square metre of floor area, equivalent to about 10 tonnes per bedroom.

Hotel type	Good		Fair		Poor	
	Gas	Electricity	Gas	Electricity	Gas	Electricity
	less than 300	less than 90	300 to 460	90 to 150	more than 460	more than 150
	less than 260	less than 80	260 to 400	80 to 140	more than 400	more than 140
	less than 240	less than 80	240 to 360	80 to 120	more than 360	more than 120

Table 1 Annual energy consumption in kWh/m^2 for the three hotel types

Hotel type	Good		Fair		Poor	
	Gas	Electricity	Gas	Electricity	Gas	Electricity
	less than £260	less than £360	£260 to £400	£360 to £600	more than £400	more than £600
	less than £240	less than £320	£240 to £360	£320 to £500	more than £360	more than £500
	less than £220	less than £300	£220 to £340	£300 to £400	more than £340	more than £400

Table 2 Annual energy cost in £/bedroom for the three hotel types

WHERE ENERGY IS USED

Understanding where energy is used

Knowing what you are paying for energy and how it is used are both important parts of good energy management.

Collect your energy use and cost data. Make sure that you are purchasing fuel at the lowest possible tariffs.

Measure the heated floor area of your hotel.

Compare your consumptions with the charts, taking account of any exceptional features you may have.

Check that the consumption pattern relates sensibly to weather conditions, occupancy level, and facilities used.

Take meter readings regularly to identify sources of waste, such as excessive night time or weekend consumptions. Read meters at the same time each day, week or month, to establish the pattern of use and to locate discrepancies.

Wherever possible install sub-meters so that costs can be allocated to each main area or activity.

Make the catering facility a cost centre – following the procedure recommended in the *Uniform system of accounts for hotels* (Hotel Association of New York City Incorporated, 8th edition, 1986).

End use	Fossil fuel consumption in kWh/m²	Electricity consumption in kWh/m²
Heating	225	9
Hot water	96	3
Lighting	0	40
Catering	56	17
Other, including air-conditioning and ventilation	7	42
Totals	384	111

Table 4 Annual delivered energy consumption of a typical hotel

Table 4 was drawn up from an analysis of over 50 detailed energy surveys of hotels (conducted by independent consultants) and is based on their estimates.

It shows average values of where energy is used in hotels. Figure 5 shows delivered energy by use in percentage terms.

Although, at almost 50%, heating is the largest consumer of energy by delivered kWh, this is about 30%, in terms of cost, as shown in table 5 and figure 6.

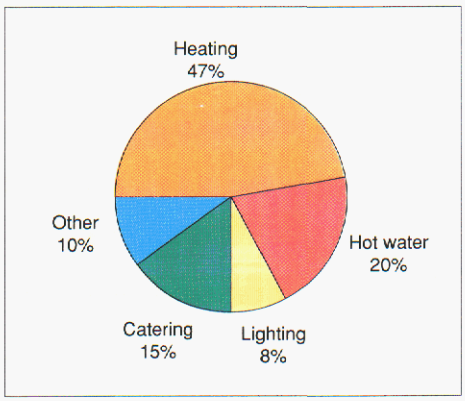

Figure 5 Analysis of delivered energy by use

How to use energy more efficiently

Make a member of staff responsible for energy management. They should try to ensure that the minimum amount of energy, consistent with the required levels of service, is used, and waste is reduced to a minimum.

Use the ideas in this Guide together with house tours at various times of day and night to establish a checklist of items for attention.

There are technological developments that can help you to use energy efficiently. Try to ensure that initially you use the equipment and services you already have as efficiently as possible; for example, make sure that equipment is maintained properly. With little or no capital investment it is possible to adopt good housekeeping measures that can be put into operation straight away and offer immediate benefits.

Try to identify measures that have other associated benefits – such as improving your guests' perception of comfort and service.

Involve staff by explaining your plans and invite them to propose their own suggestions for energy saving. Ensure they are given feedback about energy use, and consider incentives for successful ideas.

A set of Good Practice Case Studies, showing how cost-effective energy savings have been achieved in a number of hotels, will support this Guide. The Case Studies are currently under development.

End use	Fossil fuel cost in £/bedroom	Electricity cost in £/bedroom
Heating	170	32
Hot water	72	11
Lighting	0	144
Catering	42	61
Other, including air-conditioning and ventilation	5	151
Totals	289	399

Table 5 Annual energy costs at 1993 prices

Table 5 and figure 6 show estimates of the average cost of energy for various end uses in hotels. They are based on detailed surveys – with fuel costs updated to 1993 values. For consistency with the units used elsewhere in this Guide they have been expressed as costs in £/bedroom/year.

It can be seen that, although heating is the largest single cost, lighting represents about 20% of the total.

About one-quarter of the cost is taken up by other items of electrical equipment, including mechanical ventilation, air-conditioning, lifts, and many other items.

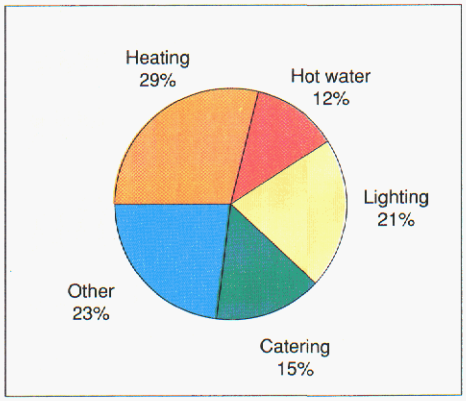

Figure 6 Analysis of delivered energy by cost

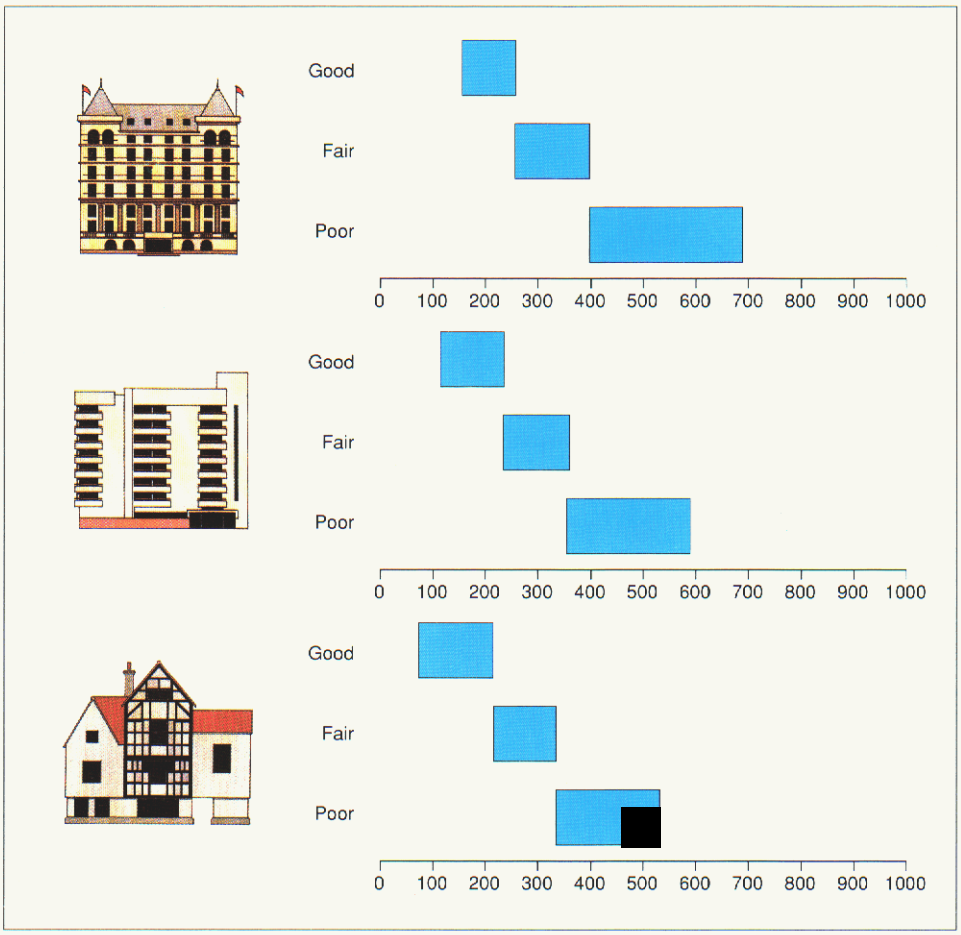

Figure 3 Annual gas cost for the three hotel types in £/bedroom

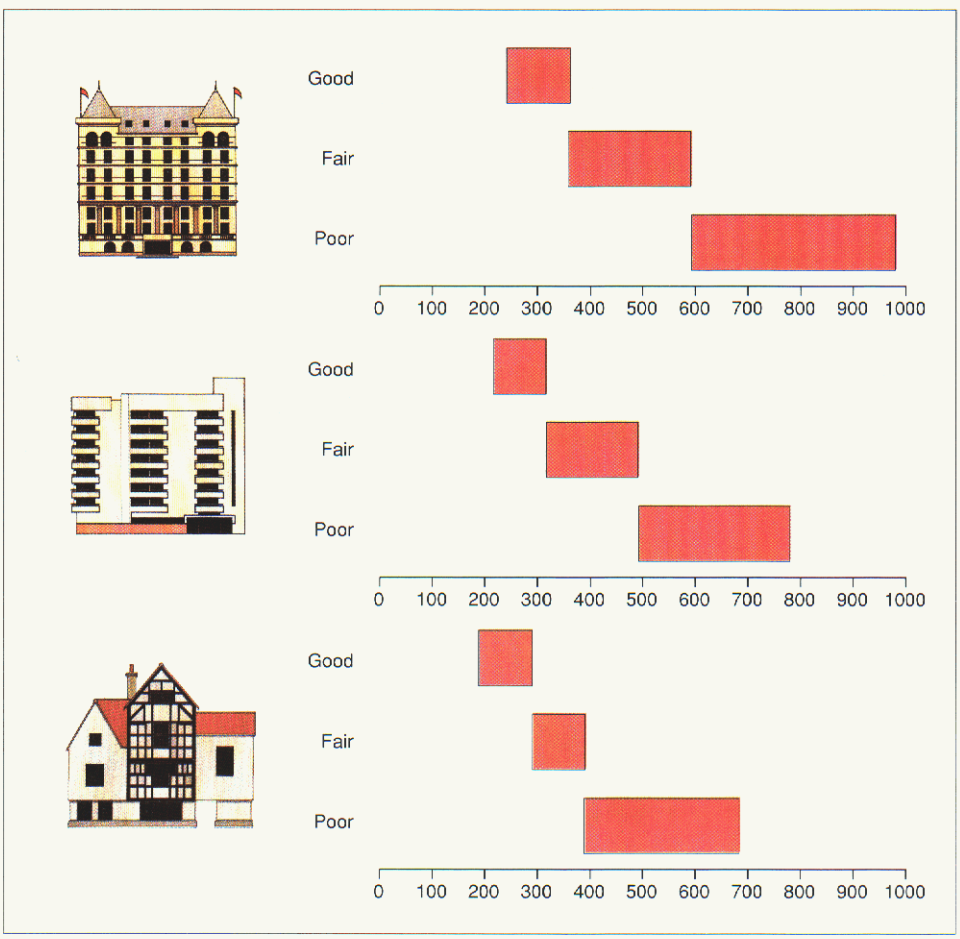

Figure 4 Annual electricity cost for the three hotel types in £/bedroom

Air-conditioning

If your hotel has air-conditioning, an additional allowance may be made for its effect on consumption. The extent and use of air-conditioning can vary widely but, as a general guide, hotels with extensive air-conditioning use about 50% more electricity than those without. They also use more energy for heating, largely due to additional ventilation. Table 3 shows bands of performance for luxury hotels with air-conditioning.

	Gas		Electricity	
	kWh/m²	£/bedroom	kWh/m²	£/bedroom
good	<330	<£290	<130	<540
fair	330 – 500	290 – 440	130 – 220	540 – 900
poor	>500	>440	>220	>900

Table 3 Annual consumption in air-conditioned hotels

Combined heat and power (CHP) units

CHP units burn fossil fuel, typically gas, to generate electricity on site, and recover the 'waste' heat from the process for space and water heating; they can lower running costs. Success depends on: accurate appraisal of the hotel's potential for CHP; the correct sizing of the CHP unit to suit the hotel's pattern of energy use; and a well engineered, well controlled and reliable installation. Assess the feasibility of installing CHP after, not before, energy use has been brought under good management practices. CHP units raise the amount of delivered gas consumed, while reducing metered electricity, but usually lead to a reduction in overall energy costs. If you have CHP you can assess your consumption against the values in this Guide in one of two ways.

1. To use the £/bedroom/year unit add your gas and electricity costs together and compare them with the sum of gas and electricity costs from the charts.

2. To use the energy consumptions in kWh/m²/year, it is best to convert both these, and your own fuel consumptions, into the equivalent of primary energy before making the comparisons. To make the conversion of both your own delivered energy and the values in the charts, multiply the electricity consumption figure by 3.5 and then add it to the gas consumption. You can then compare your primary energy consumption with the appropriate performance band in the charts.

Example. Suppose you have a luxury hotel annually consuming 800 000 kWh of gas, or other fossil fuel, and 300 000 kWh of delivered electricity. This represents 800 000 kWh of delivered fossil fuel, and approximately (300 000 x 3.5) kWh of fossil fuel consumed in generating, at the power station, electricity delivered to your hotel, ie 1 850 000 kWh of primary energy.

If the heated floor area is 3000 m², the annual specific primary energy consumption is:

(1 850 000 ÷ 3000) kWh/m², ie 617 kWh/m²

From the charts, a luxury hotel will make the 'good' category if the annual combined gas and electricity consumption, in primary energy terms, is less than 300 + (90 x 3.5) kWh/m², ie 615 kWh/m² of primary energy. Therefore your hotel just fails to make the 'good' category.

How to use the charts on these pages

Obtain all your fuel bills and/or meter readings for the most recent 12 monthly period for which they are available.

Decide on the units you are going to use – kWh per square metre or £ cost per bedroom. Using kWh/m^2 has the advantage of taking into account wide variations in reception and conference areas, and other facilities – which in turn affect the average floor area per bedroom. Conversely, certain uses of energy, such as hot water and catering, are likely to be related to the number of bedrooms rather than to floor area. Using cost rather than kWh also ensures that maximum demand, power factor and standing charges are included in the calculation. If possible, use both units to help identify anomalies.

Work out your annual consumption, keeping electricity separate from fossil fuels.

Measure the heated floor area of the hotel in square metres. Exclude areas such as unheated storage and car parking. Make a note of the number of bedrooms available.

As a check, divide your floor area by the number of bedrooms and compare the result with the values given for the three hotel types. If your hotel averages out to very large or very small rooms you should certainly use kWh/m^2.

Divide your consumption by the floor area, or the cost by the number of bedrooms.

Establish in which of the three categories of hotel your premises lie.

Compare your consumptions and costs with the bands given in the charts.

Checking your data against the charts

The charts are based on measured consumptions in 'typical' hotels with 'normal' facilities for their type. If your hotel differs greatly from the norm, consumption will be affected. Abnormal factors include:

- exceptionally exposed, or sheltered, location
- unusually severe, or mild, weather conditions
- very high or very low occupancy.

and exceptional facilities or operation such as:

- on-site laundry
- large swimming pool
- intensive programme of banquets.

It is important to consider how the pattern of energy consumption relates to these items. If you have a laundry or pool, or provide frequent banquets, you should introduce submetering of fuel to ascertain how much energy they consume and how much they are costing.

For detailed calculations on how to allow for abnormal weather conditions, please consult the EEO's Fuel Efficiency Booklet No 7: Degree Days.

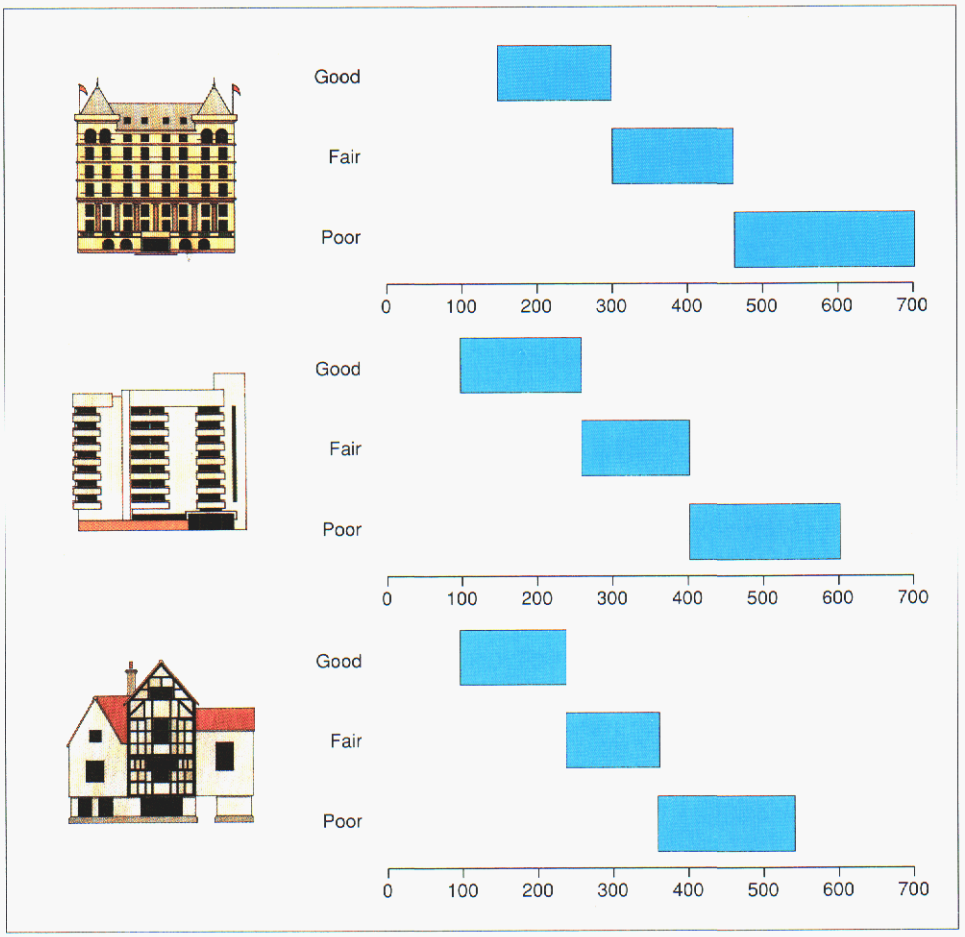

Figure 1 Annual gas consumption for the three hotel types in kWh/m^2

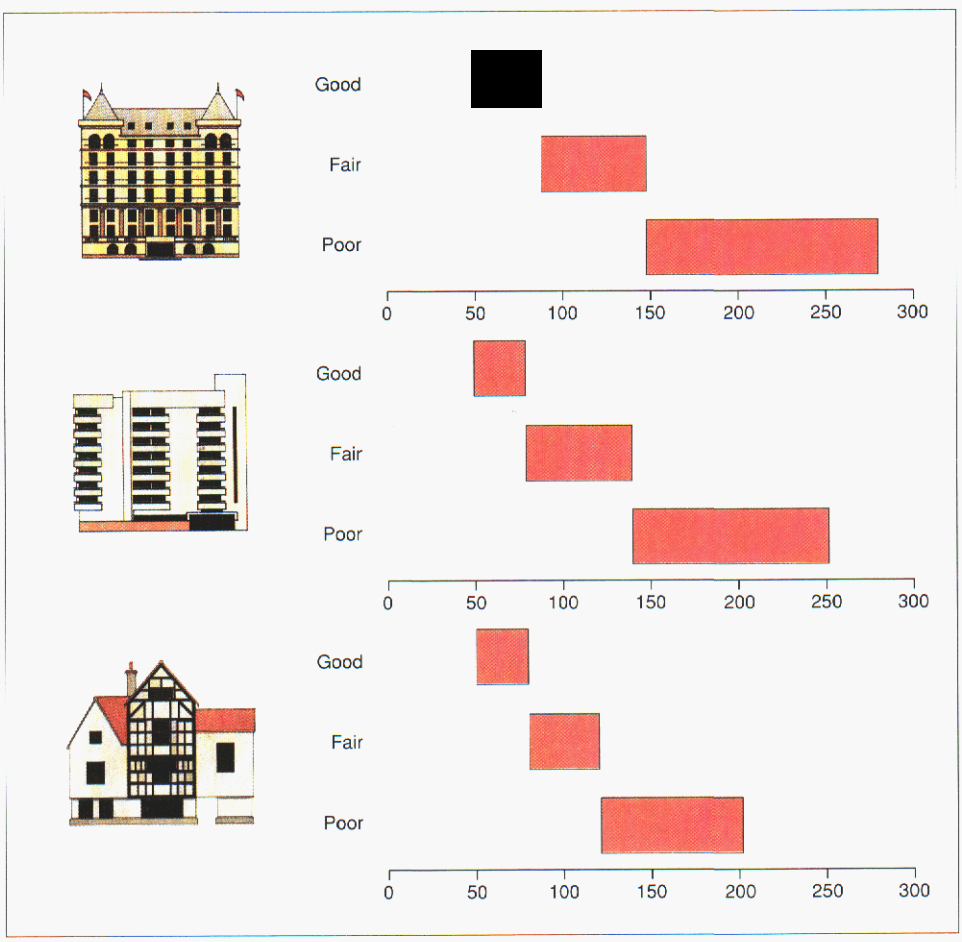

Figure 2 Annual electricity consumption for the three hotel types in kWh/m^2

When considering energy efficiency measures, assess their applicability, technical feasibility and reliability in use. How many examples are there of successful implementation in premises similar to your own? Can predicted savings be verified? Check the history and reputation of the supplier. Seek independent advice if you need it from other hotel operators, trade associations, or professional consultants.

Table 6 Energy efficiency measures and percentage savings

Savings quoted are the **minimum** you can expect to achieve. Remember that even small percentage savings can mean appreciable cash benefits.

	BOILERS, CONTROLS AND HOT WATER	fossil saving %	electricity saving %	**LIGHTING, CATERING AND OTHER SERVICES**	fossil saving %	electricity saving %
NO COST	Ensure systems come on only when, where and to the extent they are needed.	1	2	Switch off lights and other equipment wherever possible. Label light switches.	0	0.5
	Establish a daily routine for checking control settings, especially where they may have been over-ridden in response to unexpected circumstances.	1	1	Make maximum use of daylight. Place lights where they will be most effective. Clean light fittings and use translucent shades. Improve the reflection of light from walls and ceilings by using pale colours.	0	0.5
	Use your existing equipment effectively. Check that timers, programmers, optimum start controls and weather compensation controls are set up and operating correctly.	3	1	Set illumination levels to the type of activity. Reduce lighting levels where possible and remove surplus lamps (but do not compromise safety).	0	0.5
	Isolate parts of systems which are not in use, for example, seasonally. Remove redundant pipework during refurbishment.	1	0	Provide training for catering staff about energy costs and correct use of equipment. Set energy targets for meals, monitor consumption and give feedback to staff.	0.2	0.2
	Ensure plant is regularly and correctly maintained.	0.5	0.5	Ensure regular maintenance of cooking utensils, all appliances, burners, timers, controls and taps. Badly maintained equipment wastes energy.	0.2	0.2
	Review hot water thermostat accuracy and temperature settings periodically. Reducing temperatures will save energy – but take precautions to avoid the risk of Legionnaire's Disease.	1	0	Ensure optimum use of hot water, ventilation and lighting in the kitchen for various times of day and night. Do not use hobs or ovens for space heating. Run dishwashers only on full loads.	0.2	0.2
LOW COST	Fit draught stripping around windows and doors. Fit heavy curtains to guest and public rooms.	1	0	Where fittings allow, replace 38 mm fluorescent light tubes by 26 mm type, and install electronic starters and ballasts.	0	0.5
	Check boiler efficiency periodically and make improvements as required.	2	0	Consider replacement of tungsten lamps (including light fittings where necessary) by compact fluorescent types.	0	6
	Provide temperature and time controls for domestic hot water.	1	0	Consider installation of timers, dimmers, photocells and sensors so lighting operates only when, where and to the extent needed.1	0	1
	Install showers and flow restrictors where possible. Reduce standing losses from hot water storage by lagging pipes and tanks.	2	1	Consider installation of bedroom key fobs so lights and other electrical items operate only when rooms are occupied.	0	1
	Consider direct fired water heaters for hot water in place of boiler serving calorifier.	3	0	When replacing catering equipment, review current developments in appliance design to select the most energy efficient.	1	1
	Establish a system for setting targets for energy consumption, monitoring actual consumption and assessing performance.	1	2	If you have a swimming pool, provide and use a cover to reduce heat losses at night.	0.5	0
	Modernise heating and ventilation plant controls.	6	1	Ensure enough linen is available so that laundry equipment is run at full load.	0.5	0
	Provide power factor correction, and consider load shedding to reduce maximum demand charges. This will not save fuel but will reduce electricity charges.	—	—	Use high efficiency lights for all external lights, including car parking areas, controlled by timers and/or photocells.	0	0.5

Table 7 Capital investment

When you have implemented measures costing little or nothing, consider investing some capital to make further savings. This can be particularly cost-effective if you are contemplating a refurbishment or plant replacement.

Measures	**Simple payback in years (approx.)**
Zone heating system and ensure co-ordination between room lettings and space heating	2
Install building energy management system	5
Replace heating plant with condensing boiler and modern controls	3
Install combined heat and power (CHP) unit	3
Fit automatic door closers on external doors and construct draught lobbies	2
Install new lighting system based on the use of high efficiency lights	1
Install energy efficient appliances when refurbishing kitchens	1
Double glaze windows and install wall and roof insulation	3

For further copies of this or other Best Practice programme publications please contact BRECSU and ETSU.

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