ED 453 650 EF 005 947

AUTHOR	Isbell, Paul
TITLE	Purchasing Energy. Managing School Facilities, Guide 5.
INSTITUTION	Department for Education and Employment, London (England). Architects and Building Branch.
ISBN	ISBN-011-271-036-0
PUB DATE	1998-00-00
NOTE	59p.
AVAILABLE FROM	The Stationary Office, P.O. Box 29, St. Crispins House, Duke Street, Norwich NR3 1PD England (8.50 British pounds). Tel: 0870-600-5522; Fax: 0870-600-5533; e-mail: customer.services@theso.uk; Web site: http://www.clicktso.com.
PUB TYPE	Guides - Non-Classroom (055)
EDRS PRICE	MF01/PC03 Plus Postage.
DESCRIPTORS	Decentralization; Elementary Secondary Education; *Energy Management; Foreign Countries; *Guidelines; Public Schools; *Purchasing
IDENTIFIERS	*Cost Containment; *Energy Consumption; United Kingdom

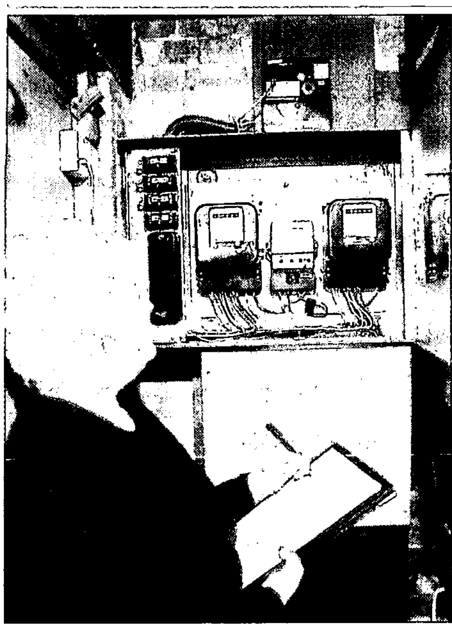
ABSTRACT

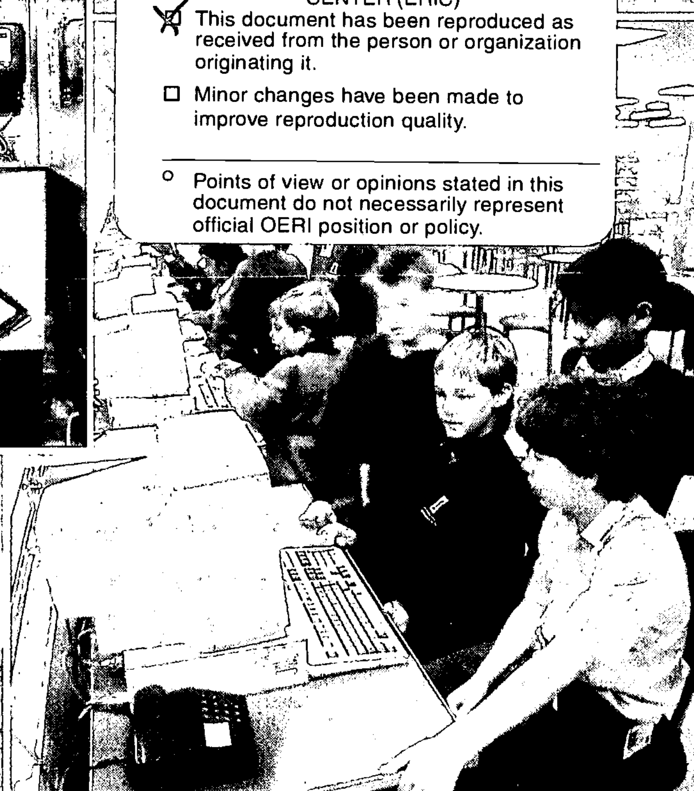
This booklet examines the purchasing choices which will be available with the introduction of full competition for all electricity and gas supplies in the United Kingdom, giving schools the chance to make significant savings on energy costs. The guide offers detailed purchasing information on such topics as tariff structures, contract energy management, the types of contract energy management available, and transportation charges. The central role of energy management is stressed, and the accounting procedures and tools required to maximize savings are described. (GR)

Managing school facilities

Guide 5

Purchasing





DfEE

Department for Education and Employment

ACKNOWLEDGEMENTS

This guide has been produced by the Architects and Building Branch of the Department for Education and Employment (DfEE).

It was researched and written by consultant Paul Isbell
E-mail: ISBE11@AOL.COM

The DfEE would also like to thank Peter Bradwell and the Society of Electrical and Mechanical Engineers serving Local Government, OFGAS, OFFER and HM Customs and Excise for their help.

DfEE Project Team:	Chris Bissell	Principal Architect
	Richard Daniels	Senior Engineer
Graphics:	Paul Isbell	
Photographs:	P. Locker, Photo Graphic Design, Bolton	
Cover Design and typesetting:	The Stationery Office	
Cover photographs:	Caretaker and students at Rooks Heath High School, Harrow, Middlesex. Library resource area at Bradford City Technology College.	

Printed in the United Kingdom for The Stationery Office
J58490 C20 9/98

ISBN 011 271 036 0

Purchasing Energy

CONTENTS

NB. Superscript numerals within brackets in the body of the text refer to references on page 52.

Publications in Managing School Facilities Series.

Guide 1 Saving Water

Guide 2 Swimming Pools

Guide 3 Saving Energy

Guide 4 Improving School Security

Guide 5 Purchasing Energy

Guide 6 Fire Safety (to be published September 1998)

Introduction

Schools in England and Wales currently spend approximately £250 million on energy each year. This is roughly twice as much as they spend on books. Good housekeeping measures can reduce the average school bill by 10% and low cost energy saving measures with a payback of less than 5 years can reduce it by a further 20%. However, purchasing energy at the most favourable prices is just as important as energy efficiency to ensure that the efforts made are translated into annual cost savings. This book is intended to help schools and colleges save money on their energy bills.

By the year 1999 there will be full competition for all electricity and gas supplies. The UK is leading the world in removing a rigid structure and providing complete choice of utility supplier right down to the domestic user. The new structure will bring with it the freedom to negotiate, but will need a strict discipline of keeping detailed records of consumption and costs. This data will be the raw material with which to obtain the keenest prices for your school or college. Without this information you are likely to pay more than you need to. Use the Planning Aid on page 18 to help you find out the energy options that should be considered for your establishment.

Complete choice

Competition among energy suppliers is increasing. With electricity for example, instead of being limited to one regional electricity company with perhaps five alternative tariffs you will be able to obtain your electricity supply from any number of licensed Public Electricity Suppliers (PES), national generators, other second tier suppliers or small locally based generation companies who are generating and selling within one PES area. There may be potentially 30 different suppliers. If each of these can offer you five different tariffs there could be 150 or more options to choose from. The lifting of all the barriers to competition will mean that small electricity generators could sell their electricity direct to a school using what are called supply and top up tariffs. The school could become a generator of energy itself. Innovative options might even use renewable energy (see page 51).

To analyse the various options, you need to be clear about what you are doing. If you are using an outside agency, they will need to know your criteria for selection.

The pilot schemes for the purchase of energy in the domestic market showed that people needed to familiarise themselves with all the tariff options and these will be continually changing.

It is important therefore to compile the necessary data for each energy account so that you are fully prepared either to carry out the process yourself, or to pass it on to another agency. This process is detailed in the following sections.

Ensure that personnel who have historically been responsible for the bill payment function are aware of new procedures, otherwise they may feel that it is their responsibility to investigate new supply options and there will be duplication of effort.

An action plan for purchasing energy

- Establish data on the cost and consumption for each energy account and convert the energy to a common unit, ideally the kWh. A kilowatt-hour (kWh) is 1000 watts in use for one hour. It is very easy to grasp if you consider that a one bar electric fire switched on for one hour uses one kWh. Conversion factors are given in the chart on page 54. Record the M number for the gas account and the supply number for the electricity account (shown on bills) together with the reference number on the meter (or meters). These will be essential to be able to change supplier. Annual energy consumption figures should be recorded and, with electricity, all the tariff details. The more accurate this information is, the better - ideally aim to keep monthly records. It is worthwhile recording this information together on a computer spreadsheet for ease of use. It could also form the basis of a monitoring system for your energy consumption.

From the annual total you can establish the markets that you will be buying in. This will affect the lowest price that will be achievable.

For gas this is based on the annual total consumption.

1. Gas under 73,267 kWh (2,500 Therms). Domestic supply under £1,100 a year (eg, small primary schools of less than 100 pupils or catering supply to schools with oil heating).
2. Gas 73,267 to 732,677 kWh (2,500 to 25,000 therms) (eg, most primary schools).
3. Gas Over 732,677 kWh (25,000 therms) (eg, most secondary schools).

For electricity this is based on the average of the highest three maximum demands in a year.

1. Electricity under 100 kW. Domestic and small commercial users under £12,000 a year (eg, primary and small secondary schools).
2. Electricity over 100 kW but under 1 MW (eg, larger secondary schools).

3. Electricity over 1 MW (eg, large college campuses with over 5000 students).

- Analyse the data to get an overview of the energy usage of the establishment/s. Use the chart inside the back cover to break down the energy use into the main areas as detailed below and divide for each month of the year.

The following should be identified as using electricity, oil or gas etc.

1. Electricity for lighting and power, day and night split.
2. Space heating.
3. Hot water services.
4. Cooking.
5. Swimming pool.

This detailed information may not always be available and must be estimated where not known.

Estimating consumption data

Kitchen equipment	Kitchen equipment can be estimated from the badged consumption rate and the time used.
Hot water domestic services derived from a central boiler plant	A plot of energy consumption against degree day data will give the non-degree day element. See Section 3 for more details of this method.
Electricity day/night split	Read electricity meters in the morning on arrival and again at night when the establishment shuts.

The chart on the next page shows the type of questions that can arise from this analysis.

A The % of electricity used at night and day	This could raise questions eg, why is the establishment using so much energy at night when no one is there? Chilled drinks machines, photo-copiers, freezers, computers and lights left on could be reasons. Increased awareness of the real cost of energy for each drink bought and better housekeeping will result.
B The split of consumption throughout the year	Winter heating and less natural light suggest that more energy would be used in the winter than at other periods. If there is only a slight drop in spring and autumn this would indicate equipment was on when it should not be.
C Kitchen consumption	Having calculated the amount of energy used to produce meals, obtain data on the number of meals consumed and calculate energy consumption and cost per meal. Is more energy being used than necessary?
D 7.00am-4.00pm winter heating oil/gas HWS electric Electric power and light	Some electric hot water system heaters could be converted to point-of-use heaters, if gas is available. Example: 5 to 8 pence/kWh reduces to 1 to 1.5 pence/kWh This could put gas consumption in the year into the over 732,677 kWh (25,000 therm) band and therefore reduce total costs even more. Example: 1.2 to 1.5 pence/kWh reduces to 0.88 to 1.4 pence/kWh. Check the prices of oil and gas. Can you maximise the saving? Example: (fig) 10.56 pence/litre = 1 penny/kWh so 15.5 pence/litre = 1.46 pence/kWh Using commercial gas at 1.00 penny/kWh therefore saves 0.46 pence/kWh. Establish if this would be cost effective. The differential may be subject to change as gas prices rise relative to oil. However, a change to gas may also affect the consumption band so that a larger contract amount may be bought at a lower price.

E	7.00am-4.00pm All electric off-peak heating and HWS Electric power and light	• Ensure that time clocks are set correctly so that heaters only operate in the off-peak time. • Eliminate all on-peak electric heaters where used for normal heating if possible and replace with additional off-peak heaters. Example 5 to 8 pence/kWh reduces to 2 to 4 pence/kwh. Ensure electric kilns only operate during the night period.
F	4.00pm-12.00 pm Community use 100 kW site	The evening period from 4pm to 8pm is the time of the national peak electricity usage and consumption in this period will increase the cost of electricity to the site. • Consider trying to reduce electricity consumption at this time by ensuring that all light fittings are high efficiency in sports hall, showers and changing rooms etc. • Consider changing to a gas or oil hot water system if it is electric on-peak. • An off-peak heating installation might not have been designed for evening usage and you may be having to top up at peak rates; check this.
G	Swimming pool	The site should be examined for a potential Combined Heat and Power scheme. If there is all year usage it is possible that the pool could be used as a heat dump for any excess heat generated.
H	Sprawling site	The total gas consumption of all the small uses on a sprawling site added up may come to more than one of the consumption bands, and the gas could then be obtained on a commercial tariff at a much lower price than the domestic tariff.

- **Set up a meter reading system to read each meter every month so that your initial estimates can be refined throughout the year as the data is collected. Section 3 gives more details on setting up data collection systems and how to analyse the data. This will enable the**

production of a target energy consumption for the property to be evolved, providing a target to monitor consumption against.

- If you are part of a local authority, establish if it is going to be carrying out the process centrally.

- If you are in the <2,500 therms per annum gas market, obtain a list of potential suppliers from OFGAS. The commencement of the <100kW electricity market depends on the area of the country but will start in September 1998 on a rolling programme (see page 26) and similar lists will be available for electricity suppliers.

- Send each supplier the same information and stipulate the return date you require for their quotation, allowing reasonable time. It will also save you time so that you can compare them together rather than looking at each individually. The pilot domestic gas areas have shown that there is much information that has to be amassed on say 10 to 15 suppliers before you can make an informed choice. It may help to obtain preliminary prices so that you can decide which questions to ask. Some examples of these follow.

Examples of possible areas for questions to suppliers:

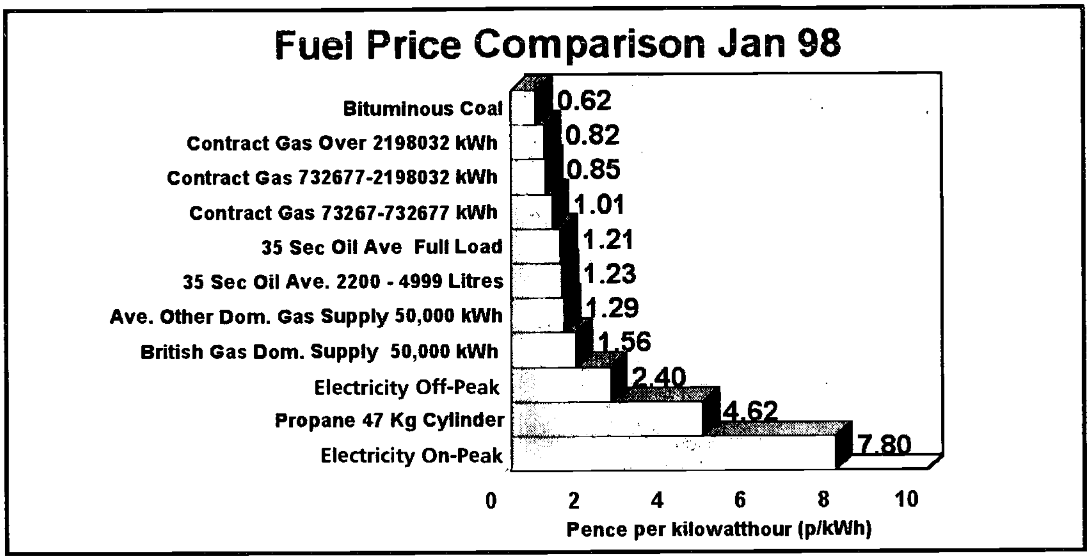
Early sign-up offers	Early sign-up offers such as store vouchers may be available. These may be very tempting but can cloud the issue. Study the fine print. Try to include the cash value of these inducements in your analysis of the prices on offer.
Prices	There are normally different prices quoted for different payment options eg, standard payment, direct debit, monthly or quarterly and tiered arrangements which lower the price the more that is used ie, a minimum of three prices from each supplier. Monthly direct debit generally has a cheaper cost.
VAT	Does the price per unit include or exclude VAT ? Ensure that you compare consistently, see Section 3.

Notice of change of supplier	In the domestic market a supplier has to allow a customer to change to another supplier with 28 days notice, but there may be penalties for changing after only a short time. Commercial contracts normally are for a minimum period of a year.
Penalty charges for late payment	It should be established if the contract stipulates that there will be a charge for late payment of the account. A punitive charge could wipe out any perceived saving.
Fixing of the price	It needs to be established if the contract price is fixed for a certain time period or if it can vary. This is similar to different mortgage types eg, a fixed price for a period of time which is initially slightly higher may be a better deal than a short term very low price which goes up much higher in the longer term.

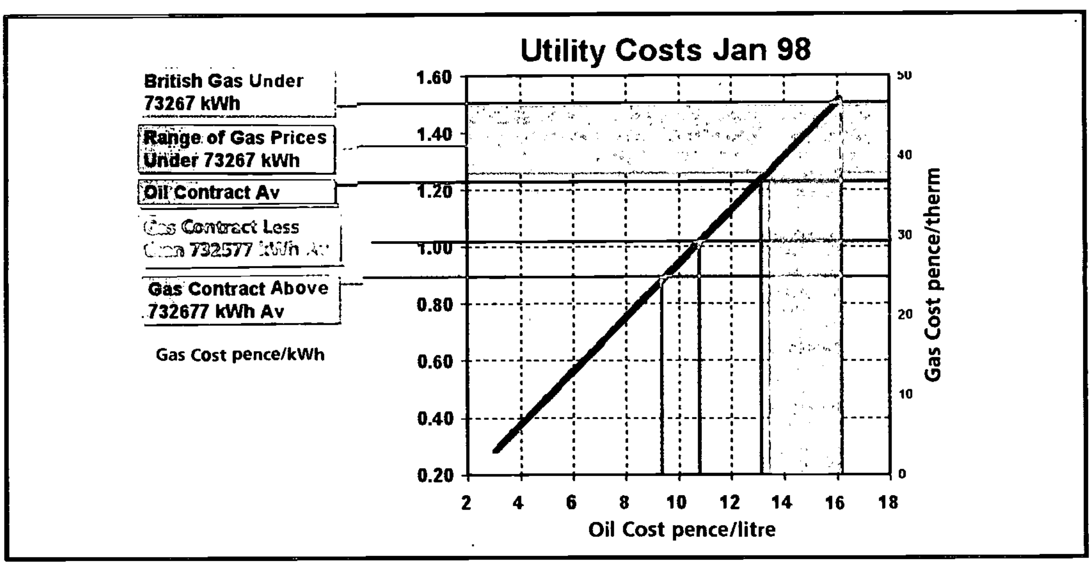
- Before you sign your contract check it very carefully.
- On the agreed date of change over of supplier make sure that you take a reading of the meter/s so that you can check the final reading of the original supplier and the start reading of the new supplier.
- Contact your new supplier to confirm that they have taken over your site(s).

Comparing costs

The chart below shows the comparative costs of many different fuels, the most expensive being electricity of course. However, the relative cost of propane used in temporary buildings may be a surprise and shows that if possible a lower cost fuel should be chosen. The chart also reflects the lower prices of fuel purchased on large multi-site contracts rather than individual sites.



The previous chart shows how important it is to know the relative costs of different forms of energy. The chart below for heating fuel compares oil and gas prices in their respective units so that the most cost effective fuel can be used.



Monitoring and checking

Energy and utilities are probably the only areas of expense in the education annual budget for which the actual costs are not known until the bills arrive. Even then a bill could be an estimate so you may have to wait a year for an accurate bill.

With energy you will now be able to select the rate for supply. However if the amount of energy being used is not monitored, it will not be possible to know whether you have spent your budget allocation or not. Section 3 outlines the options for auditing accounts.

Local authority energy management units

Where they still exist, local authority energy management units have a wealth of knowledge and experience of the sites concerned and usually provide a service of high quality. Due to compulsory competitive tendering these units may now be part of a building practice or a client department. Some charge will be made for the services provided unless it is covered by a rebate from the energy supplier.

Buying consortia

Energy purchasing has now become quite complex and a great deal of up to date knowledge of the current market influences is required. By pooling together hundreds of similar properties a greater purchasing power is achieved which should enable a lower price to be obtained compared to that of a single property obtaining a price on its own.

Buying consortia exist in a number of forms whether as a group for types of establishment, such as schools, or those operated regionally by local authorities. Where possible consortia maximise the economies of scale.

Costs for operating the consortia can be recovered in many ways.

- In the public sector, local authorities may pay the salaries and operating costs and therefore the cost of the service is essentially free.

- Consortia operating as a business or in a cost reflective environment in local government will need to make a charge for their services. The normal method is a rebate paid to the consortium by the successful tenderer. This would be recovered by a fractional cost added to the energy price to cover overheads etc.

- A specific charge may be made based on a percentage of the savings or a fixed fee. It should be noted that many tariff consultants in the business sector charge 50% of the saving achieved from the original price.

Individual consultancy

Many consultancy practices in the country operate specialist energy units who may be able to provide an individual service to your school or college. This could however be an expensive option.

Tariff consultancy companies

You may have received letters from firms suggesting that they can check the price that you are paying and arrange a cheaper package at no extra cost. They will probably be receiving a rebate from the successful company so you may not be getting a true indication of all available prices. It is quite normal for these companies to claim up to 50% of the saving for three to five years, so watch the small print.

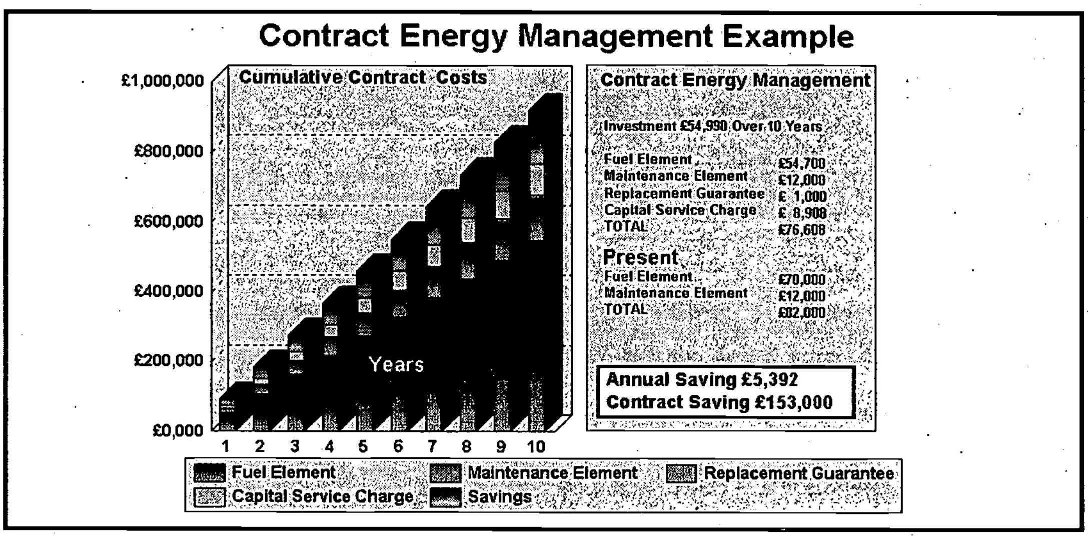
Contract energy management (CEM)

This is an agreement with a company to operate the boiler plant and services for your establishment. It can also involve the purchase of the energy to operate the plant and equipment. Companies often provide finance to carry out energy conservation works, particularly boiler replacements using modern condensing gas boilers which have efficiencies of up to 97%. Old inefficient boilers may only have an efficiency of 45%. This boiler change can result in a substantial running cost saving which the company would assess before the contract is let. Normally the contract would operate for seven to ten years. In this time the company would expect to recover the cost of the efficient plant and make a profit from the running cost savings. The customer would have the benefit of the new plant and a proportion of the reduced running costs. It is in the company's interest to ensure that plant is operating at maximum efficiency so that it is cost efficient. A maintenance contractor would only be concerned that it was working.

CEM, or wider schemes involving provision of engineering services, can involve significant transfer of risks from the public to the private sector depending on the type of contract used and the extent of the services provided. The government is encouraging some of these types of schemes under its Public Private Partnership (PPP) programme.

The PPP programme helps to develop partnerships where private sector finance is used to finance public sector projects with annual repayment over a number of years. The criteria for support include trasfer of significant risk to the private sector and value for money equal or better than treasury guidelines for capital investment[9]. All of the types of contract energy management shown on page 17 could be operated under PPP arrangements. Further advice on CEM and PPP possibilities is given in Energy Services for the Public Sector[10].

Devolved budgets under LMS (Local Management of Schools) add complexity to contract energy management schemes. Tripartite arrangements will be necessary as schools are responsible for energy payments and the authority is responsible for maintenance of the plant. An example is shown below.



A local authority school contemplating this option on its own is advised to check that financial regulations don't prevent it making a financial commitment in future years.

A school will not necessarily be able to keep savings resulting from its efforts at energy management, as under quite a lot of LMS schemes, funding may be reduced if a school becomes more energy efficient. A school needs to consider, together with the LEA if necessary, what the real savings to itself will be. LEAs can encourage energy efficiency by allowing schools to retain a proportion of the savings.

Types of Contract Energy Management available

	ADVANTAGES	DISADVANTAGES
HEAT SERVICE * Contractor supplies useful energy * Client controls energy consumption and pays for the amount used	* Simple to understand * Guaranteed supply * Client in control	* No incentive for the contractor to reduce the clients demand * Most suited to users with high process loads
SHARED SAVINGS * Contractor installs and finances energy improvements and is paid out of savings (PPP is possible)	* Incentive for both parties to make savings	* Share of savings depends on accurate calculations these are very complicated and frequently the subject of dispute
FIXED PRICE * Contractor takes over management of building services (including maintenance and payment of fuel bills). Cient pays fixed price based on level of service he requires (PPP is possible)	* Costs known in advance; no complicated adjustment for independent variables	* No incentive for client to reduce energy consumption * Control surrendered to the contractor
INDIVIDUALLY NEGOTIATED * A package that is put together to suit the need * This may provide scope for external finance for repair and maintenance programmes funded from savings in energy costs (PPP is possible)	* This scheme would probably be most suitable for local authority schools where tripartite arrangements are necessary as locally managed properties are responsible for energy payments and the authority is responsible for maintenance of the plant An example is shown on page 16.	* A management fee funded from any savings may need to be paid to the local authority to monitor the performance of the energy contract

The following is a two-stage tender programme based on a suggestion from the Chartered Institute of Building Services Engineers (CIBSE)[11].

1. Obtain a list of companies that operate contract energy management as a separate category from a contractors list.
2. Select three companies (or what the specific standing orders specify) to provide a preliminary breakdown of proposed works, costings, and savings for the properties on an individually negotiated contract basis.
3. Review first stage proposals.
4. Select contractor.
5. Ask selected contractor to carry out final detailed investigations and draw up specific proposals. (NB CIBSE recommend that this service is paid for.)
6. Negotiate the contract.

Planning Aid for energy purchasing

	Key Questions	Circle relevant category
1	Has your establishment got personnel with the knowledge and time available to carry out the processes necessary to obtain the most competitive price for the energy and water supply, or is this a service that should be bought in ?	In house personnel Bought in staff
2	If you have the personnel available how much would their time cost to carry out the extra area of work ? What won't get done if they do it? One day a month costs £1000 a year with an annual salary of £21,377 and is 4.6% of the time.	
3	If you are not going to carry out the work yourself, are you going to buy it in from local authority, Consortium, Consultant? (See pages 14 and 15.)	Local authority Consortium Consultant
4	Is a suitable computer and software available to record the data, or would it have to be purchased?	Yes Needs investigation No

5	Establish who pays utility accounts at present. Do they know what is happening?	Yes No (Need to set up liaison meeting)
6	Does the school/college have a swimming pool or residential accommodation with use throughout the year? If yes, consideration could be given to a site CHP scheme. (See page 51.)	Yes Needs investigation No
7	Can the school become a partner in a larger CHP scheme eg, if a city centre scheme is being developed to create a sustainable future for the area? (See page 51.)	Yes Needs investigation No
8	Are there opportunities to utilise renewable energy sources on the site or to become a partner with a local scheme eg, wind generator, small scale hydroelectricity, solar panel?	Yes Needs investigation No
9	Can local materials be used rather than transporting fossil fuels? (See pages 4 and 5.)	Yes Needs investigation No
10	Is the boiler plant extremely old and inefficient and/or is the lighting installation energy-wasteful?	Yes Needs investigation No
11	Is it proposed to replace equipment soon?	Yes Needs investigation No
12	Have you considered Contract Energy Management which may be a way to effect overall savings combining plant replacement and reduced running costs? A local authority establishment would need to seek approval for this financial mechanism as it may not be allowed to commit money from future years. (See page 15.)	Yes Needs investigation No

GAS

Gas energy units

For those who will be responsible for energy purchasing it may be helpful to clarify the confusion that exists over the metering of gas. The old imperial measure of heat before metrication was the British thermal unit (Btu) and 100,000 Btu comprised a therm. The therm was the unit used to sell gas until it was changed by British Gas from therms to kilowatt hours (kWh) to line up with EC legislation. One therm is 29.3071 kWh. In the Système International d'Unités (SI units) however, the unit of energy is the Joule (J) and the unit of power is the Watt (W). One Watt = one Joule/second.

Unlike electricity, when the digits that are read on the meter are those that are used to make up the bill, the gas meter measures a volume of gas that has passed through it. This volume of gas used to be measured in hundreds of cubic feet, but new installations have meters that read in cubic metres.

The volume of gas is converted to an amount of energy by utilising the calorific value of the gas ie, the amount of energy obtained when one unit volume of the gas is burnt. Although the majority of meters still read in hundreds of cubic feet the readings are converted to cubic metres on bills. A site with a multitude of meters could have both types and check readings should be carried out to ensure that the correct units have been used in drawing up the bill.

The calorific value of the gas varies depending on the constituent hydrocarbons. The gas is sampled, and average system figures are used. On large meter systems the property of a gas to change its volume due to temperature and pressure is taken into account by a corrector meter. At the metering point there will be three readings, the actual meter reading, and two digital outputs from the corrector indicating the corrected reading and the uncorrected reading.

At a change of supplier, meters could be misread or confused and it is well worth checking which meter is being used on the bill.

Purchasing gas

Prior to 1993 British Gas was the only supplier of gas to most of the country. They owned the pipeline system, and were responsible for most of the gas that was put into the pipes and came out at the other end, right up to and including the meter. The Gas Act changed this and a plan for providing a competitive market for gas in all sectors was evolved. This will eventually enable every gas user who has a connection to the main distribution network to take a supply of gas from whichever company they choose.

To regulate this competitive market The Office of Gas Supply (OFGAS) was set up. This body has overseen the transition from a monopoly gas supplier over a number of years, releasing supplies of gas of different quantities to competition at different times as follows:

1	Annual consumption over 25,000 therms (732,677 kWh)	1986
2	Annual consumption between 25,000 and 2,500 therms (732,677 kWh and 73,267 kWh)	1992
3	Annual consumption under 2,500 therms (73,267 kWh)	Complete by May 1998

OFGAS was originally set up in 1986 to control British Gas prices and levels of service, to protect the interests of gas consumers and to help develop competition in the gas market. It was responsible for ensuring that the structure of British Gas was suitable for the competitive market. After various changes British Gas has been split into two; BG plc which includes Transco responsible for the pipeline system and Centrica which includes British Gas Trading Ltd, who will continue trading as British Gas in the competitive gas market just like any other gas supplier in the country. By the end of the roll out of gas competition in May 1998, 20 million domestic and small commercial customers will be able to purchase their gas competitively.

The amount of gas used on a site affects the price paid, and the thresholds in the chart above determine which price band an establishment falls into.

Transportation charges

Gas producers carry out the business of exploration, drilling and transporting gas to the mainland. The gas is put into the distribution system at a number of input terminals.

Gas shippers are the companies that trade in transporting gas, buying input gas and selling it at the output point. They have their main dealings with BG Transco.

Gas suppliers are the interface through which gas is sold to businesses, schools, colleges etc. A supplier may also be a shipper or have a contractual arrangement or affiliation with a shipper.

To be able to supply gas a supplier must have a licence from OFGAS. An up to date list of licensed suppliers can be obtained from them (see telephone number on page 53).

British Gas Transco operates the pipeline and meter system for the country.

The British Gas Transco network has millions of outlet points but only a few inlets from three sources; off-shore gas, on-shore gas and gas that has been stored.

Imagine a gigantic balloon with many outlets and a few inlets. If gas is taken out more quickly than it is put in, the pressure in the balloon will drop. Conversely if the inlets keep supplying gas and it is not flowing from the outlets the pressure will rise and it could explode. To maintain the gas pressure at a constant level gas can be put into or taken out of storage. This facility is used to even out the daily and seasonal variation of requirements.

The largest colleges (eg, over 2500 students) with annual consumption over 5,861,420 kWh (200,000 therms) can elect to be on an interruptible contract giving a price reduction. (This will not apply to even the largest of schools.) However, this can only be accommodated if an alternative

fuel system can be switched to in a short space of time. This will probably mean additional costs for technical staff which will have to be taken into account. The interruptions give Transco and the shipper the option of cutting off the supply at times of very high system demand, such as on peak winter days to balance supply and demand and maintain the pressure at other sites.

The costs associated with moving the gas from inlet to outlet, balancing and metering are know as the transportation charges. These charges have a number of elements, the relative proportions of which are likely to change in the period up to 2000 to make them more cost reflective.

The transportation charge is made up of the following.

1. National and local capacity charges (based on the peak day consumption) and how this varies over the year, the input terminal and which of the 33 exit zones in the country it is used in.
2. A National commodity charge and local commodity charges relative to the peak day consumption.
3. Customer charges eg, type of metering.

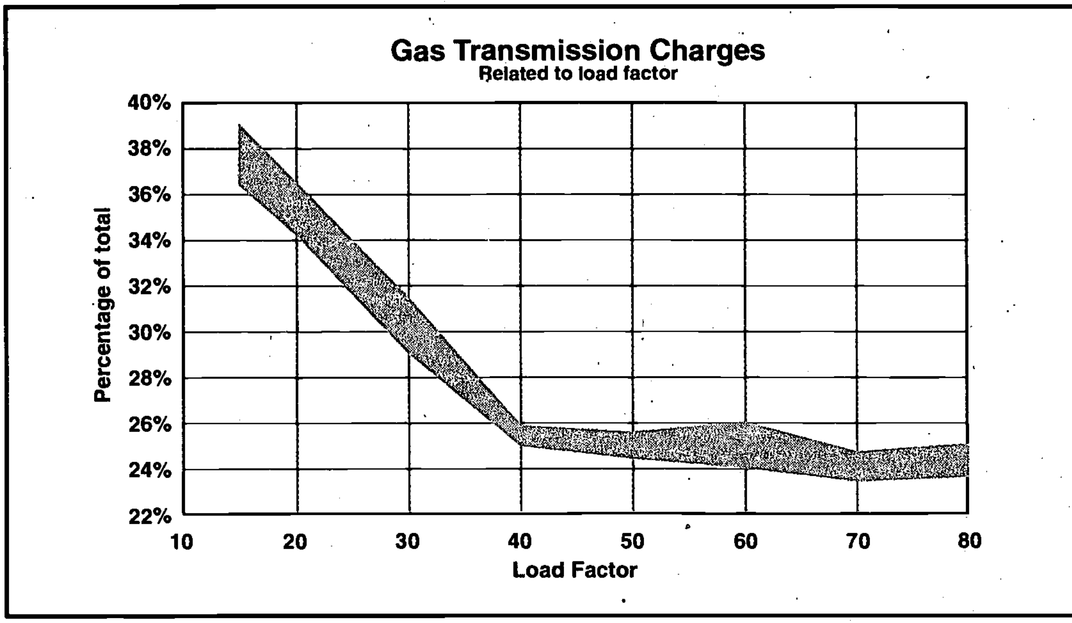
The transportation charge can be calculated for each supply point in the country once the above information is obtained from Transco. This will be a fixed charge irrespective of the supplier.

Load Factor

A process using gas to make a product will consistently consume the same amount of gas each day, whereas a gas boiler in a school will burn gas dependent on the need for heating and hot water. The load factor is a measure of the consistency of a load as follows:

$$\text{Load Factor} = \frac{\text{Annual Consumption}}{\text{Peak Day Take} \times 365}$$

The transportation charges can account for 23% to 40 % of the total cost of the gas supplied to your establishment. The graph below shows how this varies with the load factor; a poor load factor increases the percentage considerably.



A lower price will be obtained for your gas supply by having a more consistent load during the year which is probably very difficult to achieve in a school with a normal consumption pattern of heating in winter and hot water service during the year. Fabric insulation could reduce the heating demand and if gas use was maximised with cooking and hot water use the load factor would rise. Schools have to take into account the long summer holidays which affects the load factor by reducing the annual consumption.

Network Code

Transco and the independent gas shippers have agreed a Network Code. One of the requirements of this code is that all users of the pipeline system must each day balance the gas their customers take out against what they add in to the system.

This daily balancing has meant that to avoid the shippers having a shortfall and paying penalty charges to Transco to make up the difference a mechanism has been devised that allows shippers to buy the gas from whoever has it for sale. This has created a daily gas price market similar to that which exists for oil.

The M Number

To enable each user of gas in the country to be uniquely known Transco has given each meter an M number. This number should be shown on your current gas bill. If it is not, then you should obtain it from your current supplier. It will be needed to enable you to change supplier and should be quoted when requesting prices.

ELECTRICITY

Electricity energy units

Electricity is measured in kilowatt-hours (kWh). Fortunately electricity meters measure kWh directly so that the digits that are read on the meter are those that are used to make up the bill.

Larger schools and colleges may also have a maximum demand meter which measures in kW. These occur where the establishment is on a maximum demand tariff. The meter would be read each month and then reset. Modern electronic meters however can now register the demand profile continuously at the same time as the units and can be read remotely over radio or telephone networks. Tariff types are explained in more detail later.

Purchasing electricity

Prior to 1990 electricity was a nationalised industry and a supply could only be obtained from the local Regional Electricity Company (REC). The Electricity Act changed that and a plan for providing a competitive market for electricity in all sectors was evolved which would eventually enable every electricity user to take a supply of electricity from any company with a Public Electricity Supply (PES) license including the RECs.

To regulate the new market The Office of Electricity Regulation (OFFER) was set up. This body has overseen the transition from a monopoly electricity supplier over a number of years, releasing areas of electricity supply to competition at different times as shown in the following table.

1	Average of three highest monthly maximum demands over 1 Megawatt.	April 1990
2	Average of three highest monthly maximum demands over 100 Kilowatts.	April 1994
3	All other consumers.	On a rolling programme beginning in September to December 1998 depending on your Region.

OFFER's role is to:

- ensure a safe supply to meet all reasonable demand;
- promote competition in generation and supply;
- protect customers' interests;
- promote energy efficiency; and
- ensure financial viability of parties licensed to generate, transmit, distribute and supply electricity.

HOW THE ELECTRICITY MARKET WORKS

Generation

In England and Wales, instead of one company being responsible for the generation and transmission of electricity, as used to be the case with the Central Electricity Generating Board (CEGB), it is now generated from a number of different sources. The two main national generators are Powergen and National Power. Eastern Electricity and British Energy, which owns Nuclear Electric, are also large generators. Magnox Electric which operates the older nuclear stations is still owned by the government. In addition there are the Scottish generation companies which as well as selling their output to suppliers in Scotland export electricity to England and Wales through the Scottish interconnections. There are also an increasing number of independent small generators. Energy is also bought from Electricité de France.

Transmission

The National Grid Company received its transmission license in 1990 and took over the CEGB's role of transmitting the energy that is generated to distribution points around the country. In England and Wales the transmission system refers to the lines and electrical plant above 132 kilovolts. At grid supply points electricity flows from the National Grid transmission system to the PES distribution system. In Scotland, transmission activities are undertaken by Scottish Power and Scottish Hydro-Electric.

The National Grid Company charges for the use of its system. The charge is based on the average of the top three peak demands that occur between November and February which must be at least 10 days apart. This is commonly referred to as the 'Triad'. Triad charges vary over charging zones. Charges are based on the average of the triad demand multiplied by the £/kW in the relevant charging zone.

The distribution and supply of electricity to customers is carried out in the area of the local public electricity supplier. Each PES makes a charge for the use of its system for the delivery of electricity from the grid supply point to the customer. These are published charges and shown separately in PES tariff leaflets.

In addition, there are charges for connection to both the transmission system and the distribution system that have to be paid.

The electricity pool

It is not possible to store large quantities of electricity and therefore the generation by power stations must continuously match the demand for electricity by customers. The electricity that is generated is pooled to meet the demand and the market place for trading electricity is called the Electricity Pool.

The effects of this trading arrangement are that:

1. the price for electricity is set for each half hour of every day;
2. the price can vary considerably from one half hour to another depending on supply and demand;

The pool price is also weather dependent. A harsh winter will increase the price and a mild winter may see reduced prices.

In general the electricity suppliers buy electricity from the Pool and distribute it to their customers, the exception being some very large customers who buy direct from the Pool. The electricity is metered so that suppliers can receive payment from customers and generators from suppliers.

Electricity that is sold on a tariff normally has a set price for a period of time, generally a year. Similarly electricity sold on contract has usually been for a minimum of a year. Contract electricity is available at a cost related to the pool price but, due to the continual changes, the price can be very unpredictable. The lowest fixed price rates for a year will probably give a greater measure of predictability, as long as consumption does not rise abnormally. With a price that can vary every half hour of every day, each supplier has to estimate what the eventual outturn pool selling price is going to be. It is this estimate which decides the price that is quoted for large electricity contracts, and the level of charges in published tariffs. Electricity suppliers can hedge against pool price volatility using financial instruments. For a premium they can lock in the pool price and offer fixed tariff and supply contract prices.

The metering maze

The pricing of electricity every half hour is continued throughout the whole of the electricity supply system. The first two phases of competition use special meters which record the electricity consumed on a customer's site every half hour.

Different standards of meter are installed for different sizes of load eg, 100kW loads use what is termed a Code 5 meter. The chart following shows the different terms and the loads they apply to. Code 6 meters cannot be used above 70kW as they directly measure the energy consumed. Code 7 is a metering system specification where half hour data is stored in the meter or elsewhere in the system.

Metering and Data Options Chart

Supply	Meter arrangement	Options for handling of data
Over 1 MW	Code of Practice 3 must be used.	• Remote Meter Reading: daily down load of half hour data to Settlements System
Over 100kW supply	Code of Practice 5 must be used.	• Remote Meter Reading: daily down load of half hour data to Settlements System. Before April 1998 a Meter Operator had to be appointed as a separate contract to operate the meter. Since then the electricity supplier who wins the contract for supply has the responsibility for this. However, a preferred Meter Operator will be allowed.
70 to 100kW Supply	Code of Practice 5 or existing metering.	• Remote Meter Reading: install Code 5 metering with daily down load of half hour data to settlements. • No Communications 1: install Code 5 meter which can store up to a year of data enabling manual reading. Stay on standard tariffs with monthly or quarterly readings, then use data down-loaded from a fast data transfer port to a lap-top computer to ascertain if contract electricity is worthwhile. • No Communications 2: leave existing metering in place, meters read manually as now. There will be competition in non-half hourly metering from April 2000.
Under 70Kw Supply	Code of Practice 6 or existing metering.	• Options as above but with Code 6 meter or code 7 metering system.

Metering over 100 kW supply

The majority of secondary schools and colleges who spend about £12,000 a year on electricity will probably already be on a contract for their electricity. From October 1997 it became a necessity for all supplies over 100kW to have half hourly metering. Contact your supplier if you do not yet have this. There is a separate charge for the rental of the special meter. Alternatively the meter can be purchased.

The half hour consumption data at your property is down loaded every night to the Data Collector for use in the **Settlements System**. The information is used by your supplier to provide billing information. It is also useful for examining the consumption pattern to effect savings. Half hour data may be provided on a disk from the supplier (there may be a separate charge if it was not included in the contract). Some suppliers enable the information to be down loaded over the internet and with the right software and protocols for the meter it is also possible to dial them up directly.

Profile example

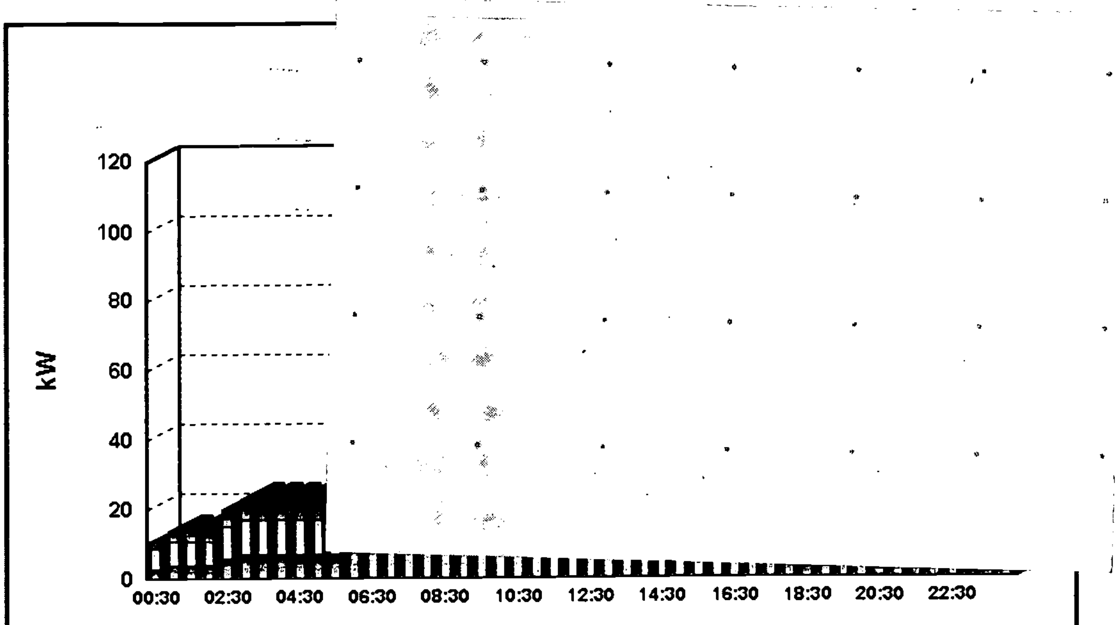
In general the maximum demand of a school is during the morning and at lunch time, which does not coincide with the system peak. Community schools with 100kW contracts should watch their consumption pattern in the peak period between 16:00 and 19:00, as a large increase may affect the contract price obtained.

In the example opposite the base load does not drop below about 10 kW all night and is over 20kW between 02:30 and 05:30 which is more than is used at 18:30 just before the evening lettings start. Energy could be being wasted at these times and, if rectified, would reduce costs.

The electricity bill

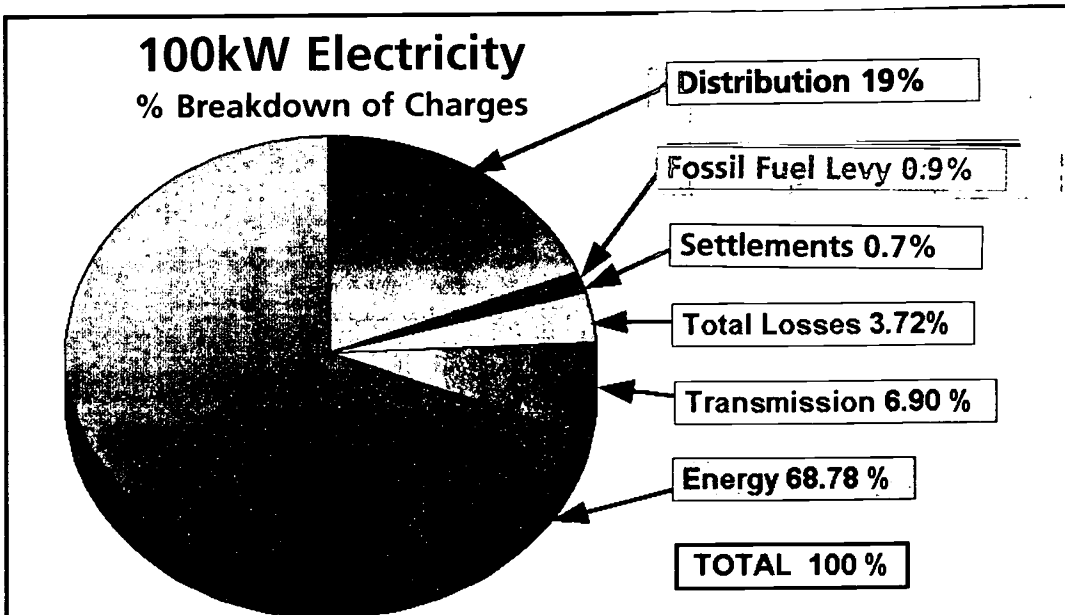
The bill that is received from a contract electricity supplier will include all the elements:

- transmission
- distribution
- system losses
- settlements
- energy charge from the supplier.



The load for each of the 3 phases is shown red, yellow and blue for each half hour

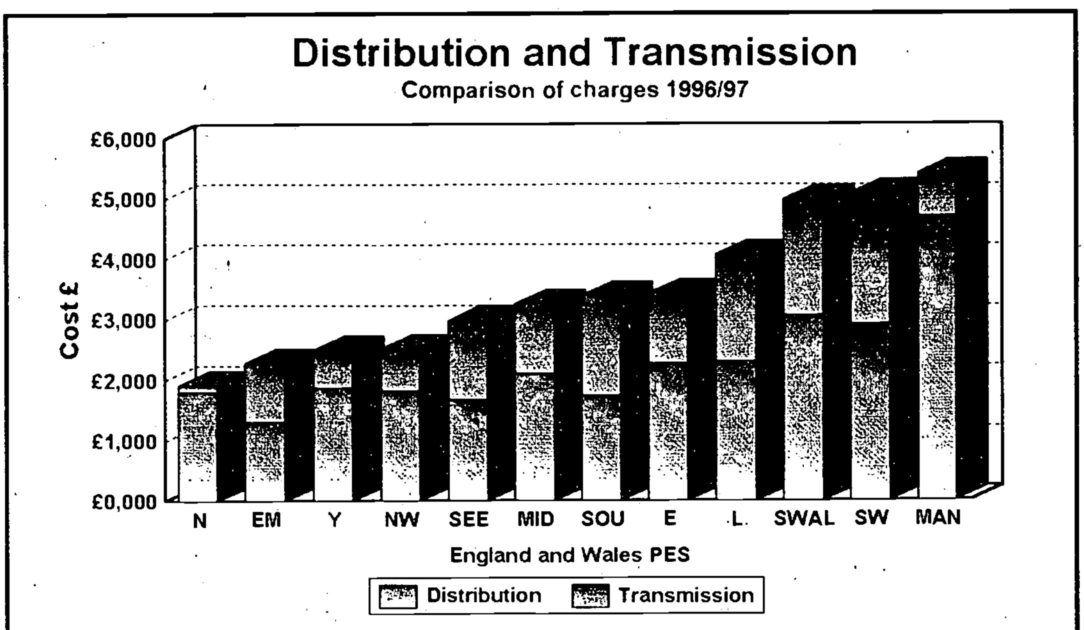
To this will be added the fossil fuel levy which is currently 0.9% in England and Wales and 0.8% in Scotland. This is a levy which is collected by the government, originally to aid the nuclear industry. However, following privatisation of the nuclear industry, the levy is primarily used to assist the installation of more renewable energy generation capacity.



For a particular supply in a PES area the pie chart above shows that 31.22% of the charges are fixed and 68.78% (the energy charge) are variable depending on what the supplier wants to charge. This amount will in turn depend on the suppliers' contracts for generation and the projections of future cost that these are based on.

Regional electricity price variation

Transmission charges set by the NGC and distribution charges set by the local PES are fixed for each location. The following graph gives an indication of how the charges vary for each PES area with an annual 200,000 day units, 50,000 night units and a maximum demand of 150kW. It can be seen that generally the southern PES areas are more expensive than the northern, with the difference between the lowest and highest in this example being around £3,500, or 184% greater. This should be borne in mind when comparing prices with schools and colleges in different areas. The variations in these charges will also affect the tariff rate available from each local PES.



Note: As distribution and transmission charges vary each year the position of each company may change.

The under 100 kW supplies

From September to December 1998 all the regions will begin to open their electricity markets to competition on a rolling programme. This will mean an increase from about 55,000 customers seeking competitive prices in 1997 to 23 million in 2000.

As the electricity industry operates on half hour consumption data an assessment of all the electricity used at each of the 23 million sites will be required after 1998 so that it is possible to establish who has supplied who. The customer will need to decide if paying for the installation of half hour metering is warranted. The cost of having the data provided will need to be weighed up against the benefit of having the data for load reduction and tendering. This will have to be ascertained when exact costs are known. It is perceived that there will be little gain for a site that has a demand below 50kW.

Each under 100kW site which does not have special half hour metering will be assigned one of eight standard consumption profiles by the electricity pool in conjunction with suppliers (see page 34). The profiles are the mechanism by which the suppliers account for the energy they use. The customer would not normally know of their existence and will still continue to pay on a tariff or contract price. However if the profiles are known, the customer can notify the supplier when consumption moves into a different standard profile.

The Settlement System will know the total load of all profiled domestic customers in a PES area by taking the total of all half hour loads away from the total load at the grid supply point group. The resulting load for each half hour will be compared with the expected load for all the profiles and the difference will be shared out between all suppliers. The costs for the distribution, transmission losses etc. will have to be averaged out over all customers registered in the new trading arrangements. (Over 100kW customers will be able to remain in the old trading arrangements until the new market is considered stable.)

Standard Profiles	
[1] Domestic unrestricted (day)	[5] Commercial 20%load factor
[2] Domestic restricted (day/night economy)	[6] Commercial 20%-30% load factor
[3] Commercial restricted	[7] Commercial 30%-40% load factor
[4] Commercial unrestricted	[8] Commercial over 40% load factor

Note: the proposed code on the supply number is shown in brackets [ ]

Supply number

In a similar way to the gas competitive market, the electricity competitive market will have a unique identification number which will be shown on existing electricity bills, called the Supply Number. This number will need to be quoted in any competitive tender bid. The Supply Numbers appeared on bills from December 1997.

Obtaining a competitive price over 100kW by tender

The result of liberalisation of the electricity market to the 100kW level since 1994 has created a complicated market with many technical terms which need to be understood to obtain the best from the process. There is also a strict time scale to be followed to ensure that contracts are in place.

Apart from understanding what all the various fixed and variable costs are, the suppliers have different ways of charging them. Each supplier may offer a price in a number of different formats, for example by:

- listing each element (it is essential that nothing is left out);
- following the conventional pattern of a capacity charge, units charge and maximum demand charge (see page 35);
- lumping all elements together to give a common pence/kilowatt hour figure;
- splitting between day and night (night for one company may occur at different times from another);
- seasonal time of day (STOD) type tariffs where the price varies according to the time and month. These result in extremely high costs at times of high system usage.

To obtain a fair assessment of the various options the quotations for each of the different companies should be analysed using a common set of consumption data to ensure that every element of the price is included.

This can be complex for those who are not familiar with all the requirements and is probably better left to specialists.

The contract electricity market has progressed in recent years and supply companies require a complete set of up to date half hour data for the whole year ie, 17,520 pieces of information. This reduces their risks which should provide a better price.

Obtaining a competitive price under 100kW by tender

Supplies below 50kW will probably be dealt with by the same sales team as domestic supplies who may well use telephone sales. Larger supplies will probably be dealt with by the same sales team as supplies over 100kW.

A multi-million pound tender from a local authority or a consortium containing all types of consumption would most likely be dealt with by the 100kW team and this would probably result in the lowest price.

Where consortia are bidding for a number of sites it is important that they have the authority to conduct the business or they will not be taken seriously by a supplier. Therefore it is advisable not to ask a supplier to quote the same site as a one-off bid and then as a group bid. Their computer systems will pick this up and it could well be treated as time wasting, with a consequent adverse result.

The payment terms will increasingly affect the final price that is quoted. For example, accepting direct debit payment terms will give a discount, normal payment terms will be fourteen days, with longer periods probably incurring an extra cost. Default payment will incur penalty interest charges. In the future fast track electronic payment may be required to obtain the lowest prices. Some suppliers now also sell gas and some are owned by water companies. This could mean that in future an establishment could get an integrated utility bill, with a larger saving if more services are supplied. The comparisons then become even more complicated.

Types of tariff

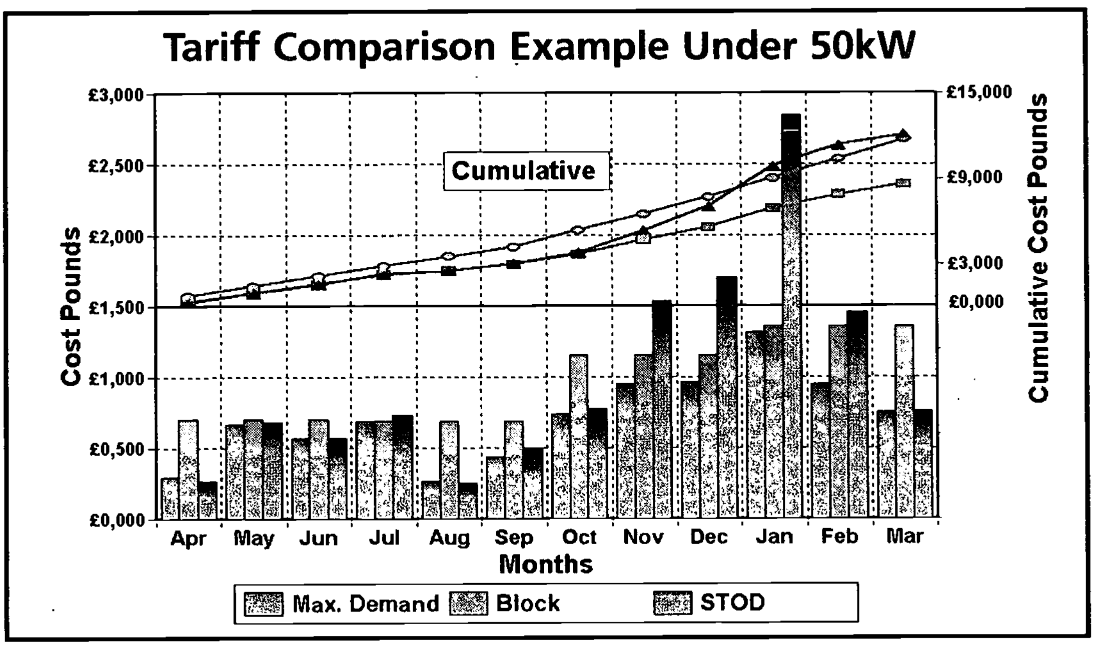
Small commercial and domestic tariffs under 100kW have essentially three components, the distribution cost, the cost of supplying the units consumed and a cost related to the demand. Consumers above a 50kW demand have a tariff where these elements are charged separately whereas for most other consumers the parts are combined in the unit charge. However, loads below 50kW can opt for this type if it is viable, eg, a large primary or small secondary school could be supplied on a units only tariff, a maximum demand type tariff or a seasonal time of day (STOD) tariff. In recent years the increased consumption in schools due to information technology etc, may have altered the best choice of tariff. It is advisable to check this. Please refer to pages 14 & 15 regarding who is best suited to provide a tariff analysis service.

Maximum demand tariffs

The best way to understand this type is to examine each element as follows:

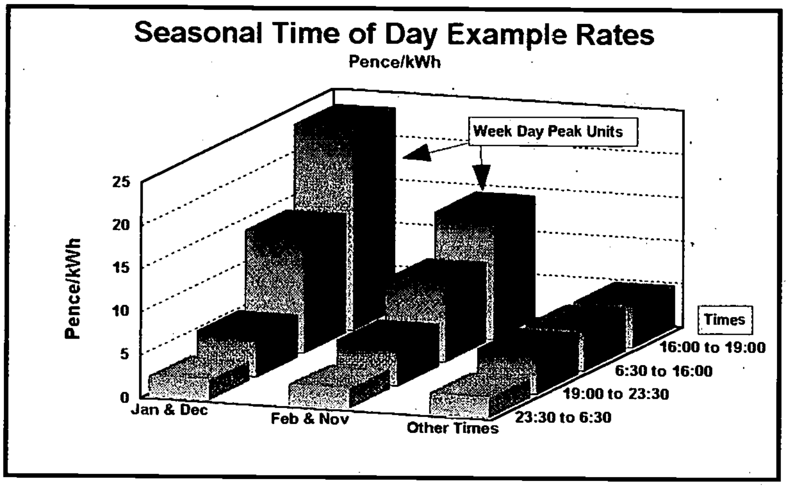
Metering and Data Options Chart	
Monthly charge	A standard charge that is paid irrespective of the amount of the supply, which may also include metering.
Availability	A charge that reflects the cost of the supply being made available, it will normally be based on the highest of either an agreed capacity set for a period of five years or the highest demand that has occurred in a 12 month period.
Units	A charge for each kWh used. There may be different rates for different times of the day.
Maximum demand	A separate charge during the winter months of November to February, with a cost per kW or kVA. The cost for each kW of maximum demand in December and January is generally higher than November and February.

Reactive units or power factor charges	It is more expensive for the electricity suppliers to supply inductive loads such as motors and discharge lighting than purely resistive loads such as electrical heating elements. This is because inductive loads have their current waveform slightly lagging behind their voltage waveform. The more inductive the load the more the current lags, the lower the power factor is and the more reactive units (KVArh) are measured at the meter. In each month the average Power Factor (PF) is measured by the electricity company and normally a charge will be made if the PF drops below 0.9, or sometimes 0.95. The additional amount charged by the supplier depends on the reactive power units (kVArh) recorded at the meter. Where these PF charges are high, on site power factor correction using banks of capacitors may be worth installing.



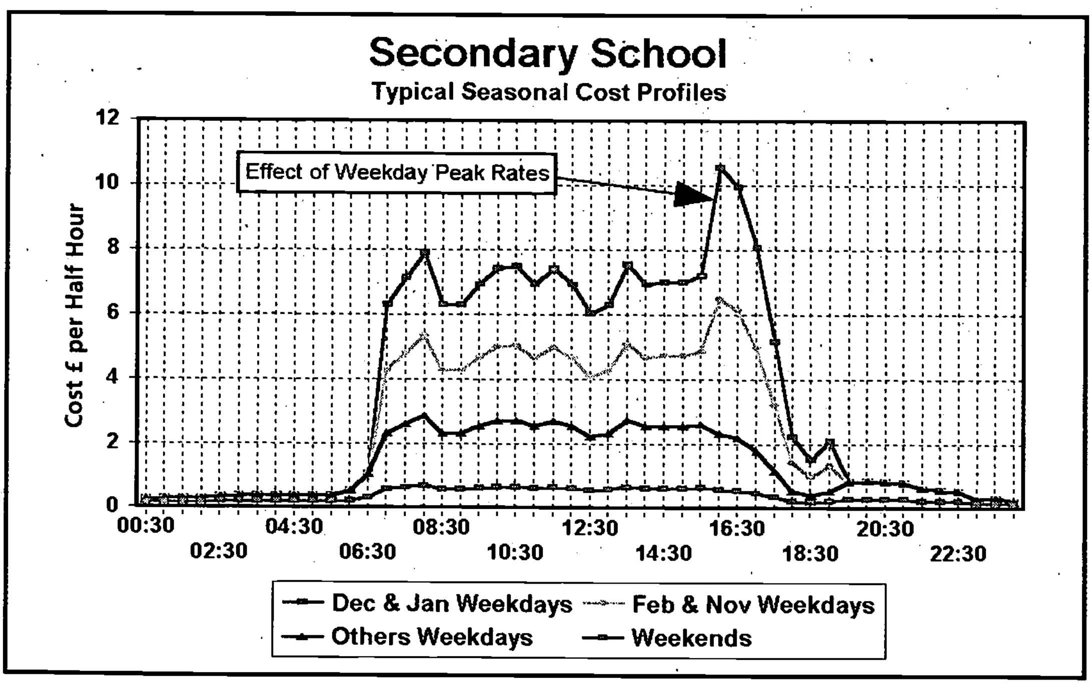
The chart above shows a typical monthly charge break-down for the three tariff options available to a small secondary school. In this example the monthly maximum demand will give a lower cost but this is not always the case. If the night units are over 15% a change to a day/night option may give reduced costs.

Some PES companies provide graphs in their tariff booklets to enable the lowest tariff to be chosen for a particular demand. However, if they don't, a computer spreadsheet could be used to produce comparison charts of your own.



STOD tariffs have a different price for different parts of the day which also vary according to the month of the year, as shown on the left. There may be a push to use these more, although they may not be the cheapest option.

This is due to the cost of supplying units at these times. Savings will be made by carefully avoiding peak times from 16:00 to 19:00 on winter weekdays. To show the effect of these costs the example profile on page 31 has been used below to show the comparative cost for each half hour for the various seasons.



41

OIL

Purchasing oil

The price of oil is dependent on rates set in the global market and can be subject to sudden change. During the Gulf oil crisis prices soared to 20 pence a litre, almost double what they were before. The chart below shows how the oil price has varied over a number of years.

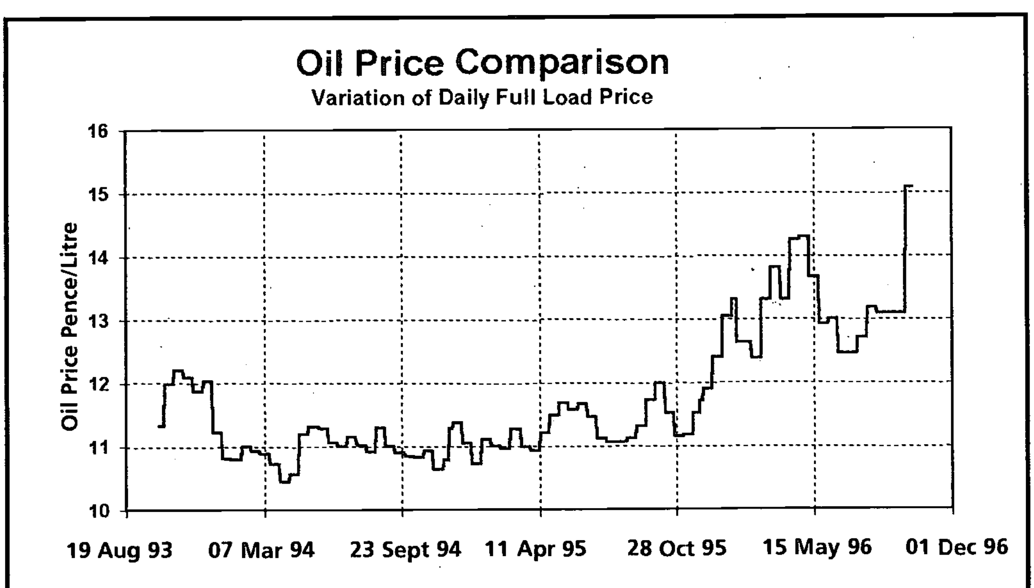
Types of contract

Purchasing oil through a consortium will, over time, probably give the lowest costs. There are a number of ways in which oil can be purchased by the consortium to maximise the group purchasing power.

- Rotterdam related contracts take the daily price for a particular oil stock averaged over a number of weeks as a base. Oil duty and a delivery margin including profit are added giving a final cost/litre.

This method provides an oil price that reflects market changes. The example shown in the chart below has two week prices.

- Inland Schedule Price (ISP) contracts on the other hand generally give a low price at the start of the contract for a fixed period. The price rises during the length of the contract period. The contract administrator carries out continual negotiation to try and limit the schedule price rises and maximise schedule price falls caused by world events.



- Fixed price contracts are another alternative, giving a price that is negotiated for a fixed period of time such as a year. Although there will be protection from large increases the benefits of a fall in price may be lost.

Oil delivery surcharge

If a full tanker load of 22,000 litres cannot be delivered at a site a part load would have a surcharge added (see example below). To reduce costs, establish the surcharge rates of your supplier so that the quantity you order falls in the cheapest price band. However, if you are soon to commence an ISP contract, with a low start price, a small quantity would be a better option.

Litres Oil Load Band	500 to 899	900 to 2199	2200 to 4999	5000 to 7499	7500 to 9999	1000 to 14499	1450 to179 99	18000 to 21999	Full Load
Surcharge Pence/Litre	1.00	0.9	0.58	0.4	0.35	0.32	0.19	0.07	0

SOLID FUEL

Purchasing solid fuels

Until the early 1990s most coal was mined and sold by British Coal. In 1995 all coal production moved to private ownership. There are also wholesalers and traders who source fuel from other countries. Coal is a natural and variable source of energy and its inherent properties differ from colliery to colliery. There are different types of coal described as bituminous and anthracite, and various grades within the two types. When purchasing the fuel you need to know the correct grade, type and inherent qualities such as calorific value, ash content and free burning characteristics required for your plant. Your local authority, plant manufacturer or fuel supplier can advise accordingly. Some typical grades are: washed singles; washed doubles; cobbles; washed smalls and pearls.

Pricing

Solid fuel is sold in tonnes (1,000kg) in varying quantities dependant on available storage, size of delivery vehicles and bulk discounts.

Coal can be purchased from a producer or a local supplier. However, where available, take advantage of bulk purchase arrangements that have been tendered by local authorities for their properties. The cost of coal may be affected by the following.

- Total bulk purchase contract.
- Annual requirement for your property.
- Size of individual load with the ability to accept larger loads attracting possible discounts.
- Geographical location and transportation costs from the source to your property.
- Prevailing market pressure.
- Availability of seasonal discounts.

Delivery

Coal can normally be delivered within two to three days of ordering, but be careful during the winter holiday period. Bulk delivery will normally be by a heavy goods vehicle with a pneumatic system which can blow coal into the bunker. Alternatively, smaller deliveries may be bagged or loose tipped fuels.

BOTTLED GAS

Bottled gas may have been installed as the energy source for what was originally going to be a temporary solution, such as extra class rooms, when mains gas was not available. The use of short term heating installations should be reappraised as they can have the highest costs. The following procedure is recommended:

- calculate the total cost and consumption of gas bought in a year;
- check to see if it can be bought in a cheaper way by obtaining prices from different suppliers for the annual amount;
- compare the annual energy consumption with the cost if the energy was provided from a different source, such as mains gas for example;
- assess whether the difference in cost would finance the installation of a mains gas supply.

Checking utility accounts

As each invoice is received it should be examined to see if the cost relates to the consumption and that it is correctly related to the tariff. Consumption should also be examined to see if it relates to that which would be expected eg, energy consumption related to the severity of the weather or the consumption of water related to the number of people.

Utility invoices, where electronic metering is not installed, are increasingly being estimated. This means that over-consumption or waste is difficult to establish until long after it has occurred.

To prevent this, meters should be read monthly and analysed to check the consumption. The analysis can be carried out on a computer spreadsheet or on specific energy monitoring software. Two types of software are available, financial and technical, ranging in price from £100s to £1000s.

Financial tools

- Cost and consumption data is entered from utility invoices usually by staff untrained in energy management techniques.
- Consumptions for heating fuels are related to degree days, which are a measure of the severity of the weather. From the data it is possible to fit a regression line and use this as the base against which to measure performance and target reductions. Using a statistical method termed 'cusum' (this is a cumulative sum of consumption throughout the year) it becomes very easy to see when there has been a deviation from the past trend.
- Non-heating fuels tend to be checked inconsistently as those simple programmes do not have the facility for building a historical pattern against which to plot a trend.
- As the data is entered the software checks that the consumption is within certain limits.

- The software would contain a number of standard reports which are generated as required.

The following problems may be encountered with software systems.

1. Clerical staff, in an attempt to clear backlogs of bills which could be months behind (with quarterly accounts this could be six months), do not have time to look at the cusum graph for each meter.
2. Many accounts are now estimated, and the data becomes inadequate. Consequently the chances of taking quick corrective action is lost.
3. Some systems do not operate on straight line relationships.

To overcome some of these problems a number of solutions are available which could be called technical tools.

Technical tools

One system based on a spreadsheet creates from the historical data (to a varied number of relationships) a form for the year to which self-read meter readings are added. It is intended that technical personnel would, at a set time each week/month, take readings and fill out the form. With some simple addition and subtraction the technical staff can instantly spot any waste and correct it. The main computer data can be updated as and when administration time is available. A running total of expenditure against budget can be instantly seen and before the end of the financial year, predictions of over or under expenditure can be made.

With an efficiently run establishment the data could be input into a computer on the day of collection. One spreadsheet system will, once all the data has been input, produce a printout in order of priority for the amount of waste at each meter which can be passed on to technical personnel for action. This takes out all the time delays of the other systems but is not simply a bill checking device. It is, as one supplier states, a procedure for detecting avoidable waste.

Meter reading considerations

On large school or college campuses there may be large numbers of meters to enable consumption to be apportioned to budget holders and for returns to be made to funding bodies. However this situation poses a number of questions.

- Who will collect the meter data?
- Will qualified staff be available to enter the data into a computer? If not would a paper form system be suitable? Are technical staff able to operate the system or is it beyond them?
- Will the data entry of additional meters be by the same staff who are carrying out bill checking? If so, will this incur delays in getting output? Will they see it as non-essential work which will not get done in practice?
- An alternative solution to manual reading would be to automatically read meters. These could be added to energy management systems or read remotely. However, this could be an expensive solution and would need to be the subject of an individual survey.

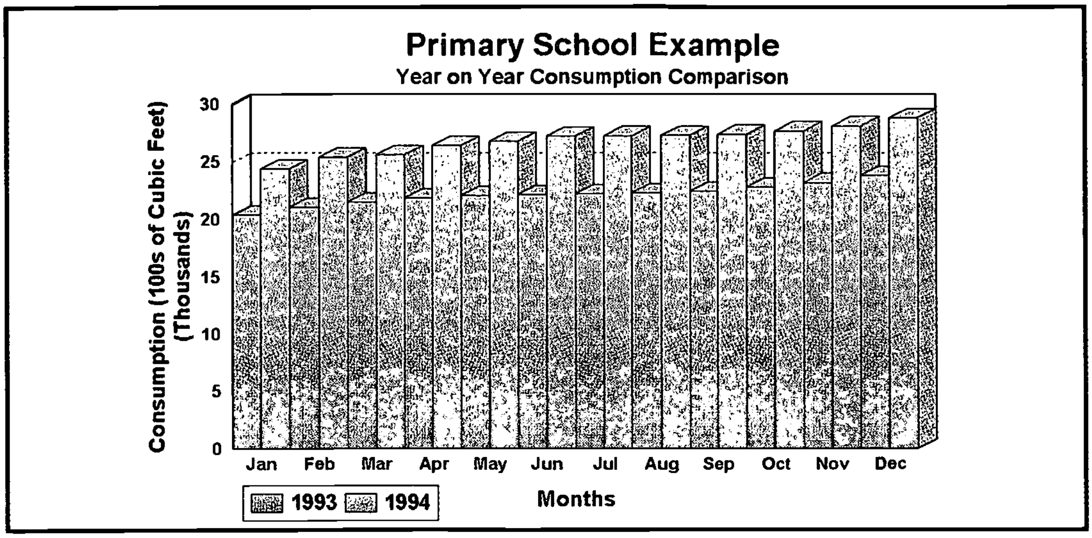
Examining the data

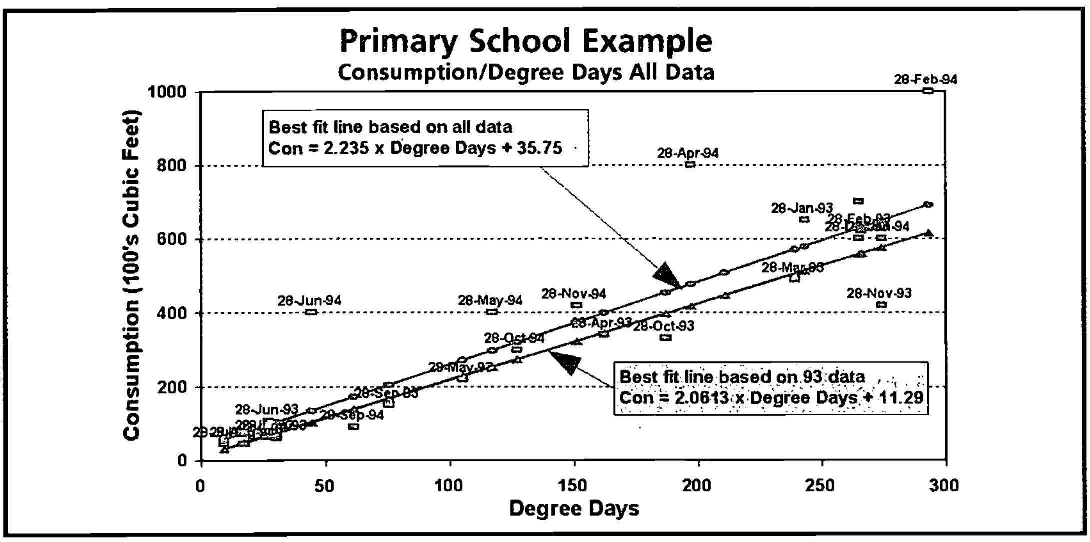
The bar chart opposite is actual gas consumption data from a primary school showing the comparison over two years. The year on year comparison shows there has been an increase each month but it is not possible to see what is actually going on.

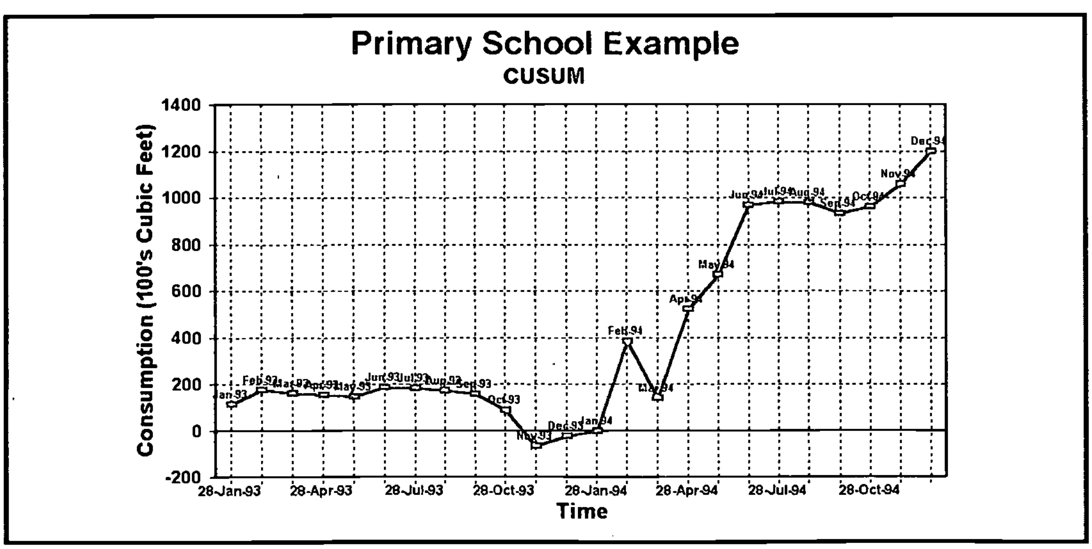
By plotting the data against the degree days a line of best fit can be obtained as shown opposite. The top line includes all the data points and the bottom line is the line for just the first year. This shows that the consumption per degree day has gone up compared to the first year.

The third chart plots the cusum of the data comparing the first year to the second and shows a significant increase in consumption has occurred.

The cusum is the cumulative sum of the difference of the actual data from that predicted by the line of best fit of the first year, a very powerful analysis method.


Primary School Example
Year on Year Consumption Comparison
Consumption (100s of Cubic Feet) (Thousands)
0
5
10
15
20
25
30
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
1993
1994
Months


Primary School Example
Consumption/Degree Days All Data
Consumption (100's Cubic Feet)
Degree Days
Best fit line based on all data
Con = 2.235 x Degree Days + 35.75
Best fit line based on 93 data
Con = 2.0613 x Degree Days + 11.29
28-Feb-94
28-Apr-94
28-Jan-93
28-Mar-93
28-Nov-93
28-Jun-94
28-May-94
28-Nov-94
28-Apr-93
28-Oct-93
28-Oct-94
28-May-93
28-Sep-93
28-Jun-93
28-Sep-94
0
200
400
600
800
1000
0
50
100
150
200
250
300


Primary School Example
CUSUM
Consumption (100's Cubic Feet)
Time
1400
1200
1000
800
600
400
200
0
-200
28-Jan-93
28-Apr-93
28-Jul-93
28-Oct-93
28-Jan-94
28-Apr-94
28-Jul-94
28-Oct-94
Feb-94
Apr-94
May-94
Nov-94
Dec-94

The increase was due to increased numbers at the school and the installation of temporary classrooms. The cusum method is very good at showing up changes from the normal and can highlight increases which are less obvious, and show when they occurred. The method is contained in many energy monitoring programmes. However they generally use a straight line for the best fit. It should be recognised that data may not be a straight line, eg, if the boiler plant was inadequate and could not heat the property adequately, from a certain point the increasing number of degree days would not relate to an increase in consumption.

Most spreadsheet packages are able to carry out a cusum analysis[5].

VAT issues

All supplies of fuel and power are subject to the standard rate of VAT (17.5%) unless there is a provision for the reduced rate (5%) for qualifying use or zero rate to apply as set out in HM Customs and Excise Fuel and Power VAT Notice 701/19/98. (See summary table on next page.)

Supplies to most educational institutions such as schools, sixth form colleges, further education colleges and universities are not taxed at the reduced rate unless the institution is a charity engaged in non-business activities.

Local education authorities claim refunds of VAT under Section 20 of the VAT Act 1983, on purchases in respect of their non-business activities. This includes expenditure on fuel and power delegated to school accounts under the Local Management of Schools. Therefore, LEA maintained Schools must not attempt to register for VAT in connection with activities involving the use of official budgets under LMS schemes. (See DfEE circular 2/94 *Local Management of Schools*.)

Fee paying independent schools are liable for VAT at the standard rate.

Voluntary aided schools, grant maintained schools and city technology colleges, which all have charitable status and make no charge for the education they provide, are taxed at the reduced rate for fuel and power.

Further information about the business status of educational institutions can be found in Customs and Excise VAT Notice 701/30. These notices are available from local VAT offices, whose addresses are given in local telephone directories.

Where schools have residential accommodation the percentage of the energy consumption for non-business use will need to be assessed. The school will need to give the supplier a certificate stating the ratio of business/non-business use. Where separate meters are not available an estimate has to be made of the relative amounts of energy used.

Further advice on heating contracts and contracts with fuel and power companies is given in VAT Notice 701/19/98.

	17.5% STANDARD RATE OF VAT	5% REDUCED RATE OF VAT
Supplies of fuel and Power to Businesses	YES	NOT APPLICABLE
Small Quantities of Fuel And Power	NOT APPLICABLE	SMALL SUPPLIES ALWAYS AT REDUCED RATE 1. Supplies of electricity of not more than an average of 33kWh per day. 2. Not more than one tonne of coal or coke. 3. A supply of wood, peat or charcoal. 4. A supply of not more than 4,397 kWh/ (150 therms) a month of gas. 5. A supply of liquefied petroleum gas which consists of not more than 20x50 kg cylinders. 6. A supply of liquefied petroleum gas which consists of bulk storage that is less than 2 tonnes. 7. A supply of not more than 2,300 litres of oil.
Domestic Use including residential accommoda-tion of pupils, students and staff	NOT APPLICABLE	YES
Charity Non-Business Use	NOT APPLICABLE	YES

Table continued on next page

Table continued from previous page

	17.5% STANDARD RATE OF VAT	5% REDUCED RATE OF VAT
MIXED USE. The supplier will need a certificate from the customer stating the percentage of fuel and power that would qualify for the reduced rate There are penalties for both if there has been incorrect assessment resulting in under payment of VAT.		
MIXED USE Less Than 60% Domestic/ Non-Business Charity Use	If less than 60% of the fuel and power is for domestic/non-business charity use, then 17.5% charged on the business portion.	If less than 60% of the fuel and power is for domestic/non-business charity use then 5% charged on the domestic/non-business portion.
MIXED USE At Least 60% Domestic/ Non-Business Charity Use	NOT APPLICABLE	If at least 60% of the fuel and power is for domestic/non-business charity use then 5% charged on the whole of the supply.

Energy management

To obtain maximum benefits from energy management, schools need a person who is responsible for this area of work whether they carry it out themselves, or whether it is delegated to an outside agency such as a local authority energy unit or consortium.

The Energy Management Matrix for Schools taken from *Building Energy Efficiency in schools*[8] reproduced below has six key organisational issues and five levels of attainment for each. Information, collection and analysis are required for effective purchasing and the matrix shows how this fits into the overall scheme of energy management. A line should be drawn connecting the boxes to indicate the current position of the establishment identifying at a glance how far it has progressed in its energy strategy and what still needs to be achieved.

	Energy policy	Organising for energy efficiency	Education	Information and collection	Communication	Investing in energy efficiency
4	Senior management are committed to energy policy and action plan with regular review as part of environmental strategy.	Energy management fully integrated into management structure. Clear delegation of responsibility for energy consumption.	Full involvement of students in the management of energy in the school to a level appropriate to their age.	Comprehensive system setting targets, monitoring consumption, identifying faults, quantifying savings and providing budget tracking.	Formal and informal channels of communication regularly exploited by energy co-ordinator, students and school management team.	Positive discrimination in favour of green schemes with investment appraisal of all new build and refurbishment opportunities.
3	Formal energy policy but only low level commitment from senior management.	Energy co-ordinator accountable to senior management and governors.	Co-ordinated approach to energy efficiency education linked to the school energy policy.	Monitoring and tracking reports for premises and major users where possible. Savings not reported effectively to users.	Programme of energy awareness, including regular publicity campaigns aimed at all users of the building.	Same payback criteria employed as for all other investments.
2	Unadopted energy policy set by senior management.	Energy co-ordinator in post but line management and authority are unclear.	Some identification of opportunities for using the school to teach about energy efficiency.	Monitoring and targeting reports based on actual meter readings. Analysis of trends and input into budget setting.	Some ad hoc awareness training for all users of the building.	Investments using short term payback criteria only.
1	An unwritten set of guidelines.	Energy management responsibilities have been identified but are not co-ordinated.	Unco-ordinated delivery of energy efficiency education in the school.	Annual cost reporting based on fuel bill data with some analysis of yearly trends.	Informal contacts used to communicate school energy performance and plans for improvement.	Only low cost measures taken.
0	No explicit policy.	No energy management or formal delegation of responsibility for energy consumption.	No known teaching of energy efficiency.	Meter readings not recorded and bills not analysed.	No communication of school energy performance.	No investment in increasing energy efficiency of the premises.

The whole school approach set out in the document is recommended to all establishments. The collection and analysis of data as an educational assignment by willing students would greatly assist in the overall task. For this, meters are best placed in areas accessible to students without supervision eg, in foyers or corridors rather than plant rooms.

The maximum control of energy is made when there is a comprehensive system for setting targets, monitoring consumption, identifying faults, quantifying savings and providing budget tracking.

It is recommended that copies of 'Building Energy Efficiency in Schools' are obtained for management to consider and formulate an action plan for each of the following activities.

- Information systems.
- Investment in energy conservation.
- Production of an energy/environmental policy.
- The establishment of an energy committee.
- Motivational awareness programmes and staff awareness training.

Environmental costs

Scientists generally agree that global warming is occurring and that one of the main causes is carbon dioxide (CO_2) emissions, 50% of which come from energy used in buildings. In the future high CO_2 generating fuels may cost more. When planning major changes such as building extensions or new boilers, the future environmental costs should be taken into account. The table below gives the conversion factors for kilograms (kg) of CO_2 from kilowatt-hours (kWh) of energy used.

Fuel	Kilograms of CO_2/kWh
Electricity	0.58
Coal	0.34
Oil	0.29
Gas	0.21
Renewable Energy	0.01

Renewable energy schemes

Increased concern for the environment has meant that more renewable energy schemes are being introduced. These include wind farms, small scale hydroelectricity and bio-crops such as wood chips burnt to produce steam to drive a generator. This 'Green Energy' produces little or no CO_2 compared to the burning of fossil fuels and could be used in some schools.

A rural school could consider having a boiler that was designed for burning straw while a school in a forest area could use wood chips. These options would probably replace or reduce the need for burning oil which may also have high delivery charges. Some locations may allow partnership in a small scale hydroelectricity scheme or burning methane gas produced from small scale anaerobic waste plants. It is however necessary to ensure adequate and reliable sources of energy.

Some suppliers are beginning to sell renewable energy at a slight cost premium to their normal rates. They guarantee that they are in turn buying renewable energy from generators. A policy on the use of renewable energy may become increasingly important for each organisation.

Combined heat and power

Many local authorities and large establishments now have Combined Heat and Power schemes (CHP), in which a fuel, such as gas or coal, fuels an engine which drives a generator to produce electricity. The cooling water from the engine is used in heating and hot water systems just like water circulated from a boiler. Where there is a constant load for electricity and heat such as that required for a swimming pool these plants are extremely efficient. Some very large CHP schemes have district heating schemes in which hot water or steam from the CHP unit is pumped around the streets in a network of pipes. These may become more common and city centre schools and colleges would be increasingly asked if they want to take advantage of this option for their heat and/or electricity. This would most likely be as a customer to take the heat and power, rather than as a supplier.

Advice should be sought from an independent source such as the local authority or Combined Heat and Power Association (CHPA) to ensure that any proposed option is in the best interests of the school. This particularly applies to the metering of the hot water that will be purchased.

Bibliography

1. *Saving Energy*, Managing School Facilities Guide 3, DfEE, ISBN 0 11 270880 3, HMSO, 1995, £3.95.

2. Energy Efficiency Best Practice. Information available on all topics from BRECSU. A computer disk is available listing all the publications.
   Contact BRECSU (Building Research Energy Conservation Support Unit), Building Research Establishment, Garston, Watford, WD2 7JR. Tel 01923 664258; Fax 01923 664787.

3. *Energy Management*, free journal containing monthly degree day information. Available from Readerlink. Tel 0181 756 3000.

4. Fuel Efficiency Booklet 13: *Waste Avoidance Methods*, London, DOE, 1993. Obtain from BRECSU (see above).

5. *Energy Monitoring and Target Setting Using Cusum*, Peter Harris, Cheriton Technology Publications, St Stephen's House, 50 St Stephen's Place, Cambridge, CB3 OJE.

6. *Energy Management Accounting Scheme Applied to Energy in Buildings*, Peter Harris, Cheriton Technology Publications, St Stephen's House, 50 St Stephen's Place, Cambridge, CB3 OJE.

7. Fuel Efficiency Booklet 7: *Degree Days*, London, DOE, 1993. Contains a section on their use with cusum. Obtain from BRECSU (see above).

8. *Building Energy Efficiency in Schools*, A guide to the whole school approach. London, DOE, 1996. Obtain from BRECSU (see above).

9. *Economic Appraisal in Central Government: A Technical Guide for Government Departments*, guidance on investment appraisal. HM Treasury, April 1991, The Stationery Office.

10. *Energy Services for the Public Sector*, published by the Department for the Environment, Transport and the Regions and available from BRECSU (see above).

11. *Contract Energy Management* (AM6 1991). CIBSE The Chartered Institute of Building Services. Tel 0181 675 5211

Organisations

Centre for Research Education and Training in Energy (CREATE).
Enquiry service and publications on energy.
Managers of the 'SchoolEnergy Programme' on behalf of the Energy Savings Trust. Tel 01942 322271, Internet www.create.org.uk
E-mail info@create.org.uk

Energy Savings Trust, 11-12 Buckingham Gate, London, SW1E 6LB.
Tel 0171 931 8401; Fax 0171 931 8548.

OFGAS, Gas market regulation, Licensed supplier lists. Tel 0171 828 0898. Regional offices are listed in local telephone directories and on the reverse of gas bills.

OFFER, Electricity market regulation, Licensed supplier lists.
Tel 0171 456 2100. Regional offices are listed in local telephone directories and on the reverse of electricity bills.

Note: The government plans to replace OFGAS and OFFER with one combined energy regulator in the near future.

DfEE Architects and Building Branch, Caxton House,
6–12 Tothill Street, Westminster, London, SW1H 9NF.
General Enquiries Tel 0171 273 6237; Fax 0171 273 6690.

DfEE Schools Private Finance Team, Sanctuary Buildings,
Great Smith Street, London, SW1P 3BT. Tel 0171 925 5530.

Conversion chart to kWh

Fuel	Unit of supply		Conversion factor gross calorific value to kWhs
Natural Gas	Cubic Feet	X	0.302
Natural Gas (as found on old meters)	100s Cubic Feet	X	30.210
Natural Gas	Therms	X	29.307
Natural Gas (as on new meters)	Cubic Metres	X	10.675
Natural Gas	kWhs	X	1.000
Propane	tonnes	X	13,888
Propane	litres	X	6.96
Butane	tonnes	X	13,694
Butane	litres	X	7.85
Domestic heating oil (28 sec)	litres	X	10.22
Gas Oil D (35 sec)	litres	X	10.58
Light Fuel Oil E	litres	X	11.22
Medium Fuel Oil B	litres	X	11.28
Heavy Fuel Oil G	litres	X	11.42
Coal: Anthracite good	tonnes	X	8,330
Coal: Anthracite moderate	tonnes	X	8,206
Coal: Best washed graded bituminous	tonnes	X	8,078
Coal: Washed singles good	tonnes	X	7,890
Coal: Washed smalls good	tonnes	X	7,806
Reasonable cleaned coals	tonnes	X	7,640 to 7,306
Coal: Poor quality bituminous	tonnes	X	7,140
Industrial Coke	tonnes	X	7,075
Coke	tonnes	X	7,883
Air dried wood (burnt as waste)	tonnes	X	4,395

Energy Overview Chart

Month		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	TOTAL
Lighting	Elec. On-Peak													
	Elec. Off-Peak													
Power	Elec. On-Peak													
	Elec. Off-Peak													
Heating	Elec. On-Peak													
	Elec. Off-Peak													
	Gas													
	Oil													
	Other													
Hot Water	Elec. On-Peak													
	Elec. Off-Peak													
	Gas													
	Oil													
	Other													
Cooking	Elec. On-Peak													
	Elec. Off-Peak													
	Gas													
	Oil													
	Other													
Swimming	Elec. On-Peak													
Pool	Elec. Off-Peak													
	Gas													
	Oil													
	Other													

This guide is the fifth in the DfEE series Managing School Facilities. It has been produced to inform headteachers and governors about the purchasing choices which will be available with the introduction of full competition for all electricity and gas supplies. This gives schools the chance to make significant savings on energy costs.

The deregulation of the market for gas and electricity is now almost complete. Since May 1998 all small gas supplies have been part of the competitive market and beginning in September 1998 smaller electricity supplies will be subject to competition.

The guide gives detailed purchasing information eg, on tariff structures and VAT and stresses the central role of energy management. It also describes the accounting procedures and tools required to maximise savings.

The Stationery Office

Published by The Stationery Office and available from:

The Publications Centre
(mail, telephone and fax orders only)
PO Box 276, London SW8 5DT
General enquiries 0171 873 0011
Telephone orders 0171 873 9090
Fax orders 0171 873 8200

The Stationery Office Bookshops
123 Kingsway, London WC2B 6PQ
0171 242 6393 Fax 0171 242 6394
68–69 Bull Street, Birmingham B4 6AD
0121 236 9696 Fax 0121 236 9699
33 Wine Street, Bristol BS1 2BQ
0117 9264306 Fax 0117 9294515
9–21 Princess Street, Manchester M60 8AS
0161 834 7201 Fax 0161 833 0634
16 Arthur Street, Belfast BT1 4GD
01232 238451 Fax 01232 235401
The Stationery Office Oriel Bookshop
The Friary, Cardiff CF1 4AA
01222 395548 Fax 01222 384347
71 Lothian Road, Edinburgh EH3 9AZ
0131 228 4181 Fax 0131 622 7017

The Stationery Office's Accredited Agents
(see Yellow Pages)

and through good booksellers

£8.50

ISBN 0-11-271036-0

9 780112 710363

NOTICE

REPRODUCTION BASIS

☒ This document is covered by a signed "Reproduction Release (Blanket) form (on file within the ERIC system), encompassing all or classes of documents from its source organization and, therefore, does not require a "Specific Document" Release form.

☐ This document is Federally-funded, or carries its own permission to reproduce, or is otherwise in the public domain and, therefore, may be reproduced by ERIC without a signed Reproduction Release form (either "Specific Document" or "Blanket").